

**Programme Outcomes (POs), Programme Specific
Outcomes (PSOs) and Course Outcomes (COs)**

(2018-19 to 2022-23)



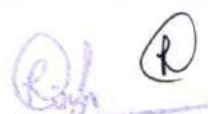
**Sardar Vallabhbhai Patel University of Agriculture &
Technology, Meerut-250110**

website: <https://svpuat.edu.in>


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Documentation Summary Sheet

Criterion	Criterion 01-Curricular Aspects	
Key Indicator (KI)	1.1 Curriculum Design and Development	
Metric No	1.1.1: Curricula developed and implemented have relevance to the local, national, regional, and global developmental needs, which is reflected in the Programme outcomes (POs), Programme Specific Outcomes (PSOs) and Course Outcomes (COs) of the Programmes offered by the University	
S.N.	Programme Name (Undergraduate)	Pg. No.
1	BSc (Hons.) Ag	3-26
2	B.Tech (Biotechnology)	27-37
3	BVSc & AH	38-44
4	B. Tech (Food Tech.)	45-47
5	B. Tech (Dairy Tech.)	48-83
6	B. Tech (Ag. Engg.)	84-92
7	BSc (Horticulture)	93-95


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COLLEGE OF AGRICULTURE

	Local
	Regional
	Global
	National

Undergraduate

Degree Programme: - BSc (Hons.) Ag

The College of Agriculture, as the first constituent faculty of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, was established in year 2000 within the existing infrastructure and manpower as the western campus of GBPUA&T, Pantnagar consequent upon the division of the Uttar Pradesh. The college admitted 23 students in undergraduate degree programme in academic session 2001-02. Since then, the college has been progressively gaining new dimensions in all the spheres.

Objective:

1. To impart teaching for the development of human resource who can apply their acquired knowledge and skills to diversify and industrialize agriculture for socio-economic transformation of the rural society.
2. To develop strategies for enhancing income of farmers and to make them globally competitive.
3. To support extension education programme for upliftment of rural masses

PROGRAMME OUTCOMES (POs)

Students graduating with the B.Sc. (Hons.) Agriculture degree should be able to acquire

- PO-1: Sound knowledge in the agriculture and allied science subjects required to solve local problems in management of crop cultivation, improvement, livestock rearing and their marketing.
- PO-2: Able to recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions. To understand the process of entrepreneurship.
- PO-3: Understand the impact of the professional agricultural solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO-4: Demonstration on research-based knowledge of the legal and ethical environment impacting agriculture organizations and exhibit an understanding and appreciation of the ethical implications of decisions.


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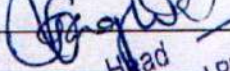
- PO-5: Demonstrate an ability to engage in critical thinking by analysing situations and constructing and selecting **viable solutions to solve problems**. Ability to work effectively with others. To develops analytical ability and team work spirit.
- PO-6: Understand and analyse the **current events and issues that are occurring in agriculture** and how they affect futuristic agriculture.
- PO-7: Understand how all aspects of agriculture combine and are used by scientists, marketers, producers and understand how employer characteristics and decision-making at various levels **enhance the success of an agricultural enterprise**. To understand components of agri-business and economics of market.
- PO-8: Able to demonstrate critical thinking and problem-solving skills as they apply to a variety of animal and or plant production systems. **To understand problem solving skills in crop production and animal husbandry**.
- PO-9: Knowledge of Weather codes and Symbols, Reading and Recording of weather and climatic data. To get trained for **climatologically records, soil data and soil nutrition**.
- PO-10: To develop critical and self-critical opinion and approach aiming at solving the most important practical problems in the field of agriculture to develop competence to work in **Government, public and private sectors**
- PO-11: Demonstrate knowledge and understanding in horticulture section: Current applications of horticultural principles and practices: propagation, pest management, production, maintenance, and business practices. **Comprehensive knowledge of horticultural production**
- PO-12: This programme will also help **students to enhance their employability for jobs** in different sectors

PROGRAMME SPECIFIC OUTCOME (PSOs)

- PSO-1: Impart knowledge from ancient to modern agricultural practices
- PSO-2: Impart in-depth **practical knowledge in crop cultivation practices**
- PSO-3: Acquire detailed knowledge about agri-allied sectors
- PSO-4: Deliver knowledge on working of different farm implements
- PSO-5: Able to serve the **rural agricultural population**
- PSO-6: **Diffuse recent agricultural technologies through extension**.
- PSO-7: Detailed knowledge on various agri-business activities through student **READY program**


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Course Code	Discipline/Course title	Credit Hrs
Agronomy		
AGR-111	Fundamentals of Agronomy	4(3+1)
AGR-112	Introduction to Forestry	2(1+1)
AGR-121	Fundamentals of Crop Physiology	2(1+1)
AGR-211	Environmental Studies & Disaster Management	3(2+1)
AGR-212	Crop Production Technology - I (<i>Kharif</i> crops)	3(2+1)
AGR-221	Crop Production Technology - II (<i>Rabi</i> crops)	3(2+1)
AGR-223	Farming System & Sustainable Agriculture	1(1+0)
AGR-224	Introductory Agro-meteorology & Climate Change	2(1+1)
AGR-311	Geoinformatics and Nanotechnology and Precision Farming	2(1+1)
AGR-312	Practical Crop Production - I (<i>Kharif</i> crops)	2(0+2)
AGR-321	Rainfed Agriculture & Watershed Management	2(1+1)
AGR-322	Practical Crop Production - II (<i>Rabi</i> crops)	2(0+2)
AGR-323	Principles of Organic Farming	2(1+1)
Genetics & Plant Breeding		
GPB-121	Fundamentals of Genetics	3(2+1)
GPB-211	Fundamentals of Plant Breeding	3(2+1)
GPB-221	Principles of Seed Technology	3(1+2)
GPB-311	Crop Improvement-I (<i>Kharif</i> crops)	2(1+1)
GPB-321	Crop Improvement-II (<i>Rabi</i> crops)	2(1+1)


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Agricultural Engineering		
AGE-112	Farm Machinery and Power	2(1+1)
AGE-121	Soil and Water Conservation Engineering	2(1+1)
AGE-211	Environmental Studies & Disaster Management	3(2+1)
AGE-222	Renewable Energy and Green Technology	2(1+1)
AGE-322	Post-harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
Basic Science		
BAS-111	Comprehension & Communication Skills in English (Gradiual course)	2(1+1)
BAS-212	Agri- Informatics	2(1+1)
BAS-213	Statistical Methods	2(1+1)
BAS-312	Intellectual Property Rights	1(1+0)
Soil Science and Agricultural Chemistry		
SAC-111	Fundamentals of Soil Science	3(2+1)
SAC-121	Agricultural Microbiology	2(1+1)
SAC-211	Environmental Studies & Disaster Management	3(2+1)
SAC-221	Problematic soils and their Management	2(2+0)
SAC-311	Manures, Fertilizers and Soil Fertility Management	3(2+1)
Entomology		
ENT-121	Fundamentals of Entomology	4(3+1)
ENT-311	Pests of Crops and Stored Grain and their Management	3(2+1)
ENT-321	Management of Beneficial Insects	2(1+1)
Agricultural Economics		
AAE-121	Fundamentals of Agricultural Economics	2(2+0)
AAE-221	Agricultural Marketing Trade & Prices	3(2+1)
AAE-311	Agricultural Finance and Co-Operation	3(2+1)
AAE-312	Entrepreneurship Development and Business Communication	2(1+1)
AAE-321	Farm Management, Production & Resource Economics	2(1+1)
Plant Pathology		
PPA-121	Fundamentals of Plant Pathology	4(3+1)
PPA-211	Diseases of Field and Horticultural Crops and their Management-I	3(2+1)
PPA-312	Principles of Integrated Pest and Disease Management	3(2+1)
PPA-321	Diseases of Field and Horticultural Crops and their Management-II	3(2+1)
Horticulture		
HOR-111	Fundamentals of Horticulture	2(1+1)
HOR-211	Production Technology for Vegetables and Spices	2(1+1)
HOR-221	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
HOR-222	Production Technology for Fruit and Plantation Crops	2(1+1)
HOR-321	Protected Cultivation and Secondary Agriculture	2(1+1)
Agricultural Extension and Communication		
AEC-112	Rural Sociology & Educational Psychology	2(2+0)
AEC-121	Fundamentals of Agricultural Extension Education	3(2+1)
AEC-211	Communication Skills and Personality Development	2(1+1)
AEC-312	Entrepreneurship Development and Business Communication	2(1+1)

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Agricultural Biotechnology		
AGB-111	Fundamentals of Plant Biochemistry and Biotechnology	3(2+1)
Animal Production		
AAP-211	Livestock and poultry Management	2(1+1)
AAP-212	Principles of Animal Nutrition	2(1+1)
AAP-221	Breeding and Improvement of Farm Animals	2(1+1)
Remedial Courses		
UGR-111	Agricultural Heritage	1(1+0)
UGR-112	Introductory Biology	2(1+1)
UGR-113	Elementary Mathematics	2(1+0)
Non-Gradial Courses		
NCC-111	National Cadet Corps	2(0+2)
NSS-111	National Service Scheme	2(0+2)
PEY-111	Physical Education & Yoga Practices	2(0+2)
BAS - 113	Human Values & Ethics	1(1+0)
/AEC-113		
NGC - 321	Educational Tour	2(0+2)

Semester-wise distribution of courses

Course code	I Semester	
HOR-111	Fundamentals of Horticulture	2 (1+1)
AGB-111	Fundamentals of Plant Biochemistry and Biotechnology	3 (2+1)
SAC-111	Fundamentals of Soil Science	3 (2+1)
AGR-112	Introduction to Forestry	2 (1+1)
BAS-111	Comprehension & Communication Skills in English	2 (1+1)
AGR-111	Fundamentals of Agronomy	4 (3+1)
UGR-112	Introductory Biology*/	2 (1+1)
UGR-113	Elementary Mathematics*	2 (2+0)*
UGR-111	Agricultural Heritage*	1(1+0)*
AEC-112	Rural Sociology & Educational Psychology	2 (2+0)
BAS - 113 / AEC-113	Human Values & Ethics (non gradial)	1(1+0)**
NCC-111/ NSS-111/PEY-111	NSS/NCC/Physical Education & Yoga Practices**	1 (0+1)**
TOTAL *R: Remedial course; **NC: Non-gradial courses		18 (12 + 6) 03**+02**

Course code	II Semester	
GPB-121	Fundamentals of Genetics	3(2+1)
SAC-121	Agricultural Microbiology	2(1+1)


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AGE-121	Soil and Water Conservation Engineering	2(1+1)
AGR-121	Fundamentals of Crop Physiology	2(1+1)
AAE-121	Fundamentals of Agricultural Economics	2(2+0)
PPA-121	Fundamentals of Plant Pathology	4(3+1)
ENT-121	Fundamentals of Entomology	4(3+1)
AEC-121	Fundamentals of Agricultural Extension Education	3(2+1)
AGE-122	Farm Machinery and Power	2 (1+1)
	Total	24(16+8)

Course code	III Semester	
AGR-212	Crop Production Technology – I (<i>Kharif Crops</i>)	3 (2+1)
GPB-211	Fundamentals of Plant Breeding	3 (2+1)
PPA-211	Diseases of Field and Horticultural Crops and their Management -I	3 (2+1)
AEC-211	Communication Skills and Personality Development	2(1+1)
BAS-212	Agri- Informatics	2(1+1)
HOR-211	Production Technology for Vegetables and Spices	2 (1+1)
AGE-211 / SAC -211 / AGR- 211	Environmental Studies and Disaster Management	3(2+1)
BAS-213	Statistical Methods	2(1+1)
AAP-211	Livestock and Poultry Management	2 (1+1)
AAP- 212	Principles of Animal Nutrition	2(1+1)
NCC-111/ NSS-111/PEY- 111	NSS/NCC/Physical Education & Yoga Practices**	1 (0+1) **
	TOTAL **NC: Non-gradual courses Total	24(14+10)

Course code	IV Semester	
AGR-221	Crop Production Technology –II (<i>Rabi Crops</i>)	3(2+1)
HOR-221	Production Technology for Ornamental Crops, MAP and Landscaping	2(1+1)
AGE-222	Renewable Energy and Green Technology	2(1+1)
SAC-221	Problematic Soils and their Management	2(2+0)
HOR-222	Production Technology for Fruit and Plantation Crops	2(1+1)
GPB-221	Principles of Seed Technology	3(1+2)
AGR-223	Farming System & Sustainable Agriculture	1(1+0)
AAE-221	Agricultural Marketing Trade & Prices	3(2+1)
AGR-224	Introductory Agro-meteorology & Climate Change	2(1+1)
AAP-221	Breeding & Improvement of Farm Animals	2(1+1)
UGE-221	Agribusiness Management*	3(2+1)
UGE-222	Agrochemicals*	3(2+1)
UGE-223	Commercial Plant Breeding*	3(1+2)
UGE-224	Landscaping*	3(2+1)
	TOTAL *Elective Course	22(13+9) + 3*


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Course code	V Semester	
AAE-311	Agricultural Finance and Cooperation	3 (2+1)
SAC-311	Manures, Fertilizers and Soil Fertility Management	3 (2+1)
ENT-311	Pests of Crops and Stored Grain and their Management	3 (2+1)
PPA-312	Principles of Integrated Pest and Disease Management	3(2+1)
GPB-311	Crop Improvement-I (<i>Kharif Crops</i>)	2 (1+1)
AEC-312 / AAE- 312	Entrepreneurship Development and Business Communication	2 (1+1)
AGR-311	Geo informatics and Nano-technology and Precision Farming	2 (1+1)
AGR-312	Practical Crop Production – I (<i>Kharif crops</i>)	2 (0+2)
BAS-312	Intellectual Property Rights	1(1+0)
UGE-311	Food Safety and Standards*	3(2+1)
UGE312	Biopesticides & Biofertilizers*	3(2+1)
UGE-313	Protected Cultivation*	3(2+1)
UGE-314	Micro propagation Technologies*	3(1+2)
	TOTAL *Elective Course	21(12+09) + 3*
Course code	VI Semester	
AGR-321	Rainfed Agriculture & Watershed Management	2 (1+1)
HOR-321 / AGE-321	Protected Cultivation and Secondary Agriculture	2 (1+1)
PPA-321	Diseases of Field and Horticultural Crops and their Management-II	3 (2+1)
AGE-322 / HOR-322	Post-harvest Management and Value Addition of Fruits and Vegetables	2 (1+1)
ENT-321	Management of Beneficial Insects	2 (1+1)
GPB-321	Crop Improvement-II (<i>Rabi crops</i>)	2 (1+1)
AGR-322	Practical Crop Production –II (<i>Rabi crops</i>)	2 (0+2)
AGR-323	Principles of Organic Farming	2 (1+1)
AAE-321	Farm Management, Production & Resource Economics	2 (1+1)
UGE-321	Hi-tech. Horticulture*	3(2+1)
UGE-322	Weed Management*	3(2+1)
UGE-323	System Simulation and Agro-advisory*	3(2+1)
UGE-324	Agricultural Journalism*	3(2+1)
NGC - 321	Educational Tour**	2(0+2)
	TOTAL *Elective Course, **NC: Non-gradual courses	19(9 + 10)+ 3*+2**

VII Semester		
Activities	No. of weeks	Credit Hours
Rural Agricultural Work Experience and Agro-industrial Attachment(RAWE & AIA) READY-Component-I		14
RAWE- 411 (Rural Agricultural Work Experience)		


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1. General orientation & On campus training by different faculties	1	
2. (a) Village attachment training programme	8	
i. Orientation and Survey of Village		
ii. Agronomical Interventions		
iii. Plant Protection Interventions		
iv. Soil Improvement Interventions (Soil sampling and testing)		
v. Fruit and Vegetable production interventions		
vi. Food Processing and Storage interventions		
vii. Animal Production Interventions		
viii. Extension and Transfer of Technology activities		
(b) Attachment in University/College/KVK/research Station	5	
READY- Component –II		
AIA- 412 (Agro Industrial Attachment)		
<ul style="list-style-type: none"> Students shall be placed in Agro-and Cottage industries and Commodities Boards for 03 weeks. Industries include Seed/Sapling production, Pesticides- insecticides, Post harvest-processing-value addition, Agri-finance institutions, etc. 	3	4
Plant Clinic <ul style="list-style-type: none"> Seed/Sampling production, Pesticide/insecticide, post harvest industries, processing- value addition, Agri -finance institutions etc. 	2	2
Activities and Tasks during Agro-Industrial Attachment Programme		
i. Acquaintance with industry and staff		
ii. Study of structure, functioning, objective and mandates of the industry		
iii. Study of various processing units and hands-on trainings under supervision of industry staff		
iv. Ethics of industry		
v. Employment generated by the industry		
vi. Contribution of the industry promoting environment		
vii. Learning business network including outlets of the industry		
viii. Skill development in all crucial tasks of the industry		
ix. Documentation of the activities and task performed by the students		
x. Performance evaluation, appraisal and ranking of students		
Total		20

VII

I Semester READY- Component –III (Experiential Learning Programme) Modules for Skill Development and Entrepreneurship

A student has to register 20 credits opting for two modules of (0+10) credits each (total 20credits) from the package of modules in the VIII Semester

Course code	Title of module	Department	Credits
ELP-421	Production Technology for Bio-agents and Biofertilizer	Soil Science & Agricultural Chemistry	0+10
ELP-422	Seed Production Technology	Genetics & Plant Breeding	0+10


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ELP-423	Mushroom Cultivation Technology	Plant Pathology	0+10
ELP-424	Soil, Plant, Water and Seed Testing	Soil Science & Agrl chem	0+10
ELP-425	Commercial Beekeeping	Entomology	0+10
ELP-426	Poultry Production Technology	Animal Production	0+10
ELP-427	Commercial Horticulture	Horticulture	0+10
ELP-428	Floriculture and Landscaping	Horticulture	0+10
ELP-429	Food Processing	Agricultural Engineering	0+10
ELP-430	Agriculture Waste Management	Agricultural Engineering	0+10
ELP-431	Organic Production Technology	Agronomy	0+10
ELP-432	Commercial Sericulture	Entomology	0+10

Grand Total (Credit Hours) = 185

Elective Courses: A student can select three elective courses out of the following and offer during 4th, 5th and 6th semesters.

S.N.	Course Code	Courses	Department	Credit Hours
IV Semester				
1.	UGE-221	Agribusiness Management	Agricultural Economics	3(2+1)
2.	UGE-222	Agrochemicals	Soil Science & Agricultural Chemistry	3(2+1)
3.	UGE-223	Commercial Plant Breeding	Genetics & Plant Breeding	3(1+2)
4.	UGE-224	Landscaping	Horticulture	3(2+1)
V Semester				
1.	UGE-311	Food Safety and Standards	Agricultural Engineering	3(2+1)
2.	UGE-312	Bio-pesticides & Bio-fertilizers	Soil Science & Agricultural Chemistry	3(2+1)
3.	UGE-313	Protected Cultivation	Horticulture	3(2+1)
4.	UGE-314	Micro propagation Technologies	Horticulture	3(1+2)
VI Semester				
1.	UGE-321	Hi-tech. Horticulture	Horticulture	3(2+1)
2.	UGE-322	Weed Management	Agronomy	3(2+1)
3.	UGE-323	System Simulation and Agro-advisory	Soil Science & Agricultural Chemistry	3(2+1)
4.	UGE-324	Agricultural Journalism	Agriculture Extension & Communication	3(2+1)


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Course Outcome:**AGR-111 Fundamentals of Agronomy Course Outcomes**

CO.1: In modern terminology however, the word has come to mean and denote a branch of science dealing with all aspects of crop cultivation and production.

CO.2: A study of agronomy often involves a summoning of resources from related disciplines such as Botany, Soil Science, Irrigation, plant protection, Plant Genetics and Breeding, Agro- meteorology etc.

CO.3: In a more fundamental sense it can be categorized as an applied Science, the object of which is crop cultivation and management for the purpose of producing food for humans, feed for animals as well as raw materials for the industry.

CO.4: Knowledge about Indian Agriculture and importance, present status, scope and future prospect.

CO.5 Cropping seasons of India. Soil formation, classification, physical, chemical properties. Identification of important crops and crop seeds.

AGR-112 Introduction to Forestry Course outcome-

CO.1. Students will understand recognize various harvesting, transportation, and processing systems used in the management of forest resources and production of forest products CO.2. Students will understand develop and evaluate management plans with multiple objectives and constraints.

CO.2. Students will learn how to develop and apply silvicultural prescriptions appropriate to management objectives.

CO.3. Students will understand analyse forest inventory information and project future forest, stand, and tree conditions

AGR-121- (Fundamentals of Crop Physiology). Course Outcome:

CO-1: Role of crop physiology in crop health.

CO-2: Identification of deficiency symptoms of nutrients.

CO-3: To understand the metabolic and synthetic pathway of biomolecules.

CO-4: To know the difference between C3, C4 and CAM plant.

AGR- 211 Environmental Studies and Disaster Management (to be shared with Soil Science & Agril. Chemistry)

CO1: Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving. Interdisciplinary branches of environment and their scopes.

CO2: Concepts of natural resources, Food resources, mineral resources, Concept of non-Conventional energy resources, types and various applications of renewable resources and current potentials of energy resources.

CO3: Ecosystem Links between environmental components and their role and types of ecosystems.

CO4: Types of biodiversity, their values, depletion and conservation methods.

CO5: Basic Structure of atmosphere and their functions Current problems related issues context in solving environmental issues such as environmental health, food and agriculture, energy, waste and


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pollution, climate change, management, Basic knowledge about water resources, current problems related issues, water borne diseases, technologies of water treatment.

CO6: Composition of solid waste, sources of generation, collection and disposal methods of solid waste, recycling, reuse of wastes.

CO7: Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion.

CO8: Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

CO9: Meaning and nature of natural disasters, their types and effects and management

AGR-212 Practical Crop Production – I (Kharif crops) Course Outcome

CO.1: In the course study students will be acquainted with the knowledge of profitable crop production technology.

CO.2: Course content will help to students/farmers about ruminative crop production techniques.

CO.3. It helps to adopt diversified farming system according to available farming situation.

CO.4. It will assist to encourage the sustainable agriculture system.

CO.5. Profitable based farming system can we adopted with the help of course content

AGR-221 Practical Crop Production – II (Rabi crops) Course Outcome

CO.1: In the course study students will be acquainted with the knowledge of profitable crop production technology.

CO.2: Course content will help to students/farmers about ruminative crop production techniques.

CO.3. It helps to adopt diversified farming system according to available farming situation.

CO.4. It will assist to encourage the sustainable agriculture system.

CO.5. Profitable based farming system can we adopted with the help of course content

AGR-223 Farming System & Sustainable Agriculture Course Outcomes: -

CO1 The student will be able to explain the major aspects of agricultural practices and traditions through time and throughout the world.

CO2 The student will be able to explain in general the relationships among culture, economics, politics, science, and agricultural development.

CO3 A solid understanding of the cross-cultural interactions and exchange that linked the world's people and facilitated agricultural development is also expected.

CO4 The student will study and analyze the refereed-journal articles, texts, and practices that represent the perspectives of different societies and agricultural traditions.

AGR-224 Introductory agro meteorology & Climate change Outcome


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CO.1: To understand roles of agrometeorology in agriculture and its relation to other areas of agriculture to acquaint with recent developments in agrometeorology with historical development of climate change.

CO.2: Agrometeorology or Agricultural meteorology studies meteorological and hydrological factors in relation to agriculture.

CO.3: Agrometeorology studies the behavior of the weather elements that have direct relevance to agriculture and their effect on crop production.

CO.4: Weather and climate are the factors determining the success or failure of agriculture.

AGR-311 Geoinformatics and Nanotechnology and Precision Farming Course Outcomes

CO.1: Maximization of input use efficiency in agriculture through recent technology like precision agriculture, nanoscience and geoinformatics. The concept of "doing the right thing in the right place at the right time" has a strong intuitive appeal which gives farmers the ability to use all operations and crop inputs more effectively.

CO.2: More effective use of inputs results in greater crop yield and/or quality, without polluting the environment.

CO.3: Precision agriculture can address both economic and environmental issues that surround production agriculture today.

CO.4: Encourage the farmers to study of spatial and temporal variability of the input parameters using primary data at field level.

CO.5: Creating awareness amongst farmers about consequences of applying imbalanced doses of farm inputs like irrigation, fertilizers, insecticides and pesticides.

AGR-312 Practical Crop Production – I (Kharif crops) Course Outcome

CO.1: In the course study students will be acquainted with the knowledge of profitable crop production technology.

CO.2: Course content will help to students/farmers about ruminative crop production techniques.

CO.3. It helps to adopt diversified farming system according to available farming situation.

CO.4. It will assist to encourage the sustainable agriculture system.

CO.5. Profitable-based farming system can be adopted with the help of course content

AGR-321 Rainfed Agriculture & Watershed Management Course Outcomes

CO.1. The term Rain fed agriculture is used to describe farming practices that rely on rainfall for water.

CO.2. A major study into water use by agriculture, known as the Comprehensive Assessment of Water Management in Agriculture, coordinated by the International Water Management Institute, noted a close correlation between hunger, poverty and water. However, it concluded that there was much opportunity to raise productivity from rainfed farming.

CO.3 Rainfall water can be use for a larger area by suitable watershed management techniques CO.4. Conservation of soil by adopting latest soil conservation techniques will help in obtaining higher production of Rainfed crops.


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AGR-322 Practical Crop Production – II (Rabi crops) Course Outcome

CO.1: In the course study students will be acquainted with the knowledge of profitable crop production technology.

CO.2: Course content will help to students/farmers about ruminative crop production techniques.

CO.3. It helps to adopt diversified farming system according to available farming situation.

CO.4. It will assist to encourage the sustainable agriculture system.

CO.5. Profitable based farming system can we adopted with the help of course content.

AGR-323 Principles of Organic Farming Course Outcomes

CO.1. Initiative from Government for organic produce.

CO.2.Role of NGOs in producing organic products. CO.3 Selection of crops and varieties for organic produce CO.4.Certification of organic produce.

Genetics & Plant Breeding

GPB-121 Fundamentals of Genetics Course outcomes: -

CO-1: Comprehensive, detailed understanding of the chemical basis of heredity specially in crop plants to improve and develop the new varieties of plants.

CO-2: Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.

CO-3: The knowledge required to design, execute, and analyze the results of genetic experimentation in plant systems.

CO-4: Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings.

CO-5: Understanding the role of genetic technologies in industries related to biotechnology, pharmaceuticals, energy, and other fields.

GPB-211 Fundamentals of Plant Breeding Course Outcome:

CO-1: Establish the commercial plant breeding company to developed new superior crops varieties.

CO-2: Develop the insect and disease resistant varieties for environment friendly management of disease and insect.

CO-3: Serve the quality food in the market by developing high nutritive varieties.

CO-4: Increase the farm yield to get higher income on farm by developing higher yield crop varieties.

CO-5: start a consultant company to guide & supply the better varieties to the farmers.

GPB-221 Principles of Seed Technology Course Outcomes: -

CO-1: Start a seed production program for fill full the requirement of quality seed in market and increase the income.


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CO-2: Storage the pure variety seed to avoid the availability crises of pure variety seed due to adverse environmental conditions.

CO-3: To supply the disease-free seed in the market to get the environment friendly cultivation of crops.

CO-4: To increase the farm income by producing high yielding disease free quality seed and decrease the cost of cultivation also.

CO-5: Production of hybrid seed of different crops to increase the farm income.

GPB-311 Crop Improvement-I (Kharif crops) Course Outcomes

CO-1: In this course Students learn importance of wild relative to produce new varieties of kharif crop.

CO-2: Learner learns Gene preservation method for further use to improve kharif crops.

CO-3: Learner learns to applies breeding method to improve kharif crops.

CO-4: Learner learns identification of resistance gene relate to kharif crop with high yield potential against Pest and pathogen and utilization genes.

CO-5: Learner learns new genetic approaches to achieve a definite ideotype of kharif crop.

GPB-321 Crop Improvement-II (Rabi crops)

Course Outcomes:

CO-1: In this course Students learn importance of wild relative to produce new varieties of Rabi crop.

CO-2: Learner learns Gene preservation method for further use to improve Rabi varieties.

CO-3: Learner learns to applies breeding method to improve Rabi crops.

CO-4: Learner learns identification of resistance gene relate to Rabi crop with high yield potential against Pest and pathogen and utilization genes.

CO-5: Learner learns new genetic approaches to achieve a definite ideotype of Rabi crop.

Agricultural Engineering

AGE-112 Farm Machinery and Power Course Outcomes:

At the end of the course, a student will be able to understand

CO1: Various sources of farm power and their uses

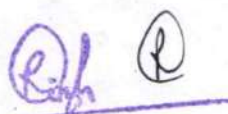
CO2: about working of IC Engines and their uses in modern equipment's CO3: about various parts of tractors and their mechanism

CO4: the financial aspects of using farm power

CO5: the various implements used in agriculture farm for various purposes.

AGE-121 Introductory Soil and Water Conservation Engineering Course Outcome:

CO-1: various causes of soil erosion and forms of water erosion, classification of gully control measures or structures.



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CO-2: Course will give the knowledge of soil loss equation and it can estimate long - term annual soil loss and guide conservationists on proper cropping, management, and conservation practices.

CO-3: This course will help the students to learn about Contour strip cropping designed to minimize soil erosion and Contour bunds which can save soils from erosion.

CO-4: By this course student get the knowledge about Grassed waterways designed to move surface water across farmland without causing soil erosion and various water harvesting techniques.

CO-5: Students will be able to understand the wind erosion, centrifugal pumps and various pressurized irrigation methods. So overall the importance of this technology in farm is given to students by teaching this course.

AGE-211 Environmental Studies and Disaster Management

At the end of the course, the student will be able to:

CO1: Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving. Interdisciplinary branches of environment and their scopes.

CO2: Concepts of natural resources, Food resources, mineral resources, Concept of non-Conventional energy resources, types and various applications of renewable resources and current potentials of energy resources.

CO3: Ecosystem Links between environmental components and their role and types of ecosystems.

CO4: Types of biodiversity, their values, depletion and conservation methods.

CO5: Basic Structure of atmosphere and their functions Current problems related issues context in solving environmental issues such as environmental health, food and agriculture, energy, waste and pollution, climate change, management, Basic knowledge about water resources, current problems related issues, water borne diseases, technologies of water treatment.

CO6: Composition of solid waste, sources of generation, collection and disposal methods of solid waste, recycling, reuse of wastes.

CO7: Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion.

CO8: Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

CO9: Meaning and nature of natural disasters, their types and effects and management.

AGE-222 Renewable Energy and Green Technology Course Outcomes-

CO1: To understand the role of renewable sources in agriculture sector.

CO2: To understand the bio fuel production and their applications in today's world. CO3: To understand and utilizing the solar energy in various aspects.


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AGE-322 Post-harvest Management and Value Addition of Fruits and Vegetables Course outcome-

Co.1- Understand the post-harvest technology of horticultural crops.

Co.2- Understand the value addition of horticulture crops.

Co.3- Understand the work space, tool and equipment design for PHT and value addition.

Co.4- study the various certification and accreditation i.e. FPO, ISO and other levelling.

Basic Science

BAS-111 Comprehension and Communication Skill in English Course Outcome (COs):

At the end of the course students will be able to understand:

CO1: Students will identify and explain their goals to the semester and also identify the needs of communication helps us meet. They will be able to understand the common misconceptions about communication and the reasons, people use language.

CO2: Students can differentiate the action, interaction and transaction models of communication. They can define the process of both perception and listening. Students can recall the importance of listening effectively and can identify strategies for communicating the cultural awareness.

CO3: Students will be able to introduce themselves to the class and begin getting to know one another and will apply communication strategies by preparing and participating in class discussion.

CO4: Students will prepare and present messages with the intent of persuading an audience. Students will be able to analyze basic communication skills, intercultural communication skills, interpersonal communication skills and public- speaking skills.

CO5: Students can demonstrate critical and innovative thinking. Display competence in oral, written and visual communication. They will be able to use current technology related to the communication field.

BAS-212 Intellectual Property Rights Course Outcomes:

1.Skill to understand the concept of intellectual property rights.

2.Develops procedural knowledge to Legal System and solving the problem relating to intellectual property rights.

3.Skill to pursue the professional programs in Company Secretaryship, Law, Business, Agriculture, International Affairs, Public Administration and Other fields.

4.Employability as the Compliance Officer, Public Relation Officer and Liaison Officer.

5.Establishment of Legal Consultancy and service provider.

Soil Science and Agricultural Chemistry

SSAC-111 Fundamentals of Soil Science Course Outcomes:

At the end of the course, Students will be able to understand:

CO1: To be able about physical and chemical properties of soil and their effect on plant's health.


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CO2: To aware the students about causes, effects and remedies to prevention and mitigation of soil pollution.

CO3: Knowledge about soil forming rocks and minerals, their weathering and soil forming processes and climatic factors affect them.

SSAC-121 Agricultural Microbiology (Course to be shared with Plant Pathology) Course Objectives

Course Outcome

CO1 Student will understand the basic microbial structure, function and study the comparative characteristics of prokaryotes and eukaryotes.

CO2 To know the various Physical and Chemical growth requirements of bacteria

CO3 Impart knowledge about production of beneficial bacteria.

SSAC-211 Environmental Studies and Disaster Management (to be shared with Soil Science & Agril. Chemistry)

At the end of the course, the student will be able to:

CO1: Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving. Interdisciplinary branches of environment and their scopes.

CO2: Concepts of natural resources, Food resources, mineral resources, Concept of non-Conventional energy resources, types and various applications of renewable resources and current potentials of energy resources.

CO3: Ecosystem Links between environmental components and their role and types of ecosystems.

CO4: Types of biodiversity, their values, depletion and conservation methods.

CO5: Basic Structure of atmosphere and their functions Current problems related issues context in solving environmental issues such as environmental health, food and agriculture, energy, waste and pollution, climate change, management, Basic knowledge about water recourses, current problems related issues, water born diseases, technologies of water treatment.

CO6: Composition of solid waste, sources of generation, collection and disposal methods of solid waste, recycling, reuse of wastes.

CO7: Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion.

CO8: Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

CO9: Meaning and nature of natural disasters, their types and effects and management.


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SSAC-221 Problematic soils and their Management Course Outcomes:

CO1: To provide knowledge about waste land and problematic soils in India and management of the soils.

CO2: Knowledge of different reclamation and management practices for the development of the soils.

CO3: To Understand different factors responsible for saline, sodic and acidic soils and their properties.

SSAC-311 Manures, Fertilizers and Soil Fertility Management Course Outcome:

CO1: Knowledge of different manure and fertilizers used in different crops according to soil condition

CO2: To understand essentiality of plant nutrients and mechanism of nutrient transport to plant and factor affecting nutrient availability.

CO3: To be able about procedure of soil testing and establish soil testing laboratory in future as a entrepreneur.

Entomology**ENT-121 (Fundamentals of Entomology)**

Course Outcome:

CO 1: To be able to identify morphological characteristics, feeding habit and habitat of agriculturally important insect-pest.

CO 2: To be able to apply concepts and analytical approaches in evolutionary biology, genetics and other areas of insect biology of the student's choice.

CO 3: To be able to categorize insects based on basic ecological, behavioural, morphological, physiological, or developmental attributes.

CO 4: To be able to examine insects deeply within a biological level of analysis and make strategies for successful pest management strategy.

CO 5: To be able to understand about different families and orders of class Insect which cause economic losses for human beings.

ENT-311 (Pests of Crops and Stored Grains and Their Management) Course Outcome:

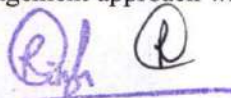
CO1: Familiarized with identification of different insect pest of field, horticulture, ornamentals, vegetables and stored grains at the field level.

CO 2: Understand how insects affect animal and Plant health and agricultural production, and be able to safely manipulate populations of beneficial and destructive species in habitats and in production agro-ecosystems with minimal environmental impact.

CO 3: To be able about the biology, diversity, distribution of insects, and their relationships to crop and the environment condition of a particular area.

CO 4: To understand identification of nature of damage and symptoms caused by the pest so suitable technique of pest management can be apply for effective control.

CO 5: Management of crop pest through Integrated Pest Management approach without side effect on plant, animal and environment health.



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ENT-321 (Management of Beneficial Insects) Course Outcomes:

CO 1: Students can adopt apiculture, sericulture and lac culture as an entrepreneur according to agro climatic zone.

CO 2: To understand commercial methods of rearing, equipment, seasonal management, insect- pest and disease and important species for commercial use of honey bee, silkworm and lac insect.

CO 3: Identification of different bio control agents (Predator, Parasite and Parasitoids) and their use for sustainable pest management.

CO 4: Learn about mass multiplication technique of biological control agents and established a bio control lab in future as an entrepreneur.

Agricultural Economics**AAE-121 (Fundamentals of Agricultural Economics) Course Outcome:**

CO-1: Identify elements of business success in agriculture and food-processing as well as elements that determine economic role of agriculture in national economy.

CO-2: Propose methods of micro- and macroeconomic decision making in agriculture in different agro-ecological and agro-economic circumstances.

CO-3: Describe and explain models of production, supply and demand of agricultural and food products on national and international markets

CO-4 :Understand the concepts of consumer choice and how it affect the farm / ranch level agriculture firm.

CO-5: understand the macroeconomics aspects of the economy as they affect the agricultural sector.

CO-6: apply economics principles to understand the conduct and performance of the agricultural industry.

AAE-311 (Agricultural Finance and Co-Operation) Course Outcome:

CO-1: Explain the broad feature of Indian financial institutions with instruments to control credit in the country.

CO-2: Effectively narrate the kinds and components of money with its regulatory system. Be aware of the functions, objectives and limitations of commercial bank.

CO-3: Identify the existence and development of non- banking financial institutions, know the important role of mutual fund. LIC investment companies etc. Utilize and effectively participate in the development process.

CO-4: Understand the conditions of financial markets and its impact in the economy.

CO-5: Understand the macroeconomics aspects of the economy as they affect the agricultural sector.

CO-6: Apply economics principles to understand the conduct and performance of the agricultural industry.


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AAE-312 Entrepreneurship Development and Business Communication Course Outcomes:

- CO1 Define basic terms, Analyse the business environment in order to identify business opportunities
- CO2 , Identify the elements of success of entrepreneurial ventures
- CO3 Consider the legal and financial conditions for starting a business venture,
- CO4 Evaluate the effectiveness of different entrepreneurial strategies,
- CO5 Specify the basic performance indicators of entrepreneurial activity,
- CO6 Explain the importance of marketing and management in small businesses venture,
- CO7 Interpret their own business plan.

AAE-321 (Farm Management, Production & Resource Economics) Course Outcome:

- CO-1: The course contains a comprehensive treatment of the traditional agricultural production economics topics employing both detailed graphics and differential calculus.
- CO-2: Focus on the neoclassical factor-product, factor-factor and product- product models, and is suitable for an advanced undergraduate or a beginning graduate –level course in static production economics.
- CO-3: Understand limited resources available in the economy. Realize the need to exploit and utilize through development and improvement of production techniques.
- CO-4: Make them aware of the availability of rich natural endowments to achieve sustainable agricultural development with this knowledge they can challenge the problems of unemployment inequality shortage of food productions, poverty and be useful to compete advanced agricultural economies.
- CO-5: Gain knowledge of the causes of regional variations in productivity and production, social and economic inequality, size of land holdings and lack of quality inputs etc. And suggest appropriate measures for the whole economy.

Plant Pathology**PPA-121 Fundamentals of Plant Pathology Course outcome**

- CO1- Student will acquaint about concepts of plant pathogens, major disease-causing organisms and their etiology
- CO2 - To provide specific knowledge about host pathogen interactions.
- CO3 -Recognition of plant disease is the first step in doing something about them. CO4 - To give specific knowledge about environment and disease development.

PPA-211 Diseases of Field and Horticultural Crops and their Management-I Course Outcome

- CO-1. Student will know the common pathogens of different diseases.
- CO-2. Student acquire the knowledge about etiology, and symptoms of these diseases which helps in diagnosis of the diseases of field and horticultural crops



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CO-3. By knowing means of dispersal of these diseases suitable management methods can be applied.

CO-4. Eco-friendly and economically suitable management practices may be adopted.

PPA-321 Diseases of Field and Horticultural Crops and their Management-II Course Outcome

CO1. Student will know the common pathogens of different diseases.

CO2. Student acquire the knowledge about etiology, and symptoms of these diseases which helps in diagnosis of the diseases of field and horticultural crops.

CO3. By knowing means of dispersal of these diseases suitable management methods can be applied.

CO4. Eco-friendly and economically suitable management practices may be adopted.

Horticulture

HORT-111 (Fundamentals of Horticulture) Course Outcome:

CO1. - Students will be able to identify plant vegetative structure

CO2.- Students will understand basic principles, processes and plant propagation methods. CO3.- students will understand how to propagate plant, manage and harvest a variety of plant. CO4.- students will learn how horticulture relates to the economy and environments, both currently and in the future.

HORT-211 Production Technology for Vegetables and Spices Course outcome-

CO.1 Students will understand practical knowledge on specialized production techniques of vegetables and spices.

CO.2- Students understand will Importance of vegetables & spices in human nutrition improved and national economy.

CO.3- Students will knowledge about quality requirement and production and techniques CO.4- Managing skill for solving field problems.

HORT-221 Production Technology for Ornamental Crops, MAP and Landscaping Course Outcomes-

CO.1- To evaluate natural herbal products from an economic perspective. Co.2-To use medicinal and aromatic herbs sustainably.

CO.3-To set up business related to medicinal, aromatic and landscaping.

CO.4-To develop effective ideas related to collecting, processing and marketing herbal natural sources.

HORT-222 Production Technology for Fruit and Plantation Crops Course outcome-

CO.1 -To know importance of different fruit crops and plantation crops.

CO.2- Students will understand canopy architecture for higher productivity in mango and grapes. CO.3- Students will understand package of practices for the major crops like mango, banana, guava, lemon, pineapple, coffee, coconut and rubber.

CO.4- To understanding the concept of high density planting in different fruit crops.


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HORT-221 Protected Cultivation and Secondary Agriculture- Course Outcome:

CO-1: To get knowledge about green house technology, types of green houses and construction of green houses.

CO-2: Course will give the knowledge of Green house equipments, materials of construction for traditional and low cost green houses.

CO-3: This course will help the students to learn about Irrigation systems used in greenhouses, shade net house in protected cultivation.

CO-4: By this course student get the of concepts of cleaning and grading Moisture measurement.

CO-5: Students will be able to understand the Material handling equipment, principle and working.

Agricultural Extension and Communication**AEC-112 Rural Sociology & Educational Psychology Course Outcomes:**

CO1: Understand concept of rural sociology, its importance in agricultural extension, characteristics of Indian rural society.

CO2: Understand social groups, social stratification, culture, social values, social control and attitudes, leadership and training.

CO3: Understand concept of educational psychology, intelligence, personality, perceptions, emotions, frustration, motivation, teaching and learning

CO4: Acquaint with characteristics of rural society, village institutions and social organizations. Select lay leaders and train them.

CO5: Assess personality types, leadership types and emotions of human beings iv. Create a training situation under village conditions.

AEC-121 Fundamentals of Agricultural Extension Education Course outcomes-

At the end of the course, a student will be able to understand –

CO1: Education; Extension Programme planning Meaning, Process, Principles and Steps in Programme Development.

CO2: Extension systems in India: Extension efforts in Pre-independence era .

CO3: New trends in agriculture extension: privatization extension.

CO4: Monitoring and evaluation – concept and definition, monitoring, and evaluation of Extension programmes, Transfer of Technology- Concept and models.

AEC-211 Communication Skills and Personality Development Course Outcomes:

CO1: Students will analyze basic communication skills.

CO2: Students will analyze intercultural communication skills.

CO3: Students will analyze interpersonal communication skills.

CO4; Students will analyze public speaking communication skills.

 
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AEC-312 Entrepreneurship Development and Business Communication Course Outcomes:

- CO1: Define basic terms,
- CO2: Analyse the business environment in order to identify business opportunities,
- CO3: Identify the elements of success of entrepreneurial ventures,
- CO4: Consider the legal and financial conditions for starting a business venture,
- CO5: Evaluate the effectiveness of different entrepreneurial strategies,
- CO6: Specify the basic performance indicators of entrepreneurial activity,
- CO7: Explain the importance of marketing and management in small businesses venture,
- CO8: Interpret their own business plan.

Agricultural Biotechnology

AGB-111 (Fundamentals of Plant Biochemistry and Biotechnology) Course Outcome:

At the end of the course, a student will be able to understand –

- CO1. Role of cell organelles and their functions
- CO2. Functions of biomolecules and their utility in cell
- CO3. Identify the deficiency symptoms of biomolecules
- CO4. Synthesis pathways of biomolecules and regulations
- CO5. Identification of biomolecules in given sample
- CO.6 Application of plant tissue culture in crop improvement
- CO.7 Tackled the problems in convention breeding
- CO.8 Plant tissue culture is a area of entrepreneurship.

Animal Production

AAP-211 (Livestock and Poultry Management) Course Outcome:

- CO-1: Develop and evaluate animal production and management systems by integrating knowledge of animal genetics, nutrition, reproduction, and other relevant disciplines and applying scientific and quantitative reasoning to solve real-world challenges.
- CO-2: Locate, critically evaluate, and apply information from scholarly animal science literature and other sources to expand personal understanding and knowledge of animal sciences, providing a foundation for lifelong learning.
- CO-3: Create and interpret graphs, tables and diagrams illustrating scientific data and concepts, and understand basic concepts relating to the design and analysis of research in the animal sciences.
- CO-4: Communicate effectively about animal sciences to a range of audiences, both orally and in writing, using appropriate traditional and emerging media.
- CO-5: Engage actively and effectively in discussion of complex issues relevant to the animal sciences by understanding and appreciating:
 - a. the importance of animals to the health and well-being of society;


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- b. economic, environmental, animal welfare, and societal impacts of animal production and management systems at the global and local level;
- c. varied ethical perspectives on animal practices;
- d. the role of science in informing debates.

CO-6: Appreciate the breadth and depth of professional opportunities in animal sciences relating to: The keeping of animals for food and fiber production and other purposes (e.g., companionship, research and teaching, biotechnology, sports, species conservation); The application of scientific principles to animal breeding, reproduction, feeding, growth and development, health management, housing, handling, and end – product safety and quality.

Remedial Courses

UGR-111 Agricultural Heritage Course Outcomes:

CO1. Ancient Agricultural Practices & Its relevant to modern agriculture practices.

CO2 Traditional Technical Knowledge.

CO3 Our Journey (Developments) in Agriculture and Vision for the Future.

UGR-112 Introductory Biology (New) Course Outcome

1. The student will be able to read, understand, and critically interpret the primary biological literature in his/her area of interest.
2. The student will be able to design, conduct, analyze, and communicate (in writing and orally) biological research.
3. The student will recognize and be able to apply basic ethical principles to basic and applied biological/biomedical practice and will understand the role of biological/biomedical science, scientists, and practitioners in society.
4. The student will be able to explain the process of organic evolution and its underlying principles and mechanisms.
5. The student will be able to explain the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal, population, and ecosystem levels of the biological hierarchy.
6. The student will be able to explain the importance of biodiversity at the genetic, organismal, community, and global scales.

UGR-113 Elementary Mathematics Course Outcome

- CO1. Demonstrate competency in the areas that comprise the core of the mathematics major CO2. Demonstrate the ability to understand and write mathematical proofs CO3. Be able to use appropriate technologies to solve mathematical problems CO4. Be able to construct appropriate mathematical models to solve a variety of practical problems
- CO5. Obtain a full-time position in a related field or placement.


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COLLEGE OF BIOTECHNOLOGY

	Local
	Regional
	Global
	National

Undergraduate

Degree Programme: - B. Tech Biotechnology

Objectives

1. The course gives student an opportunity to learn about global trends that influence our Biological systems, environment and the living conditions and learn how different biotechnological approaches are used around the world to manage various relevant issues in diverse areas of biology.
2. The student will develop simulations to think as a biotechnological strategist and design an appropriate solution to diverse problems in areas of Agriculture, Health, Industry etc.
3. Students will develop ethical practices and imbibe values for becoming Biotechnology professionals.

PROGRAMME OUTCOMES (POs)

- PO-1: An Understanding of Biotechnological Functions: Expertise in learning processes and functions that operates in Biological Organisms.
- PO-2: Interpersonal Skill Development: Expertise in communication both spoken as well as written.
- PO-3: Developing Critical and Analytical Thinking Abilities: Critical thinking in academics, presentations, research and professional alliances relies heavily on one's ability to be creative.
- PO-4: Developing Entrepreneurship Acumen: Helps to prepare students for research/managerial roles and as entrepreneurs.
- PO-5: Developing skills to solve real-world biotechnological problems: Equips students to demonstrate the capabilities required to apply cross-functional knowledge and technologies in solving real-world biotechnological problems.
- PO-6: Appropriate techniques: Enables students to demonstrate use of appropriate techniques to effectively manage academic and research challenges.
- PO-7: Practical exposure: Providing an opportunity for the students to gain practical exposure towards the workplace of biotech laboratory and make them industry ready.
- PO-8: Decision Making: Equip students with techniques of analyzing and interpretation of the research data which is used in Decision Making.


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PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO-1: To develop students with the ability to analyse various functional issues affecting the biotechnological organization and acquiring conceptual clarity of various functional areas of biotechnology.
- PSO-2: The students understand the ethical challenges and choices in a biotechnological unit setting and develop ability to evolve strategies for research/ organizational benefits.
- PSO-3: To inculcate in students the ability to gain multidisciplinary knowledge through seminar reports, case study analysis, Research projects and industrial training and Organizational visits.
- PSO-4: Demonstrate ability to work in Groups and acquire leadership quality required in their career.

COURSE OUTCOMES (COs)

Subject	Subject Code	Course Outcomes
Human Ethics	BAS 112	CO1. Understand and analyses universal human aspirations, Human values and ethics, Sensitization towards others. CO2. Understand and associate spirituality, positive attitude and scientific temper CO3. Understand rights and responsibilities, Human relations and harmony CO4. Provide depth knowledge on developing personal code of conduct (SWOT Analysis) CO5. Management of anger and stress.
Basic Mathematics-I	BAS 116	Learn mathematical description of CO1. Number system and Complex numbers. CO2. Theory of equations. CO3. Geometric, harmonic and binomial series. CO4. Trigonometric calculations.
Basic Botany	BAS 114	Provides study of different aspects of Botany, viz. CO1. Plant kingdom and features of each group. CO2. Cell structure; DNA, chromosome and genes; Cell and tissue types. CO3. Plant taxonomy, systems of classification. CO4. Characteristics and economic importance of different families.
Communication Skills & Personality Development	BAS 115	Development of understanding on CO1. Meaning and process of communication CO2. Reading and comprehension of general and technical articles. CO3. Writing skills, Voice modulation and Oral presentation skills. CO4. Organizing seminars and conferences.


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		CO5. Attributes of an effective leader; Stress, conflict and Time management. CO6. Science of body language and role of team work.
Environmental Studies and Disaster Management	AGE/ SAC/ AGR 114	To describe, explain, and integrate fundamental concepts underlying CO1. Natural resources and its conservation for sustainable lifestyles. CO2. Ecosystems, Biodiversity and its conservation; CO3. Environmental issues like water, forest, land, wildlife conservation, Pollution, climate change etc., their effects, control measures and acts. CO4. Disaster management - Efforts to migrate natural disaster at national and global levels.
Food Science and Processing	AGE 113	Students get acquainted with skill in various areas of Food Science and Processing. CO1. Understanding of food and nutrition, CO2. Causes of food spoilage, principles of processing and preservation of food, CO3. Post-harvest handling and technology.
Crop Production Technology	AGR 113	To enable the students to understand about the various areas of crop production technology, CO1. Understanding about Soil and its components, CO2. Agronomy and its relation with other sciences, CO3. Maintenance of Soil fertility and productivity.
Basic Genetics	BTM 111	To help the students focus on and analyze the issues and strategies of basic genetics, CO1. History of Genetics, Mendel principles and genetic basis of evolution, CO2. Multiple allelism, Linkage and crossing-over, CO3. Genetic analysis in prokaryotes and eukaryotes, CO4. Mutations, Hardy-Weinberg law and Quantitative inheritance.
Introduction to Biotechnology	BTO 111	To describe and introduce basic concepts of Biotechnology including, History, definitions, concepts, scope and importance of Biotechnology. CO1. Understand Biotechnological applications in Plant, microbial, animal, medical, environmental, industrial, Marine, Agricultural, food and Nano biotechnology.
Cell Biology	BTC 111	Explain the concept of the various constituents of cell biology viz. CO1. Origin and evolution of cell, microscopy; CO2. Sub-cellular structure of prokaryotic and eukaryotic cells; CO3. Membrane structure and function, cell wall and extracellular matrix, CO4. Structure and function of cytoskeleton, CO5. Cell membrane transport, cell signaling, cell cycle and its control.
NCC/NSS/PEY (NG)	NCC/NSS/ PEY- 111	Evoking social consciousness among students through various activities viz., CO1. Working together, constructive and creative social work,

		CO2. To be skillful in executing democratic leadership, CO3. Developing skill in program development to be able for self-employment, CO4. Increasing physical fitness, awareness and desire to help sections of society.
Basic Zoology	BAS 121	Students will get to know about the introduction to various aspects of Zoology, CO1. Binomial Nomenclature and Classification and general survey of animal kingdom, CO2. Functional organization of various systems of a mammal, CO3. Study of animal cell structure and cell division.
Basic Mathematics- II	BAS 122	Learn mathematical description of CO1. Functions, Limit and Continuity of algebraic, trigonometric and exponential functions. CO2. Differential and Integral Calculus. CO3. Mathematical operations of Matrices and Determinants.
Basic Statistics	BAS 123	To apply various concepts of statistics in analysis of research data in different areas of biotechnology viz. CO1. Definition of statistics, its use and limitations; CO2. Frequency distribution and frequency curve. CO3. Tests of significance CO4. Correlation, regression and analysis of variance.
Production Technologies for Horticultural Crops	HOR 121	To introduce students about CO1. Importance and scope of fruit cultivation; Classification of fruit crops; Climatic requirement, CO2. Importance of vegetable cultivation for nutritional security; Production technology of important vegetable crops, CO3. Status and scope of floriculture in India and abroad; Production technology of commercial flower crops.
Anatomy and Physiology of Livestock	VAN/VPB 123	CO1. To understand the core issues and terms used in veterinary anatomy, CO2. Development and physiology of the organs of digestive, urogenital, cardiovascular, nervous and endocrine glands, CO3. Blood physiology; Genetic and endocrine control of reproductive system.
Basics of Plant Breeding	GPB 122	Awareness about aims and objectives of Plant breeding, CO1. Floral biology of field crops CO2. Methods of breeding for self-pollinated, cross pollinated and vegetatively propagated crops. CO3. Hybridization and its significance in crop improvement.
Introduction to Animal Breeding	AAP 121	To introduce students with newly emerging area of Animal Breeding, CO1. Mating Systems: Inbreeding, Out Breeding and Random mating, CO2. Breeding strategies in different animals.
Plant Tissue Culture	BTO 121	Familiarizes the students with Concept of aseptic culture and various techniques of plant tissue culture viz. CO1. Somatic cell cultures;

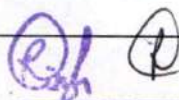

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		CO2. Morphogenesis: organogenesis and somatic embryogenesis; CO3. Micro propagation, Protoplast culture and somatic hybridization.
Molecular Biology	BTM 121	Develops understanding of the students on the biology at molecular level. CO1. Gene structure and function; CO2. DNA replication; transcription; Genetic code and translation, CO3. Gene regulation, CO4. Tools and Role of enzymes in molecular biology.
Biodiversity and its conservation	BTC 121	Introduces students with Concepts of biodiversity, bio resource and wildlife conservation and management strategies. CO1. Sustainable development, Diversification of cropping system, ecosystems and Germplasm banks. CO2. Environmental impact assessment.
Microbiology	BTP 121	Ability to understand practical and theoretical implementation of Microbiology-its applied areas, viz. CO1. Microbial features, growth and metabolism. CO2. Microorganisms and their role in fermentation, Soil and environment. CO3. Beneficial microorganisms in agriculture and Plant microbe interaction, CO4. Microbes in composting and biodegradation.
Biomathematics	BAS 211	To introduce the student to the field of biomathematics, CO1. Ordinary differential equation of first order, linear differential equation of higher order and their applications to biological problems, CO2. Numerical methods, definite integrals and its applications.
Information and Communication Technology	BAS 214	Developing understanding about IT tools, IT-enabled services and their impact on society, CO1. Features of machine language, assembly language, high-level language and their advantages and disadvantages; CO2. Principles of programming, CO3. Introduction to WINDOWS and LINUX Operating Systems, CO4. Introduction to MS Office and its applications.
Economics and Marketing	AAE 212	Students acquires knowledge of CO1. Economics, the kind of markets, cost theory, various issues of demand and other major economic concepts CO2. Have developed skills in role and functions of marketing CO3. Basic guidelines for preparation of project reports for various biotechnology/ agricultural products and value added products
Fundamentals of Crop Protection	ENT/ PPA 212	Familiarization of students with Fundamentals of Crop Protection viz. CO1. Importance of insects in agriculture, CO2. Principles and methods of insect-pests management,

		CO3. Importance and scope of plant pathology, CO4. Nature and classification of plant disease, the Management of key diseases and nematodes of major crops.
Livestock Product Technology	LPT 211	Understanding the basics of Livestock Product Technology, CO1. Composition and nutritive value of milk and meat and various factors affecting their quality, CO2. Milk and meat processing techniques and guidelines.
Breeding of Field Crops	GPB 212	The students will be able to define and explain application of genetic, cytogenetic and biotechnological techniques in breeding of various field crops, CO1. Classes of seed along with its production, maintenance and certification.
Animal Health Care	VMD/VMC 212	Introduction to various aspects of animal health; CO1. Introduction to important diseases of domestic animals, CO2. History of disease diagnosis and medicine; CO3. Animal vaccinations and disease management.
Livestock Production and Management	LPM 212	CO1. Introduction to Livestock Production and Management concepts, CO2. Animal husbandry and Breeds of livestock, CO3. General management and feeding practices of animals, CO4. Common farm management practices CO5. Diseases, parasite & hygiene control.
Recombinant DNA Technology	BTR 211	Understanding the basics of Recombinant DNA technology; CO1. Structure and function of nucleic acids, CO2. Introduction to enzymes used in the technology, CO3. Cloning through PCR and Host-vector system, CO4. Methods of Transformation.
Plant Physiology	BTB 211	Student will be able to understand and correlate concepts of Plant physiology and its scope in agriculture, viz. CO1. Water absorption, water translocation and transpiration; CO2. Stomata mechanisms and photosynthesis, CO3. Dynamics of growth and Stress physiology, CO4. Plant growth regulators, seed germination & seed dormancy.
Biophysics	BAS 221	Provides an insight into application of Biophysics in biotechnology, for e.g. CO1. Quantum mechanics, Electronic Structure of atoms and law of thermodynamics, CO2. Application of various instrumentation techniques used in biotechnology research
Entrepreneurship Development and Business Management	AEC/ AAE 222	CO1. Basic understanding and awareness of different opportunities and successful growth stories. CO2. Learn how to start an enterprise and design business plans those are suitable for funding by considering all dimensions of business. CO3. Understand entrepreneurial process and assessment of entrepreneurship skills, SWOT analysis and achievement motivation, CO4. Opportunities and challenges to Indian agribusiness, Management, Project planning, formulation and report preparation.
Electronics and Instrumentation in Biotechnology	BTB/ AGE 221	Use of various facets of Electronics and instrumentation in biotechnology, eg.


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		CO1. Use of PN junction diode, temperature measurement using thermometer and thermocouple, Force measurement using the strain gauge. CO2. Concept of generalized instrumentation system, principles and working of laboratory equipment's.
General Biochemistry	BTB 222	Understanding the basics of Cell structure and biochemical functions e.g. CO1. Bio molecules- primary, Secondary metabolites and their applications in food and pharmaceutical industries. CO2. Bioenergetics and basic Metabolism.
Introductory Bioinformatics	BTI/ BTR 221	To develop a basic understanding of bioinformatics processes viz. CO1. Databases: Nucleotide, protein sequence and Secondary databases. CO2. Introduction to sequence alignment and its applications.
Plant Genetic Transformation	BTM 221	Students will be able to define Application of genetic transformation: for quality, yield, biotic, and abiotic stresses. CO1. Generation of gene construct and Genetic transformation. CO2. Selection and characterization of transgenic plants using selectable and reportable markers and Biosafety aspects.
Classical and Molecular Cytogenetics	BTC 221	Developing an understanding of application of Cytogenetics in Locating genes on chromosome and Genome analysis, CO1. Cell division, CO2. Study of Structure of chromatin and Chromosome by differential staining. CO3. Changes in chromosome number and their structural aberrations.
Microbial Genetics	BTP 221	Students will be able to understand the characteristics, components and concept of Microorganisms as tools for genetic studies using CO1. Recombination and chromosomal mapping; CO2. Complementation testing, CO3. Genetic analysis of representative groups of bacteria, fungi and viruses.
Agricultural Informatics	BAS 311	Student will be Introduced to computers along with, CO1. Uses of DBMS in Agriculture Computer programming, CO2. Computer models in agriculture e.g. statistical, weather analysis and crop simulation models. CO3. Application of innovative ways to use information and communication technologies (IT) in agriculture and Decision support systems.
Animal Biotechnology	VMC 312	To introduce students with Basic techniques in animal cell culture and Embryo transfer technology, viz. CO1. Marker assisted breeding of livestock and Introduction to animal genomics, CO2. Rumen, its environment and manipulation of its microbes, CO3. Manipulation of lactation by biotechnological tools; CO4. Application of biotechnology in meat and meat products. CO5. Genome and protein based diagnostics of important animal diseases.



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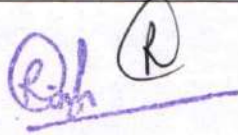
Immunology	BTI 311	<p>CO1. Provides an insight into application of components of immune system, viz,</p> <p>CO2. Immunoglobulin structure functions and Molecular organization,</p> <p>CO3. Allergies, hypersensitive response, Immunodeficiency and Vaccines,</p> <p>CO4. Various Immunological techniques and Molecular diagnostics.</p>
Molecular Genetics	BTM 311	<p>Develops understanding on genetics at molecular level, e.g.</p> <p>CO1. Molecular mechanisms of DNA replication, repair, mutation, and recombination;</p> <p>CO2. Centromere and telomere sequences and DNA packaging;</p> <p>CO3. Synthesis and processing of RNA and proteins;</p> <p>CO4. Regulation of gene expression;</p> <p>CO5. Mutations and DNA repair.</p> <p>CO6. Promoters and Transcription factors and their role in gene expression;</p> <p>CO7. Epigenetic control of gene expression, Small RNAs and RNA interference.</p>
Nanobiotechnology	BTM 312	<p>To explain the core issues of nanobiotechnology, viz.</p> <p>CO1. Biological based Nanosystems, molecular motors, biosensors and other devices,</p> <p>CO2. Nanomanipulations, material design, synthesis and their applications.</p>
Molecular Marker Technology	BTF 311	<p>Understanding types and application of molecular markers for</p> <p>CO1. Assessing genetic diversity, variety protection;</p> <p>CO2. Marker-assisted breeding,</p> <p>CO3. Human and animal health, Association with genetic-based diseases,</p> <p>CO4. Paternity determinations and Forensic studies.</p>
IPR, Biosafety and Bioethics	BTF 312	<p>Introduction to types of Intellectual Property and various issues related to it for e.g.</p> <p>CO1. International and Indian Legislations for the protection of various types of Intellectual Property;</p> <p>CO2. Patent search and filing process;</p> <p>CO3. Material transfer agreements.</p>
Genomics and Proteomics	BTR 311	<p>Introduce students with newly emerging area of genomics viz.</p> <p>CO1. Structural genomics, Physical mapping of genomes; Next generation sequencing; Genome analysis and gene annotation;</p> <p>CO2. Genome Projects of various model organisms,</p> <p>CO3. Functional genomics including various Transcriptomics and Proteomics techniques.</p>


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Enzymology & Enzyme Technologies	BTB 311	Familiarizes the students with Concept and applications of enzymes in biotechnology, industry, environment, agriculture, food and medicine. It impart exposure in several areas viz. CO1. Classification and nomenclature of enzymes; CO2. General characteristics of enzymes, active site, cofactors, prosthetic groups; CO3. Isolation, purification, characterization and assays of enzyme, CO4. Enzyme kinetics, Regulation of enzyme activity and Enzyme inhibition.
Biostatistics	BAS 321	Enhances the understanding on various applications of statistics in biology, CO1. Random variables and probability distribution of random variables. CO2. Hardy-Weinberg Law and Introduction to Poisson process and Markov chains. CO3. Chi-square test: testing heterogeneity, use in genetic experiment, detection of linkage, linkage ratios and its estimation. CO4. Analysis of variance and Estimation and significance of genotypic and phenotypic variation. CO5. Analysis of covariance, block designs and Testing of heritability.
Computational Biology	BTI/BTR 321	Provides an introduction to computational biology along with Web based servers and software for CO1. Genome visualization and analysis, CO2. Protein interaction databases, Principles of Protein structure prediction, Fold Recognition (threading), Homology modeling and Methods for comparison of 3D structures of proteins. CO3. Phylogenetic analysis and application of Genome browsers in genomic research.
Optional/ Elective Course in Plant Biotechnology	Elective I	Imparting skill set in various areas of Plant Biotechnology viz. CO1. Plant Tissue Culture and its Applications. CO2. Principles and Applications of Plant Genetic Transformation. CO3. Epigenetics and Gene Regulation. CO4. Applications of Genomics and Proteomics. CO5. Molecular Breeding in Field Crops. CO6. Molecular Breeding of Horticultural Crops and Forest Trees
Optional/ Elective Course in Animal Biotechnology	Elective II	Gain attributes and skill set in various areas of Animal Biotechnology viz. CO1. Animal Genomics.


 REGISTRAR
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		CO2. Embryo Transfer Technologies. CO3. Principles and Procedures of Animal Cell Culture. CO4. Transgenic Animal Production. CO5. Molecular Diagnostics. CO6. Molecular Virology and Vaccine Production
Optional/ Elective Course in Microbial and Environmental Biotechnology	Elective III	Provides knowledge and skill set in various areas of Microbial and Environmental Biotechnology viz. CO1. Microbial Biotechnology, CO2. Green Biotechnology. CO3. Molecular Ecology and Evolution. CO4. Molecular Pharming and Biopharmaceuticals. CO5. Food Biotechnology. CO6. Bio-prospecting of Molecules and Genes
Optional/ Elective Course in Bioinformatics	Elective IV	Exposure and developing skills in various areas of Bioinformatics viz. CO1. Programming for Bioinformatics. CO2. Computational Methods for Data Analysis. CO3. Bioinformatics Tools and Biological Databases. CO4. Structural Bioinformatics. CO5. Pharmaco genomics. CO6. Metabolomics and System Biology
Educational Tour (NG)	BTS 411	To practically impart awareness about Local, neighboring or other University/SAU/Research Station/ KVK/ ICAR/ Institutes/ Industries etc. visit based on their importance and relevance for improvement of student exposure towards different Academic/ Industrial environments.
Student READY – (04 Optional topics) In-house Skill Development Modules	BTS 412	The students will be able to know the scope, significance, and methodology used in specialized field of any one chosen elective, Elective I. Plant Biotechnology, Elective II. Animal Biotechnology, Elective III. Microbial and Environmental Biotechnology, Elective IV. Bioinformatics.
Bioprocess Engineering, Bioseparation and Downstream processing	BTO/AGE 411	Student will become efficient and acquire acumen on various aspects of CO1. Bioprocess principles including upstream and downstream processing. CO2. Chemical engineering principles applied to biological system, CO3. Principle of reactor design along with various types of microbial and enzyme reactors and Instrumentation control and optimization, CO4. Mass and Heat transfer. CO5. Media formulation and optimization.


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Student READY - Project Formulation, Execution and Presentation	BTS 421	CO1. Carry out a substantial research-based project. CO2. Analyze data and synthesize research findings. CO3. Report research findings in written and verbal forms.
Student READY - Entrepreneurial Development in Biotechnology	BTS 422	CO1. Develop idea generation, creative and innovative skills. CO2. Aware of different opportunities and successful growth stories. CO3. Learn how to start an enterprise and design research plans those are suitable for funding by considering all dimensions of business. CO4. Understand entrepreneurial process by way of studying different case studies.


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COLLEGE OF VETERINARY & ANIMAL SCIENCES

	Local
	Regional
	Global
	National

Undergraduate

Degree Programme: - BVSc & AH

Introduction

The livestock sector confers an immense contribution to the rural livelihood and food security of the masses. It provides employment to millions of livestock farmers while acting as a supplementary source of income to many agricultural farmers. It is also disproportionately benefits women being the primary animal husbandry activists in rural areas, and therefore, this sector serves a great contribution to economic and social wellbeing of farmers. Further, the sector provides valuable nutritional sources to the growing children and working population in the form of milk, meat and eggs. College of Veterinary and Animal Sciences (COVAS) was established as a constituent college of the University in 2008, to scale up rural economy by ensuring proper animal health care and management through competent human resource generation. The College has made extensive contribution for the development of animal husbandry sector of the state. In addition to development of human resources for serving the livestock farmers of the state, the college is also instrumental in various research, extension, consultancy and clinical services to the farmers. The Veterinary Council of India (VCI) permitted the admission of first batch of BVSc & AH degree programme in academic session 2011. The college is imparting quality veterinary education, training and development of entrepreneurship skills of the students for employment of the livestock sector. The college of Veterinary and Animal Science offers the Undergraduate (BVSc & AH) degree programmes which is 5½ years duration. The College is under First Schedule of Indian Veterinary Council Act, 1984. As per VCI-2016 there are 17 constituents' departments operating in the college.

Mandate

1. Advancement of education in Veterinary & Animal Science subjects for development of human resources who can apply their acquired knowledge and skills to diversify and industrialize Veterinary Sciences and other Allied sectors for socio-economic transformation of the rural society of Uttar Pradesh in particular and country in general.
2. Conduct basic, strategic and applied research in Veterinary & Animal Sciences.
3. Undertaking field and extension programmes.

Vision

To be a leading and vibrant centre of excellence in teaching, research, innovation and extension in the field of Veterinary and Animal Sciences.

PROGRAMME OUTCOMES (POS):


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- PO-1: The students will develop the ability in a field of Veterinary medical science about the treatment of animal diseases and ailments.
- PO-2: The under graduate students will possess the ability to utilize the knowledge regarding the aspects of animal husbandry, covering the various disciplines of Veterinary Science.
- PO-3: The students learn about the application of medical, diagnostic, and therapeutic principles to various types of animals.
- PO-4: The student's deals with curing, treating as well as studying the various diseases occurring in animals and birds, thus studying the physiology of the animals in detail.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO-1: To develop knowledge based efficient veterinary resources, enhance animal productivity, improving vaccine development and food processing and to reduce antimicrobial inputs.
- PSO-2: To accomplish lab to land concept by disseminating the package of practices of technologies developed at the faculty for farmers to enhance the productivity and quality of human life.

COURSE OUTCOMES (COs):

Subject	Course Outcomes
Veterinary Anatomy	<p>CO1.To define veterinary anatomy and is knowledgeable with regards to main concepts of anatomy.</p> <p>CO2. To provide a general knowledge about the muscles in the animal body.</p> <p>CO3. To provide a general knowledge about the digestive system, respiratory system, circulatory system, nervous system, urinary and reproductive system in the animal body.</p> <p>CO4. To define the osteology of the ox and differences in horse, dog, pig and fowl.</p>
Veterinary Physiology	<p>CO1. The students develop critical thinking skills, to apply physiological concepts and principles at the basic and applied levels, to develop a working knowledge of the major physiological systems.</p> <p>CO2. Student will understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems.</p> <p>CO3. Student should understand how blood circulates and how gases are exchanged.</p> <p>CO4. Understand important physiological challenges animals face and the processes by which animals deal with them.</p>


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

	CO5. To define the role of evolutionary processes (e.g. natural selection) in driving the organization of physiological systems.
Veterinary Biochemistry	<p>CO1. The students will learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system.</p> <p>CO2. The students will learn about structure and function of lipids, circulating lipids and inflammatory lipid mediators etc. They will also learn about primary, secondary, tertiary, quaternary structure of proteins.</p> <p>CO3. The students will understand about the structure and function of nucleosides and nucleotides.</p> <p>CO4. The students acquire knowledge in the quantitative and qualitative estimation of biomolecules.</p> <p>CO5. The students in understanding other accessory molecules like vitamins, plant and animal hormones, plant secondary metabolite like terpenes.</p>
Livestock Production Management	<p>CO1. The course provides specialized training in Livestock Production to the extent of the highest expertise to the students.</p> <p>CO2. To build students skills in specialized animal care.</p> <p>CO3. To define animal welfare, sustainable management of feeds, environmental physiology and genetic resources.</p> <p>CO4. To describe the Handling & Restraining, Identification, Judging, Milking, Feeding, Reproduction, Shelter, Labour Management, Management of calf, heifer, milch animals and other categories.</p> <p>CO5. To describe the management of poultry, cattle, goat, sheep, swine, horse species.</p>
Veterinary Microbiology	<p>CO1. Provide basic knowledge and principles of microbiology, the study of microbes, and how microbes are classified.</p> <p>CO2. To define the understanding of transmission strategies, immune evasion and host responses contribute to microbial pathogenesis.</p> <p>CO3. To define acquire knowledge about pathogenesis and epidemiology microbes and the function of the immune system.</p> <p>CO4. To describe the mechanisms by which microorganisms cause disease and the chemotherapeutic methods used to combat these mechanisms.</p> <p>CO5. The students acquire knowledge to take required measurements for prevention and control of bacterial, viral and fungal diseases.</p>


 REGISTRAR
 B.V.B.P.U.A.&T., MEERUT

	CO6. Laboratory sessions emphasize the proper selection, collection and transportation of bacteriologic and fungal specimens.
Veterinary Pathology	<p>CO1. To understand and learn the pathological changes that occur in tissues and organ systems and how such changes provide the basis for clinically-manifested diseases.</p> <p>CO2. To describe and explain changes in organism during typical pathologic processes (for example inflammation, fever, local disturbances of blood circulation).</p> <p>CO3. To explain how animals' normal functions, change and how healing processes work during diseases.</p> <p>CO4. To understand and can describe interactions between disease process and defense, as well as the regulatory mechanism of animals.</p> <p>CO5. To connect the results of clinical and laboratory evaluation of diseased animals to the underlining pathological mechanisms.</p> <p>CO6. The student's exposure to fresh and fixed pathological specimens (from necropsies and abattoir specimens).</p> <p>CO7. To be able to explain the principles and importance of post-mortem examination in disease diagnosis.</p>
Animal Genetics and Breeding	<p>CO1. To describe the science of animal genetics and the practice of animal breeding.</p> <p>CO2. Students will learn about the origin, evolution, and reproduction of animals.</p> <p>CO3. Focuses on the development of genomic tools and techniques for understanding the traits of different animals.</p> <p>CO4. Students will be able to carry out research on genome analysis and their findings will be useful for the development of new breeding techniques.</p>
Animal Nutrition	<p>CO1. To describe with the knowledge on feed composition, their digestion processes, and nutrient metabolism.</p> <p>CO2. To describe to evaluate the nutritional value of the different feed components, through the application of various systems.</p> <p>CO3. To provide the student with the necessary knowledge and techniques to evaluate the animal's nutrient requirements in the different growth and production stages and to estimate, control and predict feed intake.</p> <p>CO4. To define how to estimate nutrient requirements and their balance in the different stages of growing and production.</p> <p>CO5. Understand the role of food in meeting the needs of animals, and in preventing metabolic or health problems.</p>
Veterinary Pharmacology and Toxicology	CO1. To describe with an understanding and knowledge of pharmacology, toxicology and therapeutic.

	<p>CO2. To define the mechanisms of various drug actions, the PD/PK principles that are fundamental for the therapeutic uses and safe selection of therapeutic agents in clinical veterinary practice.</p> <p>CO3. To describe appropriate drug selection for various animal species.</p> <p>CO4. To define the mechanism of therapeutic action of a selected drug at the molecular, cellular, organ system and whole-body levels.</p> <p>CO5. To describe an understanding of the processes involved in absorption, distribution, metabolism and excretion of toxicants, including an understanding of the toxicokinetic behavior of toxicants in animals.</p>
Veterinary Public Health and Epidemiology	<p>CO1. To describe the role of the veterinary profession in the protection of public health.</p> <p>CO2. To explain the important epidemiological features of zoonotic diseases and relate these to control strategies.</p> <p>CO3. To describe the key principles involved in the food chain and the "Farm to Fork" approach and identify critical stages at which risks to public health may occur.</p> <p>CO4. To explain the various aspects of veterinary public health including non-foodborne zoonoses.</p>
Veterinary Parasitology	<p>CO1. To enlighten the students on the need to study veterinary parasitology, their importance in the field of medicine and veterinary sciences, the relationship between various organisms and the types of parasitism.</p> <p>CO2. To describe the knowledge of the terminology, basic principles and application of veterinary parasitology and treatment methodologies</p> <p>CO3. To define theoretical and practical skills required in veterinary parasitology, including the diagnosis, control and treatment of common parasite diseases, including zoonoses.</p> <p>CO4. To includes aspects of life cycles, pathogenesis, diagnosis, epidemiology, treatment and prevention.</p>
Livestock Technology	<p>CO1. To impart knowledge about history, current status of meat industry, muscle composition, functions and sensory quality of meat.</p> <p>CO2. To educate on factors influencing quality of meat and nutritive value.</p> <p>CO3. To motivate farmers, entrepreneurs and unemployed youth to establish their own milk and meat-based enterprises.</p> <p>CO4. The students will do research activities on various aspects like product development, development of functional meat, extension of shelf life, development of milk products etc.</p>


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Veterinary and Animal Husbandry Extension Education	<p>CO1. The students can perceive the importance of extension education in respect to technology transfer among the famers.</p> <p>CO2. They can prepare different audio-visual aids to provide informal education among the farmers.</p> <p>CO3. The students came to know the different strategies to disseminate and diffuse demand driven technologies among the farmers' and provide location specific solutions to solve farmers problem.</p>
Veterinary Clinical Practices	<p>CO1. To understanding the working of Veterinary Clinics including hospital set up, administration and work force management.</p> <p>CO2. To describe the handling, examination, diagnosis and treatment of sick animals in the field conditions under the supervision of faculty.</p> <p>CO3. Understanding the different methods of record keeping, retrieval, processing, analysis and interpretation of data.</p> <p>CO4. Handling and management of cases of Gynaecology and Obstetrics.</p> <p>CO5. To define and make understanding the use of equipment's used in treatment and Management of various surgical conditions.</p> <p>CO6. Learning the use of various advance non-invasive diagnostic aids like Ultrasonography, Ophthalmoscope</p>
Livestock Farm Practices	<p>CO1. To describe all aspects of animal rearing so that students can rear animals on their own.</p> <p>CO2. Hands on training of the students on the overall farm practices of livestock management including cleaning, feeding, watering, grooming, milking, routine health care, record keeping, sanitation, housing, fodder production, preparation of mineral mixture, cost economic of fodder production.</p> <p>CO3. Care of pregnant animals, management of parturition, care of neonatal and young stock.</p>
Veterinary Surgery and Radiology	<p>CO1. To describe History taking, physical examination, clinico-pathological testing, intraoperative and postoperative care.</p> <p>CO2. Development of anesthesiology, Terminology, classification and indications.</p> <p>CO3. To understand the different radiology techniques.</p> <p>CO4. To define and make understanding the use of equipments used in treatment and Management of various surgical conditions.</p> <p>CO5. Learning the use of various advance noninvasive diagnostic aids like Ultrasonography, Ophthalmoscope</p>
Veterinary Medicine	<p>CO1. Knowledge and understanding about basic and applied medicine science.</p>


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	<p>CO2. Know the aetiology, pathogenesis, clinical signs, diagnosis and treatment & prevention of the common diseases and disorders that occurs in all domestic animals.</p> <p>CO3. To know main medicines, their effect, pharmacodynamics, pharmacokinetics and responsible use of medicines.</p> <p>CO4. To understand and apply in practice principles of evidence-based veterinary medicine.</p>
Veterinary Gynecology and Obstetrics	<p>CO1. To develop students with basic knowledge and skill of gynecology</p> <p>CO2. To describe the causes of infertility in bovines.</p> <p>CO3. To describe scientific knowledge on physiological reproductive processes of reproductive system of animals.</p> <p>CO4. To define how to conduct investigations on the problems pertaining to animal reproduction.</p>


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COLLEGE OF POST HARVEST TECHNOLOGY & FOOD PROCESSING

	Local
	Regional
	Global
	National

Undergraduate

Degree Programme: - B. Tech (Food Technology)

PROGRAMME OUTCOMES (POS)

- PO-1: To establish itself as the leader in human resource development for supporting the food technology sector.
- PO-2: To provide knowledge and skill for better preservation techniques, processing and value addition to agricultural products.
- PO-3: To provide well equipped infrastructure and research facilities to students for carrying smoothly in allied fields of food sector.
- PO-4: To develop an awareness among the students about environmental issues and towards sustainable developments.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

- PSO-1: To impart knowledge in various aspects of food technology through theory and practical knowledge.
- PSO-2: To make the students familiar with the technologies of food processing and preservation of plant and animal foods, cereals, fruits, vegetables etc.
- PSO-3: To gain knowledge about advanced technologies adapted in various food industries by physically visiting different food industries.
- PSO-4: Give students assistance in preparing for competitive exam.

COURSE OUTCOMES (COS)

Subject	Sub Code	Course Outcomes
English Language	FBS 111	CO1. To understand the chemistry of foods- composition of food, role of each component and their interaction. CO2. To understand the functional aspects of food components and to study their role in food and nutrition. CO3. To understand the general chemical structures of the major components of foods (water, proteins, carbohydrates, and lipids). CO4. To understand the pigments and flavours and their role of food industries.
General Microbiology	FSQ 111	
Engineering Mathematics-I	FBS 112	
Engineering Drawing and Graphics	FBE 111	
Basic Electrical Engineering	FBE 112	
Workshop Technology	FBE 113	
Crop Production Technology	FBS 113	
Environmental Sciences & Disaster Management	FBS 114	
Physical Education	PPE 111	


REGISTRAR
S.V.B.P.U.A.&T., MERRUT

Food Chemistry of Macronutrients	FSQ 121	CO5. To understand the role of anti-oxidants, allergens, toxins and anti-nutritional factors in foods.
Food Microbiology	FSQ 122	CO6. To understand sources and functions of different nutrients, diseases related to their deficiencies, their transport, digestion and metabolism.
Food Thermodynamics	FPE 121	CO7. To understand the principle of Unit operation.
Computer Programming and Data Structures	FBE 122	CO8. To acquaint with fundamentals of food engineering and its process.
Fluid Mechanics	FPE 122	CO9. To understand the basics of designing of food plant and systems.
Basic Electronics Engineering	FBE 123	CO10. To understand basics of designing of food plant and storage system.
Engineering Mathematics-II	FBS 121	CO11. To know the important genera of microorganisms associated with food and their characteristics.
Post Harvest Engineering	FPE 123	CO12. To understand the role of microbes in fermentation, spoilage and food borne diseases
NCC/NSS	NCC 124 / NSS 124	CO13. To understand the important genera of microorganisms associated with food and their
Fundamentals of Food Processing	FPT 211	CO14. To comprehend the role of the microorganisms in spoilage of foods and methods of their control.
Processing Technology of Liquid Milk	FPT 212	CO15. To gain knowledge about the beneficial role of microorganisms and different types of fermented foods.
Processing Technology of Cereals	FPT 213	CO16. To identify the role of microorganisms in food borne diseases and control measures
Industrial Microbiology	FSQ 211	CO17. To understand the laboratory techniques to detect, quantify, and identify microorganisms in foods.
Food Chemistry of Micronutrients	FSQ 212	CO18. To develop knowledge and skills for estimation of important compositions of food such as protein, carbohydrates, fats etc.
Heat and Mass Transfer in Food Processing	FPE 211	CO19. To develop knowledge and skills for estimation of essential components such as moisture, acidity, ash etc.
Unit Operations in Food Processing-I	FPE 212	CO20. To develop skills for determination of viscosity of various fluids
Statistical Methods and Numerical Analysis	FBS 211	CO21. To develop skill for determining various thermal properties such as thermal conductivity, thermal diffusivity, calorific value and specific heat.
Processing Technology of Dairy Products	FPT 221	
Processing Technology of Legumes and Oilseeds	FPT 222	
Food Biochemistry and Nutrition	FSQ 221	
Unit Operations in Food Processing-II	FPE 221	
Food Biotechnology	FSQ 222	
Food Refrigeration and Cold Chain	FPE 222	
Processing of Spices and Plantation Crops	FPT 223	
Business Management and Economics	FPM 221	
Processing Technology of Fruits and Vegetables	FPT 311	
Processing of Meat and Poultry Products	FPT 312	

Instrumental Techniques in Food Analysis	FSQ 311	CO22. To develop skill for designing various pumping systems.
ICT Applications in Food Industry	FBM 311	CO23. To gain knowledge about various types of freezers.
Food Process Equipment Design	FPE 311	CO24. Basic knowledge of computer applications and their implementation in various fields of Food Industries.
Food Storage Engineering	FPE 312	CO25. To develop knowledge of toxicants that are associated with both plant and animal foodstuffs that occur as natural constituents and contaminants
Bakery, Confectionery and Snack Products	FPT 313	CO26. To introduce students to methods for evaluating different levels of toxicity in foodstuffs.
Marketing Management and International Trade	FBM 312	CO27. To gain knowledge about natural constituents that are toxicants and natural contaminants that act as toxicants
Processing Technology of Beverages	FPT 321	CO28. To acquire knowledge about various types of toxicants, chemistry, their mode of action, significance, food sources, and possible detoxification method.
Food Plant Sanitation	FSQ 321	
Food Packaging Technology and Equipment	FPT 322	
Processing of Fish and Marine Products	FPT 323	
Sensory Evaluation of Food Products	FPT 324	
Food Additives and Preservatives	FSQ 322	
Food Quality, Safety Standards and Certification	FSQ 323	
Instrumentation and Process Control in Food Industry	FPE 321	
Project Preparation and Management	FBM 321	
Communication Skills and Personality Development	FBM 411	
Entrepreneurship Development	FBM 412	
Student READY - Experiential Learning Programme	FPO 411	
Student READY - Research Project	FPO 412	
Student READY - Seminar	FPO 413	
Student READY - Industrial Tour	FPO 421	
Student READY - Internship/In-Plant Training	FPO 422	


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

COLLEGE OF POST HARVEST TECHNOLOGY & FOOD PROCESSING

B.Tech. (Dairy Technology) Programme

(As per ICAR 5th Dean's Committee Recommendations Report)

Department-wise distribution of Credit Load

Names of Departments

1. Dairy Technology
2. Dairy Engineering
3. Dairy Chemistry
4. Dairy Microbiology
5. Dairy Business Management

DEPARTMENT-WISE COURSES

Dairy Technology

S.N	Discipline	Discipline and Title of the Course	Credit Hours
1	DDT- 211	Market Milk	4 (3+1)
2	DDT- 212	Traditional Indian Dairy Products	3 (2+1)
3	DDT- 213	Fat Rich Dairy Products	3 (2+1)
4	DDT- 214	Condensed & Dried Milks	4 (3+1)
5	DDT- 221	Cheese Technology	5 (3+2)
6	DDT - 222	Ice-cream & Frozen Deserts	3 (2+1)
7	DDT- 311	By Products Technology	3 (2+1)
8	DDT- 312	Packaging of Dairy Products	3 (2+1)
9	DDT- 321	Sensory Evaluation of Dairy Products	3 (2+1)
10	DDT- 322	Food Technology - I	3(2+1)
11	DDT- 421	Dairy Plant Management	2 (1+1)
12	DDT- 422	Waste Disposal & Pollution Abatement	2 (1+1)
13	DDT- 423	Food Technology -II	3 (2+1)
		Total	41 (27+14)

Dairy Engineering

S.N	Discipline	Discipline and Title of the Course	Credit Hours
1	DDE- 111	Workshop Practice	2 (1+1)
2	DDE- 112	Fluid Mechanics	3 (2+1)
3	DDE -113	Engineering Drawing	1 (0+1)
4	DDE- 121	Thermodynamics	2 (1+1)
5	DDE- 122	Heat & Mass Transfer	3 (2+1)
6	DDE -123	Boilers and Steam Generation	2 (1+1)


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

7	DDE -124	Basic Electrical Engineering	3 (2+1)
8	DDE - 211	Refrigeration & Air-conditioning	3 (2+1)
9	DDE – 212	Dairy Engineering	3 (2+1)
10	DDE – 221	Dairy Process Engineering	3 (2+1)
11	DDE – 311	Instrumentation and Process Control	3 (2+1)
12	DDE – 321	Food Engineering	3 (2+1)
13	DDE – 322	Material Strength & Dairy Machine Design	3 (2+1)
14	DDE – 323	Dairy Plant Design and Layout	2(1+1)
15	DDE – 324	Energy Conservation and Management	2(1+1)
Total			38 (23+15)

Dairy Chemistry

S.N	Discipline	Discipline and Title of the Course	Credit Hours
1	DDC – 121	Physical Chemistry of Milk	3 (2+1)
2	DDC – 111	Biochemistry	2 (1+1)
3	DDC – 211	Human Nutrition	2 (1+1)
4	DDC – 122	Chemistry of Milk	3 (2+1)
5	DDC – 221	Chemistry of Dairy Products	3 (2+1)
6	DDC – 311	Chemical Quality Assurance	2 (1+1)
7	DDC – 321	Food Chemistry	3 (2+1)
Total			18 (11+7)

Dairy Microbiology

S.N	Discipline	Discipline and Title of the Course	Credit Hours
1	DDM – 111	Fundamentals of Microbiology	3 (2+1)
2	DDM – 121	Microbiology of fluid milk	2 (1+1)
3	DDM – 222	Microbiology of Dairy Products	2 (1+1)
4	DDM – 221	Starter Cultures and Fermented Milk Products	3 (2+1)
5	DDM – 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
6	DDM – 321	Food and Industrial Microbiology	3 (2+1)
Total			16 (10+6)

Dairy Business Management

S.N	Discipline	Discipline and Title of the Course	Credit Hours
1	DBM – 111	Milk Production Management and Dairy Development	3 (2+1)
2	DBM – 113	Computer and Application Software Packages	2 (1+1)
3	DBM – 121	Economic Analysis	2 (2+0)
4	DBM – 114	Environmental Studies	2 (1+1)

5	DBM – 311	ICT in Dairy Industry and Operation Research	4(2+2)
6	DBM – 221	Fundamentals of Dairy Extension	3 (2+1)
7	DBM – 312	Marketing Management & International Trade	2 (2+0)
8	DBM – 112	Communication Skills	2 (1+1)
9	DBM – 423	Industrial Statistics	2 (2+0)
10	DBM – 421	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
11	DBM – 422	Financial Management and Cost Accounting	3 (2+1)
Total			27 (19+8)

Semester Wise Distribution of Courses

Semester – I

S.N.	Discipline	Title of the Course	Credit Hours
1	DDE-111	Workshop Practice	2 (1+1)
2	DDE- 112	Fluid Mechanics	3 (2+1)
3	DDE- 113	Engineering Drawing	1 (0+1)
4	DDM – 111	Fundamentals of Microbiology	3 (2+1)
5	DBM – 111	Milk Production Management and Dairy Development	3 (2+1)
6	DBM – 112	Communication Skills	2 (1+1)
7	DBM – 113	Computer and Application Software Packages	2 (1+1)
8	DDC – 111	Biochemistry	2 (1+1)
9	DBM – 114	Environmental Studies	2 (1+1)
Total			20 (11+9)

REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Semester – II

S.N	Discipline	Title of the Course	Credit hours
1	DDE – 121	Thermodynamics	2 (1+1)
2	DDC – 121	Physical Chemistry of Milk	3 (2+1)
3	DDE – 122	Heat & Mass Transfer	3 (2+1)
4	DDE – 123	Boilers and Steam Generation	2 (1+1)
5	DDE – 124	Basic Electrical Engineering	3 (2+1)
6	DDM – 121	Microbiology of fluid milk	2 (1+1)
7	DBM – 121	Economic Analysis	2 (2+0)
8	DDC – 122	Chemistry of Milk	3 (2+1)
		Total	20 (13+7)
9	DRW - 121	Student READY Rural Dairy Work Experience Programme-I (Summer Break)	5 (0+5)

Semester – III

S.N	Discipline	Title of the Course	Credit Hours
1	DDT – 211	Market Milk	4 (3+1)
2	DDT – 212	Traditional Indian Dairy Products	3 (2+1)
3	DDE – 211	Refrigeration & Air-conditioning	3 (2+1)
4	DDE – 212	Dairy Engineering	3 (2+1)
5	DDT – 213	Fat Rich Dairy Products	3 (2+1)
6	DDT – 214	Condensed & Dried Milks	4 (3+1)
7	DDC – 211	Human Nutrition	2 (1+1)
		Total	22 (15+7)

Semester – IV

S.N	Discipline	Title of the Course	Credit Hours
1	DDE – 221	Dairy Process Engineering	3 (2+1)
2	DDM – 221	Starter Cultures and Fermented Milk Products	3 (2+1)
3	DDM – 222	Microbiology of Dairy Products	2 (1+1)
4	DDT – 221	Cheese Technology	5 (3+2)
5	DDT – 222	Ice-cream & Frozen Deserts	3 (2+1)
6	DDC – 221	Chemistry of Dairy Products	3 (2+1)
7	DBM – 221	Fundamentals of Dairy Extension	3 (2+1)
		Total	22 (14+8)
8	DRW - 221	Student READY Rural Dairy Work Experience Programme-II (Summer Break)	5 (0+5)

Semester – V

S.N.	Discipline	Title of the Course	Credit Hours
1	DDE - 311	Instrumentation and Process Control	3 (2+1)

2	DDM – 311	Quality and Safety Monitoring in Dairy Industry	3 (2+1)
3	DDT – 311	By Products Technology	3 (2+1)
4	DDT – 312	Packaging of Dairy Products	3 (2+1)
5	DDC – 311	Chemical Quality Assurance	2 (1+1)
6	DBM – 311	ICT in Dairy Industry and Operation Research	4(2+2)
7	DBM – 312	Marketing Management and International Trade	2 (2+0)
		Total	20(13+7)

Semester – VI

S.N.	Discipline	Title of the Course	Credit Hours
1	DDE – 321	Food Engineering	3 (2+1)
2	DDE – 322	Material Strength & Dairy Machine Design	3 (2+1)
3	DDE – 323	Dairy Plant Design and Layout	2 (1+1)
4	DDM – 321	Food and Industrial Microbiology	3 (2+1)
5	DDT – 321	Sensory Evaluation of Dairy Products	3 (2+1)
6	DDT – 322	Food Technology - I	3 (2+1)
7	DDC – 321	Food Chemistry	3 (2+1)
8	DDE – 324	Energy Conservation and Management	2(1+1)
		Total	22 (14+8)

Semester – VII

S.N.	Discipline	Title of the Course	Credit Hours
1	DPT – 411	Student READY In- Plant Training	20 (0+20)
		Total	20 (0+20)

Semester – VIII

S.N.	Discipline	Title of the Course	Credit Hours
1	DDT – 421	Dairy Plant Management	2(1+1)
2	DDT – 422	Waste Disposal and Pollution Abatement	2 (1+1)
3	DDT – 423	Food Technology -II	3 (2+1)
4	DBM – 421	Entrepreneurship Development and Industrial Consultancy	2 (2+0)
5	DBM – 422	Financial Management & Cost Accounting	3 (2+1)
6	DBM – 423	Industrial Statistics	2 (1+1)
7	DEL - 421	Student READY Experiential Learning Module	10 (0+10)
		Total	24 (10+14)

Note – Accordingly above course numbers shall be adopted in the syllabus of B.Tech. (Dairy Technology) programme.


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

Student READY Program

- In plant Training of six months duration (One semester): 20 (0+20) credit hours
- Rural Dairy Work Experience programme of 10 weeks (0+10) (total 10 credit hours) during summer vacation (spread over 2 or 3 Semester breaks) to be introduced starting from first year. The areas of internship maybe:
 - First year: On Milk Production & Procurement to be taken up in State Dairy Federations/Dairy Development Departments/Private Dairies/Animal Husbandry Department/Cattle farm/Progressive dairy farmers
 - Second Year: On Preliminary Dairy Operations to be taken up in Experimental Dairy/Referral lab/Dairy Plants
 - Third year: Exposure to Product manufacturing operations in Dairy & Food Industry or
 - Plant visits in each Dairy Technology course to have Industrial exposure in specialized products like Ice cream, Milk Powders, Cheese, By-products etc. should be made compulsory
- Experiential Learning Module of 10 (5+5) credit hours to run concurrently in the final semester along with the regular courses. This shall include development of Detailed Project Report on setting up of enterprise in the selected areas of product manufacture and Evaluation of the Module.

SYLLABUS

DDE – 111 Workshop Practice

2 (1+1)

Theory

Introduction: workshop practice, safety, care and precautions in workshop. *Wood working* tools and their use, Carpentry. *Heat treatment process:* Hardening, tempering, annealing and normalizing etc. *Metal work:* Metal cutting, Soldering, Brazing. *Welding:* Electric arc and Gas welding. *Smithy and forging operations:* tools and equipments. *Bench work:* The bench, flat surface filing, chipping, scrapping, marking out, drilling and screwing. *Introduction to following tool machines:* (a) Lathe Machine (b) Milling Machine (C) Shaper and Planner (d) Drilling and Boring machines (e) Grinder (f) CNC Machines etc.

Practical

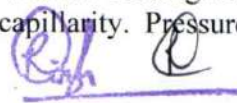
To study different types of measuring tools used in metrology and determine least counts of vernier calipers, micrometers and vernier height gauges. Job work on filing and chipping. To study different types of fitting tools and marking tools used in fitting practice. To study various types of carpentry tools and prepare simple types of at least two wooden joints. Job work on hand hack and power hack saw. Job work on metal sheet working. Job work on butt and lap welding. To study different types of machine tools (lathe, milling, drilling machines etc). To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making, threading etc.

DDE – 112 Fluid Mechanics

3 (2+1)

Theory

Units and dimensions, Properties of fluids. *Static pressure of liquids:* Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension, capillarity. Pressure


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer. *Fluid flow*: Classification, steady uniform and non uniform flow, Laminar and turbulent, continuity equation, Bernolli's theorem and its applications. *Flow through pipes*: Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs, Vena contracta, hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge. *Dimensional analysis*: Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. *Pumps*: Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing.

Practical

Study of various types of pipes and pipe fittings. Study of different types of valves. Study of reciprocating pump. Study of rotary gear pump. Study of piezometer. Study of U tube Manometer. Study of inclined tube Manometer. Study of Venturimeter. Determination of frictional coefficient of given pipe. Determination of minor head loss. Study of Pitot tube. Study the construction and working principle of centrifugal pump. Study of Reciprocating pump. Study and measurement of flow of liquid by V- notch.

DDE – 113 Engineering Drawing

1 (0+1)

Practical

Drawing of lines, lettering and dimensioning types of lines, types, types of lettering, types of dimensioning. Drawing of scales. Plain scale, diagonal scale, comparative scale and Vernier scale. Drawing of projections; Orthographic projections, methods of projections. **Drawing of screw threads**; Types of threads and terminologies used in lit. Screw fastening: Types of nuts, types of bolts, stud, locking arrangements for nuts and Foundation bolt. Drawing of rivets and riveted joints forms of rivet heads, types of riveted joints, failure of riveted joints. Drawing of welded joints: Forms of welds, location and dimensions of welds. Drawing of keys, cotter joint, pin joints types of keys, types of cotter joints, pin joints. Drawing of shaft couplings: Rigid couplings, loose couplings, flexible couplings universal coupling. Drawing of shaft bearings. Journal bearings, pivot bearings, collar bearings

DDM – 111 Fundamentals of Microbiology

3 (2+1)

Theory

Overview of history and scope of microbiology: Discovery of Microorganisms and Microscopy (types, working principles and applications); Theories of Biogenesis and abiogenesis; Contributions of Leeuwenhoek, Pasteur, Tyndal, Joseph Lister, Robert Koch, Edward Jenner and Alexander Fleming; Scope and application of microbiology in fields like Dairy, Food, Pharmaceutical, Industrial, Medical and agriculture. *Classification of Microbes*: Microbial classification systems, numerical taxonomy, General properties and principles of microbial classification, Whittaker's five kingdom and Carl Woese's three domain classification system; Systematics of bacteria and Bergey's manual of systematic bacteriology, Phylogenetic tree. *Prokaryotic and Eucaryotic microorganisms*: Structure and functions of prokaryotic cells; Differences between prokaryotes and eukaryotes; Differences between cell wall of Gram positive and Gram negative bacteria; Structure of Archeal cell wall. *Microbial growth and nutrition*: Bacterial growth curve; factors affecting growth of bacteria, direct and indirect methods of measurement of bacterial growth; Bacteriostatic and bactericidal agents; Common nutrient requirements and nutritional


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

types of microorganisms. *Diversity of Microorganisms*: Viruses: Structure and Classification; Bacteriophages; Differences between viruses and bacteria; Fungi: Classification of Fungi; Reproduction in Fungi; Protozoa and algae. *Microbial Ecology and Environmental Microbiology*: Microflora of air, soil and water and Microbes of Extreme environment like Archea. *Basics of Microbial Genetics and Host-Microbe interactions*: DNA as the genetic material, Structure of DNA/ RNA, DNA replication, transcription and translation; Basic concepts of immunology; Role of immune system in governing host-microbe interactions, Microbial Commensalism, Colonization, Infection, Disease and Vaccines

Practical

General instruction for microbiological laboratory. Microscope- simple and compound; Microbiological equipments; autoclave, hot air oven, incubator, centrifuge, colorimeter, laminar airflow, membrane filter. Simple staining- methylene blue; crystal violet; negative staining. Differential staining (Gram, spore, acid fast). Motility of microorganisms - hanging drop technique. Measurement of size of microorganisms by micrometry (ocular and stage). Preparation of commonly used growth media liquid and solid: simple and differential media. Isolation techniques for microorganisms – Streak, spread and pour plate. Enumeration of microorganisms in air and soil. Enumeration of microorganisms in water: total viable count, coliform (MPN). Visit to Microbiology Laboratory of Dairy/Food Industry.

DBM – 111 Milk Production Management and Dairy Development

3 (2+1)

Theory

Introduction to Animal Husbandry. Distinguishing characteristics of India and exotic breeds of dairy animals and their performance. Systems of breeding and methods of selection of dairy animals. General dairy farm practices - Identification, dehorning, castration, exercising, grooming, weighing. Care of animals at calving and management of neonates. Management of lactating and dry cows and buffaloes.

Methods of milking, milking procedure and practices for quality milk production. Dairy farm records and their maintenance. Systems of housing dairy animals and maintenance of hygiene and sanitation at dairy farm premises. Common disease problems in dairy animals, their prevention and control. Feed nutrients required by animal body. Feed resources for milk production and their nutritive values. Digestive system of ruminants and measures of feed energy. Nutrients requirements for growth and milk production. Feeding standards, Structure and function of mammary system. Milk secretion and milk let-down. Male and female reproductive system. Estrus and reproductive cycle, Ovulation, fertilization, gestation, parturition, pregnancy diagnosis. Artificial insemination and embryo transfer and their role in animal improvement introduction to biotechniques in dairy animal production.

Practical

Handling and restraining of dairy animals. External body parts and judging of cows and buffaloes. Feeding and management practices of calves. Identification of common feeds and fodders. Preparation of rations for adult animals. Milking of dairy animals and cleaning and sanitation of milking equipments. Identification of reproductive and digestive organs. Demonstration of semen collection, processing and artificial insemination.

DBM – 112 Communication Skills

2 (1+1)

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

non-linguistic barriers to communication and reasons behind communication gap/miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Précis writing /Abstracting/Summarizing; Style of technical communication Curriculum vitae/resumé writing; Innovative methods to enhance vocabulary, analogy questions. *Structural and Functional Grammar*: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

Listening and note taking; Writing skills, précis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

DBM – 113 Computer and Application Software Packages

2 (1+1)

Theory

History, features, classification and organization and I/O peripheral devices for computers; Features of modern operating systems; number systems and coding schemes; Basics of networking and communications; Internet, email concepts and application, Word-processing and desktop publishing, Electronic spreadsheet basics and operations, Database management system basics and operations; Fundamental of presentation-graphic packages. Recent strides in computing.

Practical

Windows Operating System, Word Processing software operations, Presentation Graphics software operations, Internet Surfing/Email usage, *RDBMS software* package basic operations, Spreadsheet software package basic operations.

DDC – 111 Biochemistry

2 (1+1)

Theory

Bio-Molecules: General structures, classification and functions of bio molecules-Amino acids, Protein Structure, Carbohydrates, Fats, Lipids, DNA and RNA. *Enzymes*: Activation energy /Transition state & Enzyme Classification, Coenzymes/Co-factors & Enzyme kinetics, Mechanism of enzyme action, Factors effecting enzyme activity, Enzyme inhibition, isozymes & Regulatory Enzymes, Immobilization of enzyme, Ribozymes & Zymogens. *Metabolism* : Glycolysis, Gluconeogenesis, TCA cycle, Glycogen synthesis and degradation, Pentose phosphate pathway, Fatty acid oxidation, Urea cycle and transaminase reactions, ATP and Electron transport chain.

Practical

Estimation of alkaline phosphatase by conversion of a non-chromogenic substrate to a chromogenic substrate. Effect of temperature, pH and enzyme inhibitors on the activity of the enzyme. Estimation of catalase by spectrophotometric method. Determination of the MichaelisMenten constant of an enzyme. Estimation of RNA by colorimetric method. Estimation of DNA by colorimetric method. Measurement of proteolysis and lipolysis. Estimation of Vitamin A in Ghee. Estimation of Ascorbic acid in plasma.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Theory

Importance and applications of thermodynamics in Dairy/Food processing. **Basic concepts:** Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics. *Ideal gases:* Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes. *The second Law of Thermodynamics:* Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability. *Air Cycles:* Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycles on p-V, T-S, p-h diagram etc. *I.C. Engines:* Concepts, Classification, Working of two stroke and four stroke cycle **S.I. engines and C.I. engines.** Parts of I.C. engine, Performance of IC engines.

Practical

A visit to dairy/ food processing plant showing the thermodynamics applications/ devices. Study of 2-stroke and 4-strokes IC engines working. Study of S.I. and C.I. engines working. Study of modern fuel injection systems of I.C. engines. Study of diesel fuel supply system (pump and fuel injector) of I.C. engine. Study of fuel supply system of a petrol engine. Study of cooling system of an I.C. engine (air cooling and water cooling). Study of lubrication system of I.C. engine. Study of Solar water heater and biogas plants and appliances

Theory

Constituents and gross composition of milk of different species and **breeds of milch animals**, *Colloidal State:* Distinction between true and colloidal solution, lyophilic & lyophobic solution, properties of colloidal system. Properties of colloidal systems, Gels-their formation and properties. **Milk as** a colloidal system and its stability. Elementary idea about emulsion. **Density :** Density and specific gravity, pycnometer method, hydrometer lactometer. Density and specific gravity of milk, effect of various processing variables on the density and specific gravity of milk. *Liquid State:* Surface tension, surface energy interfacial tension. Surface tension of mixtures. Surface tension of milk and the factors affecting it. Viscosity- Definition of viscosity, Newtonian and Non-Newtonian liquids, Stokes Law, influence of temperature and concentration of solute on viscosity. Viscosity of milk, evaporated milk and condensed milk. Refractive index. Colligative Properties of Dilute Solution: Vapour pressure, Raoult's Law, Depression of freezing point, Elevation of boiling point. Freezing point and boiling point of milk. Osmosis and Osmotic pressure. Inter-relation of colligative properties. Aqueous solution of Electrolytes: Electrolytes; non-electrolytes, ionic mobility, electrical conductance, **Ostwald Dilution Law, Kohlrausch Law**, Electrical conductance of milk. Ionic Equilibria: Dissociation of water, ionic product of water, concept of pH and pOH and their scale. Acids and bases: Bronsted Lewis concepts of acids and bases, dissociation constants of acids and bases. Salt-their hydrolysis. Buffer solutions. Derivation of Henderson – Hasselbach equation and its application, buffer capacity and buffer index, milk as a buffer system. Equilibrium of electrolytes. pH indicators. Oxidation- Reduction: Redox potential, Nernst equation, electrochemical cells. Hydrogen, glass and calomel electrodes. Redox system of milk. Nuclear Chemistry: The nature of isotopes, radio isotopes. Half life period of radio isotopes. Some of the important radio isotopes. Occurrence of radio nuclide in milk & milk products. Molecular Spectroscopy: The spectrum of electro magnetic radiation, the laws of Lambert and Beer, visible, and ultra-violet Spectroscope. Mention of mass, **NMR spectroscopy.**


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Practical

Determination of density and specific gravity of milk using pyknometer, hydrometer and lactometer. Determination of viscosity of milk using Ostwald viscometer. Determination of surface tension of milk using Stalagmometer. Interfacial tension between water-oil phase. Determination of freezing point of milk. Preparation of a buffer solution. Determination pH of buffer solution and milk electrometrically. Determination of acidity of milk electrometrically. Determination of electrical conductance of milk. Determination of redox potential of milk. Coagulation of milk using electrolytes. Determination of refractive index of skim milk and whey. Titration of amino acid in the presence and absence of formaldehyde. Determination of PKa1 PKa2 and PL. Verification of Lambert Beer Law.

DBM – 114 Environmental Studies

2 (1+1)

Theory

Environmental Science: An introduction, Ecosystem: kinds, structure, characteristics, functioning, Biochemical cycles, Natural resources and their managements, Environmental pollution, Air pollution, Water pollution, Solid waste pollution, Noise pollution, Soil pollution, Radio active pollution, Food processing industry waste and its management, Management of urban waste water, Recycling of organic waste, Recycling of factory effluent, Control of environmental pollution through law, Composting of biological waste and Sewage, uses of water disposal effluent treatment, microbial examination.

Practical

Environment and its analysis, Water quality parameters, collection of sample for pollution study, Determination of pH/acidity/alkalinity from sample, Estimation of dissolved oxygen, Estimation of BOD, Estimation of COD, Estimation of nitrates, Estimation of phosphates, Estimation of pollutant elements, Estimation of heavy/toxic elements, Estimation of lead/mercury, Visit to industrial sewage disposal unit.

DDE – 122 Heat & Mass Transfer

3 (2+1)

Theory

Basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. *One-dimensional steady state conduction:* Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines. *Steady-state heat conduction with heat dissipation to environment:* Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the FINS. Introduction to unsteady state heat conduction. *Convection:* Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient. *Heat Exchangers:* General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. *Mass transfer:* Fick's Law of


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diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer.

Practical

Determination of thermal conductivity: milk, solid dairy & food products. Determination of overall heat transfer co-efficient of: Shell and tube, plate heat exchangers and Jacketted kettle used in Dairy & Food Industry. Studies on heat transfer through extended surfaces. Studies on temperature distribution and heat transfer in HTST pasteuriser. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on Mass Transfer Heat transfer in tubular heat exchanger: co current/ counter flow Heat transfer through composite wall. Heat transfer through legged pipes. Heat transfer through natural and forced convection

DDE – 123 Boilers and Steam Generation

2 (1+1)

Theory

Fuels: Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. *Renewable energy sources:* Concepts, classification, Types and description of renewable energy sources. *Properties of steam:* Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption. *Steam generators:* Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. *Boiler Draught:* Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney, Draught analysis. *Air Compressors:* Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.

Practical

To study different types of boilers with the help of Lab models. To study Boiler mountings and steam-line layout and steam traps. Industrial exposure visit to plant with steam utilization. Study of Fire tube low pressure boiler installed in a dairy processing plant. Study of water softening plant installed with boiler in a dairy processing plant. Study the construction and working of Cochran boiler. Study of Babcock & Wilcox boiler. Study of different Boiler accessories.

DDE – 124 Basic Electrical Engineering

3 (2+1)

Theory

Alternating current fundamentals: Generation of alternating current or voltage, magnitude of induced E.M.F. Alternating current, R.M.S value and average value of an alternating current. Phase relation and vector representation. Cycle, Time period, Frequency, Amplitude, Phase and Phase Difference, Root – Mean Square Value, Average value, Form Factor, Crest or Amplitude Factor. *Poly-phase Circuit:* - Generation of Poly-phase Voltage, Phase Sequence, Interconnection of Three Phases such as Star Connection and Delta Connection and their respective value of current and voltages, Energy Measurement by using Single and Two Watt-meters. *Transformers:* - Working Principle of Transformer, Construction features of Core and Shell type transformer, Elementary theory of an Ideal Transformer, E.M.F. Equation of a Transformer, Vector diagram of transformer with and without load, Transformer losses, voltage regulation and efficiency of transformer, Construction and working on an Single Auto-transformer, Different parts of a 11/0.4 KV, Distribution Transformer. *Three Phase Induction Motor:* - Fundamental working principles, Production of rotating magnetic fields, construction, Different types of Rotor such as Squirrel Cage and


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Phase wound rotors, Starting of induction motors using Direct on Line (DOL) and Star-Delta Starter. Soft starter and variable frequency drives. *Single Phase Induction Motors*: - Introduction, Different types of single phase induction motors such as Split Phase, Capacitor type, Shaded Pole type, Universal or AC series motors, Repulsion start induction run motor, Repulsion – induction motor. *DC Machine*: - Construction and operation of DC generator, types of generators and their various characteristics. DC motors: Torque speed characteristics of DC motors, Starting and speed control of DC motors by using 3-point DC Starter. *Alternators*: - Elementary working principles, Different parts of an Alternators, Relation between Speed and Frequency, E.M.F. equation in an Alternators. Different types of Circuit Breaker and its use. Introduction to DG set system. *Electric Power Economics*: - Economics of Generation of electrical energy and related important terms such as, load curve, connected load, Maximum Demand, Demand Factor, Average load or demand, Load Factor, Diversity factor and its significance, Capacity Factor or Plant factor, Utilization Factor, Plant Operating Factor and Selection of Units and related numerical, Various types of Tariff used for calculation of electricity bill. *Lighting system*: Introduction to industrial lighting system. *Energy Management and Power Factor Corrections*: - Types of energy, Energy Management, Concept of Energy Audit. Concept of Power Factor, Disadvantages of low power factor, Causes of low power factor, Various methods of improving low power factor, Location of power factor correction equipment, Advantages of power factor improvement.

Practical

Introduction to various basic circuits of parallel wiring, stair case wiring, fluorescent light fitting. Study of voltage and current relationship in case of Star connected load. Study of voltage and current relationship in case of Delta connected load. Measurement of power in 3-phase circuit; for a balanced load, using watt meters. Measurement of power in 3-phase circuit; for a unbalanced load, using watt meters. Measurement of iron losses of Single Phase transformer by conducting open circuit test. Measurement of Copper losses of Single Phase transformer by conducting short circuit test. Starting and reversing the speed of a single phase induction motor. Starting and reversing the speed of a three phase induction motor using **Direct on Line (DOL)** Starter. Starting and reversing the speed of a three phase induction motor using manual Star Delta Starter. Starting and reversing the speed of a DC shunt motor using 3-point DC Starter. Starting of slip-ring induction motor by manual and automatic Slip-ring Induction Motor Starter. To determine the relation between induced armature voltage and speed of separately /self excited DC Shunt Generator.

DDM – 121 Microbiology of Fluid Milk

2 (1+1)

Theory

Microbes associated with raw milk: Significance of specific groups of microorganisms in milk i.e. psychrotrophic, mesophilic, thermophilic and thermophilic bacteria - their morphological and biochemical characteristics and classification. Microbial contaminants in raw milk, their sources during various stages of production - milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms; Microbiological changes in bulk refrigerated raw milk. *Sources of contamination and microbial spoilage of raw milk*: Microbial contaminants of raw milk supplies, their sources during various stages of production i.e. milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms and preventive measures. Types of microbial spoilage - souring, curdling, bitter cream, proteolysis, lipolysis, abnormal flavors and discolouration. Mastitis milk - types of mastitis, causative micro-flora of mastitis, compositional and microbiological changes during mastitis infection, their processing and public health. *Concept of clean milk production*: Hygienic milk production system; Cleaning and sanitation

of udder, animal, utensils, equipments and dairy farm environment; Microbiological quality of milk produced in organized and un-organized sector in India and comparative information in developed world; Microflora of aseptically drawn milk and its natural antimicrobial systems - immunoglobulins, lactoferrin, lysozyme and lactoperoxidase (LP) system. **Microbiological aspects of fluid milk:** Pasteurization, boiling, sterilization, ultra high temperature (UHT), non thermal (pulsed field) micro-filtration, bactofugation, standardization and homogenization. Significance of heat resistant and post processing contaminants in fluid milk with special reference to proteases and lipase enzymes and their role in spoilage of processed milk. Bio-film formation during processing and their control measures. **Public health aspects of fluid milk:** Microbial zoonotic diseases transmitted through fluid milk; Milk borne diseases - food infection, intoxication and toxin-infection caused *E. coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Bacillus cereus*, *Listeria monocytogenes*, *Shigella species*, *Campylobacter* etc. Microbiological grading and legal standards of raw and processed milk.

Practical

Morphological examination of common dairy microorganisms (size and shape, arrangement and sporulation). Estimation of microbial load in raw milk by **standard plate count (SPC)** and **dye reduction tests (MBRT, RRT)**. Grading of processed/ market milk by total viable count, coliform and methylene blue reduction time. Enumeration of psychrotrophic, thermophilic, thermotolerant and spore forming bacteria in raw and market milk. Detection of sources of contamination: Air, water, utensils, equipment and personnel, line testing. Spoilage of milk caused by microorganisms: souring, sweet curdling, gassiness, lipolysis, ropiness, proteolysis and discoloration. Detection of mastitis milks: pH, SLST, somatic cell count, chloride content, **Hotis test and CAMP test**. Detection and estimation of coliforms: presumptive, rapid coliform and IMViC Test.

DBM- 121 Economic Analysis

2 (2+0)

Theory

Basic concepts-wants, goods, wealth, utility, consumption, demand and supply, Consumer behaviour-law of diminishing marginal utility and equi-marginal utility, cardinal and ordinal utility approach for consumer's behaviors. Theory of demand-law of demand, demand schedule, demand function, determinants of demand, individual consumer demand and market demand, demand forecasting, elasticity of demand, price elasticity, income elasticity and cross elasticity, Consumer's surplus. Theory of production- concepts of firm and industry, basic factors of production and their role, production function for a single product, nature of production function, laws of returns. Concepts of costs-fixed and variable costs, short run and long run costs, average and marginal costs, economics and diseconomies of scale. Concept of market- types of market, pricing and output under different market situations, market price and normal price, price determination under perfect Competition, monopoly, oligopoly and monopolistic competition. National income – GDP, GNP, NNP, disposable personal Income, per capita income, inflation.

DDC – 122 Chemistry of Milk

3 (2+1)

Theory

Definition and structure of **milk**, factors affecting **composition of milk**, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition, physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins: α -Lactalbumin and β -Lactoglobulin. Properties of α -Lactalbumin and β -lactoglobulin, Immunoglobulin and other minor milk proteins and non proteins nitrogen constituents of


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milk, Hydrolysis and denaturation of milk proteins under different physical and chemical environments, Estimation of milk proteins using different physical and chemical methods, Importance of genetic polymorphism of milk proteins, Milk enzymes with special reference to lipases, Xanthine Oxidase, phosphates, proteases and lactoperoxidase, Milk carbohydrates their status and importance. Physical and chemical properties of lactose, Sugar amine condensation, amadori re arrangement, production of hydroxyl methyl furfural (HMF), Processing related degradation of lactose, Definition, general composition and classification of milk lipids. Nomenclature and general structure of glycerides, factors affecting the fatty acid composition. Milk phospholipids and their role in milk products, Unsaponifiable matter and fat soluble vitamins, Milk Salts: Mineral in milk (a) major mineral (b) Trace elements, physical equilibria among the milk salts and Milk contact surfaces and metallic contamination.

Practical

Sampling techniques of chemical examination of milk. Determination of pH and titratable acidity of milk. Determination of fat in milk by different methods. Determination of total solids and solids not fat in milk. Determination of total milk proteins by Kjeldahal method. Determination of casein, whey proteins and NPN in milk. Estimation of alkaline phosphatase and lipase in milk. Determination of lactose in milk. Determination of ash in milk. Determination of phosphorus and calcium in milk. Determination of chloride in milk. Determination of temporary and permanent hardness of water. Estimation of available chlorine from bleaching powder.

DDT – 211 Market Milk

4 (3+1)

Theory

Market milk industry in India and abroad: Distinctive features of tropical dairying as compared to those of the tropical climate of developed countries. Collection and transportation of milk; a) Organization of milk collection routes b) Practices for collection of milk, preservation at farm, refrigeration, natural microbial inhibitors, lactoperoxidase system. Reception and treatment (pre-processing steps) of milk in the dairy plant: a) Reception, chilling, clarification and storage: General practices. b) Homogenisation: Definition, pretreatments, theories, synchronization of homogenizer with operation of pasteurizer (HTST) c) Effect of homogenization on physical properties of milk. d) Bactofugation: Theory and microbiology. Thermal processing of milk: a) Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F value, Q_{10} value. b) Factors affecting thermal destruction of microorganisms. c) Definition and description of processes: Pasteurization, thermisation, sterilization, UHT Processing. d) Product control in market milk plant. e) Defects in market milk. f) Manufacture of special milks: toned, doubled toned, reconstituted, recombined, flavoured, homogenized, vitaminised and sweet acidophilus milk. g) Manufacture of sterilized milk. h) Distribution systems for market milk. UHT processing of milk: a) Relevance of UHT processing in the tropical climate b) UHT plants: Description. Direct, Indirect, with upstream and downstream homogenization, third generation UHT plants. c) Aseptic packaging, types and systems of packaging, sterilizing packages, filling systems. d) Technical control in the UHT plant. e) Shelf life of UHT milk and tests for UHT milk. Nutritive value of milk. Effect of heat processing on nutritive value. Cleaning and sanitization of dairy equipment.

Practical

Familiarization with equipments for reception of milk in plant. Pretreatments: Chilling, clarification, filtration. Standardization and numericals relating to it. Cream separation: parts of separator and the process. Operation of LTLT, HTST pasteurizer, laboratory steriliser.


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Preparation of special milks; toned, double toned, standardised, flavoured, sterilised. Cleaning of storage tanks, cream separators, HTST plants; manual cleaning and CIP. Detection of adulterants and preservatives in milk. Assessment of homogenisation efficiency in milk. Strength of common detergents and sanitizers used in market milk plant.

DDT – 212 Traditional Indian Dairy Products

3 (2+1)

Theory

Status and significance of traditional Indian milk products in India. *Khoa*: Classification of types, standards methods of manufacture and preservation, factors affecting yield of khoa. Mechanization in manufacture of khoa. *Khoa based sweets*: Burfi, Peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices. *Rabri and Basundi*: Product identification, process description, factors affecting yield, physico-chemical changes during manufacture. *Channa*: Product description, standards method of manufacture, packaging and preservation. *Chhana-based sweets*: Rasogolla, Sandesh, Rasomalai. Mechanization of manufacturing process, advances in preservation and packaging. *Paneer*: Product description, standards, method of manufacture, packaging and preservation. Mechanization of Paneer manufacturing/packaging process. *Chakka/Maska and Shrikhand*: Product description, standards, method of manufacture, small scale and industrial process of production, packaging and preservation aspects. *Misti Dahi*: Product description method of manufacture and packaging process. *Kheer and Payasam*: Product description methods of manufacture, innovations in manufacturing and packaging processes. Biopreservative principles in enhancing the self-life of indigenous milk products including active packaging.

Practical

Preparation of *Khoa* from cow, buffalo and concentrated milk. Preparation of Burfi, Peda, Kalakand, Milkcake and Gulabjamun. Preparation of Paneer from cow, buffalo and mixed milk. Preparation of Chhana from cow and buffalo milk and mixed milk. Preparation of Sandesh and Rasogolla. Preparation of kheer. Preparation of Rabri, Misti Dahi, Chhaka and Shrikhand. Visit to industry.

DDE – 211 Refrigeration and Air-Conditioning

3 (2+1)

Theory

Basic refrigeration cycles and concepts: Standard rating refrigerating machines; Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressors; Theoretical vapour compression cycle; Departure from theoretical vapour compression cycle, representation on T-S and p-h diagrams; Mathematical analysis of vapour compression refrigeration system. *Refrigerants*: Primary and secondary refrigerants; common refrigerants (Ammonia, Freon, *HFC, HCFC etc*); Brine, their properties and comparison. *Multi-Pressure Refrigeration Systems*: Applications; Multi-evaporators with single stage and multi-stage compression and expansion systems; Working, Control and mathematical analysis of above systems. *Refrigeration Equipments and Controls*: Introduction to the types, construction, operation and maintenance of Refrigeration Components, Controls and Safety Devices as used in different refrigeration applications. Capacity control methods, Refrigeration Piping: Purpose, Types, Materials, Fittings and Insulation. *Design and Balancing of Refrigeration System*: Basic elements of design of individual components and a complete refrigeration system. Input and Output design parameters, Balancing of components of refrigeration system for optimum performance. *Absorption Refrigeration Systems*: Simple vapour absorption refrigeration systems, Actual Vapour absorption refrigeration system, Refrigerant absorbent pairs, Absorption cycle analysis. *Cryogenic Freezing*: Cryogenics, cryogens, properties, applications, cryogenic freezers. *Psychrometry*: Definition, properties


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of moist air, psychrometric charts, psychrometric processes; Cooling/ Heating coils, humidifiers and dehumidifiers, Temperature and humidity measurements and controls. *Air-conditioning Systems*: Types of cooling loads and their calculation, Design conditions for Human and Industrial air conditioning systems, Analysis of different air-conditioning systems with the help of psychrometric chart. *Cold Storage*: Types of cold storages, Types of cooling loads in cold storages used for food/ dairy products; Construction and operation of cold storage. Insulating materials and vapour barriers.

Practical

Study of different types of Refrigeration tools generally used in installation and maintenance of a refrigeration plant/ equipment including charging and leakage-detection tools. Study of specification, components, operation, control, maintenance and precautions taken during working of a Domestic refrigerator. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Water cooler. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Bulk milk cooler. Study of specifications, components, operation, control, maintenance and precautions taken during working of a Walk-in-cooler. Study of different parts and learn the operation of a refrigeration plant/ice plant using ammonia refrigerant. Estimation of installed cooling capacity with the help of observed working pressures. Study of specifications, components, operation, control and maintenance of Ice Bank Tank (IBT). Study of specifications, components, operation, control and maintenance of a Cold Storage. Study of the Evaporative Cooling Devices like Cooling Tower, Spray Pond, Air-Washer or Room air-cooler etc. Study of the parts and components of different types of refrigerant compressors used in various refrigeration applications. Study of different types of capacity control devices used with compressors in a refrigeration plant. Experimental study of a simple refrigeration system on refrigeration tutor or an experimental set-up. (comparison of actual and theoretical performance). Experimental study of an year-round air-conditioning system on an air-conditioning tutor or an experimental set-up. Determination of SHF and By-pass factor etc. Study and plotting of psychrometric processes using refrigeration/air-conditioning tutor. Measurement of psychrometric properties using psychrometric meters/gadgets Industrial exposure visit to refrigeration/air-conditioning plant.

DDE – 212 Dairy Engineering

3 (2+1)

Theory

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings. Description, working and maintenance of can washers, bottle washers. Factors affecting washing operations, power requirements of can the bottle washers, CIP cleaning and designing of system. *Mechanical Separation*: Fundamentals involved in separation. Sedimentation, Principles involved in filtration, Types, rates of filtration, pressure drop calculations. Gravity setting, principles of centrifugal separation, different types of centrifuges. Application in Dairy Industry, clarifiers, tri processors, cream separator, self-desludging centrifuge, cold and hot separators, Bactofuge, in-line standardization system, care and maintenance of separators and clarifiers. *Homogenization*: Classification, single stage and two stage homogenizer pumps, power requirement, care and maintenance of homogenizers, aseptic homogenizers. *Pasteurization*: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Pasteurizer control, Care and maintenance of pasteurizers. *Sterilization*: Different type of sterilizers, in bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization, Aseptic packaging and equipment. Care and maintenance of Sterilizers. *Packaging machines*: Pouch filling machine pre-pack and aseptic filling bulk handling system Principles and working of different types of bottle filters and

capping machine, Blow molding machines, Aseptic PET bottle filling machine. Cup filling system. Care and maintenance. *Mixing and agitation*: Theory and purpose of mixing. Equipments used for mixing solids, liquids and gases. Different types of stirrers, paddles and agitators. Power consumption of mixer-impeller, selection of mixing equipment in dairy industry, mixing pumps.

Practical

Study of S. S. pipes, fitting and gaskets. Study and selection of pump. Study of different types of milk filter. Study of equipments at raw milk reception dock. Constructional details, operation and maintenance of straight through can washer. Constructional details, operation and maintenance of C.I.P. system. Constructional details, operation and maintenance of homogenizers. Constructional details, operation and maintenance of batch pasteurizer. Constructional details, operation and maintenance of HTST pasteurizer. Comparison of conventional and modern pasteurizer. Constructional details, operation and maintenance of cream separators. Constructional details, operation and maintenance of sterilization systems. Constructional details, operation and maintenance of pouch filling machine. Constructional details, operation and maintenance of different types of agitators. Constructional details, operation and maintenance of bottle filling and capping machine. Visit to a dairy processing plant.

DDT – 213 Fat-Rich Dairy Products

3 (2+1)

Theory

Status of fat-rich dairy products in India and abroad. *Cream*: a) Definition & Legal standards, efficiency of cream separation and factors affecting it; control of fat concentration in cream. b) Planning and operating a cream production unit) neutralization, standardization, pasteurization and cooling of cream. c) Preparation and properties of different types of cream; table cream, sterilized cream, whipped cream, plastic cream, frozen cream and chip-dips (cultured cream), UHT processing of cream. d) factors affecting quality of cream; ripening of cream e) Packaging, storage and distribution, defects (non-microbial) in cream and their prevention. *Butter*: a) Introduction to the butter making process; theory of churning, Legal standards. b) Technology of Butter manufacture, Batch and continuous methods. Over-run in butter; control of fat losses in butter-milk; packaging and storage; transportation; defects in butter; rheology of butter; uses of butter. Butter making equipment: Construction, operation, care and maintenance of cream separators, coolers and vacreator, factory butter churn and continuous butter making machine. Special butters and related products: a) Manufacture, packaging, storage and properties of whey butter, flavoured butter, whipped butter, renovated butter/fractionated and polyunsaturated milk fat products, vegetable oil-blended products and low-fat spreads. b) Manufacture, packaging, storage and characteristics of margarine of different types. *Ghee and butter oil*: a) Methods of ghee making-batch and industrial processes, innovations in ghee production, procedure, packaging and preservation of ghee; utilization of substandard milk. b) Ghee: Composition and changes during manufacture fat constants. C) Butteroil: Manufacture of butteroil, packaging and storage.

Practical

Standardization, neutralization, pasteurization and cooling of cream. Preparation of sterilized cream. Study of construction and cooperation of the power operated butter churn and butter packaging machine. Preparation of cooking butter by the hand operated churn. Preparation of desi butter. Manufacture of table butter using the power-driven churn. Preparation of ghee from cream and butter. Study and operation of continuous ghee plant.

Theory

Condensed Milks: History, status and scope in India and abroad, Definition and legal standards: Condensed milk, sweetened condensed milk and evaporated milk, manufacturing techniques; a) Manufacture of evaporated milk including pilot sterilization test, b) Manufacture of sweetened condensed milk, c) Recombined sweetened condensed milk. Grading and quality of raw milk for condensed and evaporated milk, Physico-chemical changes taking place during manufacture of condensed milk, Heat stability of milk and condensed milk and role of stabilizers in the stability of condensed milk, Chemical defects in condensed milk, their causes and prevention. Recent advances with reference to freeze concentration and membrane concentration. *Dried Milks:* History and status in India and abroad, Grading and quality of raw milk for dried milks, Manufacture of skim milk powder (SMP), whole milk powders and heat classified powders, Physico-chemical changes taking place during manufacture of dried milks, Physical properties of dried milks, Defects in dried milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk, Manufacture of infant foods, malted milk foods and other formulated dried products, Cheese spread powder, ice cream powder, cream powder, butter powder, whey powder, Management of condensed and dried milk industry.

Practical

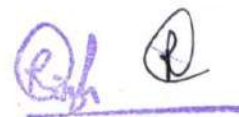
Manufacture of plain skim concentrated milk. Manufacture of Sweetened Condensed Milk. Manufacture of Evaporated Milk. Concentration of milk by membrane processing. Manufacturing of Skim Milk Powder by spray drying/roller drying. Manufacture of instant milk powder.

Theory

Fundamentals of human nutrition, concept of balanced diet, nutrient requirements of different age groups. Methods of evaluation of nutritive value of food and nutritional value of cow, buffalo and human milk, biochemical composition and energy value of foods with special reference to milk and dairy products. Nutrition, digestion and absorption, Vitamins (structure and function), Hormones (structure and function), Milk intolerance and hypersensitivity, Safety aspects of food additives, toxic elements, antibiotics, radionuclides in milk and milk products. Nutraceutical, antioxidants, food toxins, anti-nutritional factors, probiotics and cultured dairy products. Biochemical aspect of post-harvest storage specifically food spoilage.

Practical

Estimation of serum Protein (Biuret method /Lowry method). Estimation of Blood Glucose (Folin Wu method). Estimation of Serum inorganic phosphorus (Fiske and Subba Row method). Estimation of blood creatinine, triglyceride and cholesterol levels. Estimation of calorific value of food items. Diet and nutrition surveys: (a) Identification of vulnerable and risk groups. (b) Diet survey for breast-feeding and weaning practices of specific groups. (c) Use of anthropometric measurement in children. Preparation of visual aids for nutritional disorders. Field visit to (a) Observe the working of nutrition and health oriented programmes (survey based result). (b) Hospitals to observe nutritional deficiencies. Identification of Mono, Di and Polysaccharides. Identification of Proteins (albumin, gelatin, peptone). Planning and preparation of high protein, low fat and specialized diets. Detection of antibiotic/toxin in food products.



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Theory

Evaporation: Basic principles of evaporators, construction and operation, Different types of evaporators used in dairy industry, Calculation of heat transfer area and water requirement of condensers, Basic concepts of multiple effect evaporators, Operations and various feeding systems, Economy of operation, Thermo processor and MVR system, Care and maintenance of evaporators. *Drying:* Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers-spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers. *Fluidization:* Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers. *Processing equipments:* Mechanization and equipment used in manufacture of indigenous dairy products, Ice-cream and Cheese making equipments. *Packaging equipments:* Packaging machines for milk & milk products. *Membrane Processing:* Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro-dialysis.

Practical

Constructional details, operation and maintenance of Vacuum pan. Constructional details, operation and maintenance of multiple effect evaporator. Constructional details, operation and maintenance of spray drier. Constructional details, operation and maintenance of butter making equipment. Constructional details, operation and maintenance of equipment related to ghee production. Constructional details, operation and maintenance of ice-cream making equipment. Constructional details, operation and maintenance of cheese making equipment. Constructional details, operation and maintenance of reverse osmosis and ultra filtration system. Design problems on double effect evaporator and vacuum pan. Visit to a milk product plant

Theory

Types, metabolism and propagation of starter cultures: History, classification and importance of starter Cultures in dairy industry; Single, multiple, defined and mixed strain starters; Probiotics and Special cultures like exopolysaccharide production; Propagation of starter cultures-concentrates - direct bulk and direct vat starter cultures, factors affecting propagation; Metabolism of starter cultures (carbohydrate, protein, citrate) and production of metabolites and antibacterial substances; methods of starter distillates their merits/demerits.

Activity, Purity, Preservation of Starters and Starter Failure: Quality and activity tests for dairy starters and their preservation- methods (liquid, spray drying, vacuum drying, freeze-drying, frozen concentrate, concentrated dried cultures), merits and demerits; factors affecting the survival of cultures during preservation; Defects in starters and their control; Starter failures- effect of antibiotic residues, sanitizers and bacteriophages. Phages-life cycle, sources, prevention, chemical and mechanically protected systems. *Role of Starters in fermented milks:* Role of starters in the preparation of various fermented milks; Types of fermented milks - dahi, yoghurt, acidophilus milk; different types of dahi and yoghurt; preparation; defects and their control. Kefir and koumiss : origin and characteristics; microbiology of kefir grains; Other fermented milks such as Bulgarian milk, cultured buttermilk, Leben, Villi and Yakult; Microbiology of fermented milk products; their

nutritional and therapeutic significance. *Chesse Starters*: Classification, desirable properties, Artisanal and adjunct cheese cultures, primary and secondary flora of cheese; biochemical changes during ripening, bacterial and mold ripened cheeses: soft, semi-soft, semi-hard, hard, Brick and Brie cheese, Camembert and Roquefort cheese; Rennet: rennet substitutes, microbial rennet and recombinant chymosin

Practical

Testing purity of starter cultures by gram's staining, catalase test; creatine test. Testing starter activity by dye reduction tests, Horrall-Elliker, WhiteHead & Cox test. Preparation of single and mixed starter cultures. Evaluation of homo-fermentation and hetero-fermentation separately and in combination. Preservation of starter cultures by freeze-drying techniques. Preparation of concentrated starter (DVS). Effect of physical factors (temperature, pH, Salt and Sugar) on dairy starters. Testing milk for presence of inhibitory substances using *B. stearothermophilus* and *S. thermophilus* as indicator organisms. Effect of presence of antibiotic residues in milk on starter activity. Evaluation of associative growth of Starter cultures in milk. Detection of Bacteriophages in cheese whey by plaque assay method. Preparation and microbial examination of dahi, yoghurt, cultured butter milk, acidophilus milk and kefir. Analysis of cheese for total spore and anaerobic spore count. Microbiological analysis of cheddar cheese at different stages of manufacture of (storage and ripening).

DDM- 222 Microbiology of Dairy Products

2 (1+1)

Theory

Microbiology of Cream and Butter - Micro-environment and impact of critical process factors on entry of spoilage and pathogenic organisms in cream and butter; Microbiological aspects including defects in pasteurized (ripened/unripened cream), sterilized and UHT cream; Factors influencing the microbial growth during batch/continuous butter making process; Microbial Defects in butter - Bacterial/mold discoloration, enzymatic deterioration and their control measures; Regulatory microbiological standards. *Microbiology of Condensed, Evaporated and Dried products*: Type of microorganisms associated with condensed, evaporated and dried products, their growth/ survival during manufacture and storage; Microbial defects - Bacterial thickening / Mold button formation in SCM; Gassiness/bloating, Bacterial coagulation (Sour and sweet), Bitterness, Fishy flavor in evaporated milk; pre-heating/DSI temperature and their impact on microflora of dried products; Effect of reconstitution on microbial quality of milk powder including baby foods and survivability of pathogens; Regulatory microbiological standards

Microbiology of Ice Cream and Frozen desserts: Microenvironment in ice cream, microbiological quality of ingredients, critical process factors and their impact on entry of pathogens in ice cream and frozen desserts, their survival during storage, food poisoning outbreaks and legal standards. *Microbiology of Indigenous Milk Products*: Predominance of spoilage and pathogenic organisms in khoa and khoa based sweets – burfi, peda, gulabjamun, etc., paneer, Chhanna and Chhanna based sweets – rasogulla; kheer, shrikhand, dahi, kulfitec.; Factors affecting the microbiological quality in reference to production, processing, storage and distribution; Microbial safety in relation to potential pathogens and their public health significance; Microbial defects, control measures and legal standards; Active packaging concepts and role in bio-preservation.

Practical

Microbiological examination of raw, pasteurized, sterilized and UHT cream for Standard plate count (SPC) as well as lipolytic and coliform counts, direct microscopic count (DMC), dye reduction tests and sterility test. Microbiological examination of salted and unsalted butter for SPC, psychrotrophic, lipolytic, coliforms and yeast and mold count; K.Q test. Microbiological examination of concentrated milk for SPC, coliforms, spores, yeast and mold.

thermoduric and thermophilic counts. Microbiological examination of dried milks for SPC, coliforms, *Staph. aureus*, *B. cereus*, *E. coli*, *Salmonella*, Sulphite reducing clostridia and Staphylococcal enterotoxins. Microbiological examination of ice-cream and other frozen desserts for SPC, coliforms and Staphylococcal counts; Detection of *Salmonella* spp./*E. coli*. Microbiological examination of khoa for SPC, coliforms and staphylococcal counts besides yeast and mold counts. Microbiological examination of paneer and shrikhand for SPC, Spores, coliforms, yeast and molds and Staphylococcal counts. Microbiological examination of packaging materials for SPC, Spores and Yeast and mold counts.

DDT – 221 Cheese Technology

5 (3+2)

Theory

Origin and history of development of cheese manufacture, status and scope in India and abroad. Definition, standards and classification of cheese. Milk quality in relation to cheese making. Pre-treatment of milk; Physical and chemical. Additives and preservatives for cheese making. Rennet preparation and properties, rennet substitutes. Action of rennet on milk in relation to cheese making. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage. Enzyme modified cheese (EMC), flavourings, Application of membrane processing in cheese manufacture. Factors affecting yield of cheese. Packaging, storage and distribution of cheese. Accelerated ripening of cheese. Manufacture of processed cheese, cheese spread and processed cheese foods. Mechanization and automation in cheese processing.

Practical

Familiarization with equipments, accessories and standardization numericals. Study of factors affecting rennet action. Manufacture of Cheddar cheese. Manufacture of Gouda cheese. Manufacture of Mozzarella cheese. Manufacture of Swiss cheese. Manufacture of Cottage cheese. Manufacture of Processed cheese. Manufacture of Processed cheese spread. Manufacture of processed cheese food

DDT – 222 Ice-Cream and Frozen Desserts

3 (2+1)

Theory

History, development and status of ice cream industry, History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts, Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream, Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant, Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of overrun, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention, Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.

Practical

Calculation of standardization of ice-cream mixes. Manufacture of plain and fruit flavoured ice-cream. Manufacture of chocolate, fruit and nut ice cream. Preparation of sherbets/ices. Preparation of soft served and filled ice-cream. Manufacture of kulfi. Study of continuous and batch type freezers. Manufacture of ice-cream by continuous process. Determination of overrun in ice cream. Factory visit.


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DDC – 221 Chemistry of Dairy Products**3 (2+1)****Theory**

Chemical composition and legal standards of milk products. Chemistry of creaming and factors affecting the same. Ripening and neutralization of cream. Theories of churning and factors affecting the same. Butter colour. Ghee: Physico-chemical changes during manufacture. Hydrolytic and oxidative deterioration, their causes, prevention and role of antioxidants. Physico-chemical changes in milk constituents during manufacture and storage of traditional dairy products: Khoa, Paneer, Dahi, Channa, Lassi, Chakka, Shrikhand. Chemistry of cheese: milk clotting enzymes, enzymatic coagulation of milk, biochemical changes during ripening. Physico-chemical changes during preparation and storage of concentrated and dried milk products. Physico-chemical changes during processing and storage of ice cream and frozen desserts. Role and mechanism of stabilizers and emulsifiers in ice cream.

Practical

Cream: estimation of fat and acidity. Butter: estimation of fat, moisture, curd and salt content. Ghee: estimation of moisture, acid value, Butyro refractive reading and Reichert Meissl value /Polanske value. Determination of lactose and sucrose in sweetened condensed milk. Milk powder: moisture, fat, ash, solubility, acidity and bulk density. Ice cream: estimation of fat and total solids. Estimation of moisture, fat and salt content in cheese. Khoa/paneer: estimation of moisture and fat. Estimation of protein content in milk products and protein rich dairy products using Kjeldahl method.

DBM – 221 Fundamentals of Dairy Extension**3 (2+1)****Theory**

History, need, definition, philosophy, principles, approaches and objectives of extension education. Present status of dairy and animal husbandry development programme launched in pre and post-independence era. Teaching and learning process, Extension Teaching Methods, classification and selection of teaching methods. Importance of Audio-Visual-Aids. Identification of rural leaders, their characteristics, role and function in rural development, training of rural leaders. Principle of working with group and their mobilisation. Need, principle and step of programme planning. Evaluation of extension programmes. Diffusion of innovations and categories of farmers. Problems of different stake holders, Conceptual orientation about different terms, like- RRA, PRA, IVLP/TAR, ATMA, ATIC, PTD, etc.

Practical

Acquiring skill in use of audio-visual and other aids: Hands-on training on use of LCD projector, PA system, camera. Skills in preparation of documents including script writing. Preparation and use of audio-visual aids including animation for dairy stakeholders Group discussion technique, Hands on learning of field problems in dairy and animal husbandry.

DDE – 311 Instrumentation and Process Control**3 (2+1)****Theory**

Instrumentation scheme & characteristics: Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Definition, Application and types of measurements, instrument classification, Functional elements of an instrument, standards, calibration, introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems. *Introduction to various types of sensors:* Definition, principle of sensing & transduction, classification, selection and applications of Sensors., Measurement of parameter : Measurement of length ,angle, area , temperature , pressure flow , speed, force , torque, vibration , level

concentration (conductivity and ph) measurement . Flow measurement using magnetic flow measurement. Piezoelectric transducer. *Micro-sensors and smart sensors*: Construction, characteristics and applications. *Electronic Instruments*: Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope, Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. Display devices and recorders like X-Y & X-T recorders.

Automation: Introduction to plant automation, automation hierarchy, PLC, SCADA

Practical

Strain gauge characteristics and weight measurement. Measurement of pressure using bellows and diaphragm. Preparation and calibration of thermocouple. Study the construction and working of Bourden pressure gauge. Test and calibration of pressure gauges using dead weight tester. Study the mechanism of pH meter and its electrodes. Study a Proximity sensor. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study of RTD and Thermister. Study of different speed measurement sensor/ instruments. Study of LVDT. Study of level/flow controller. Study of PLC. Visit to a automatic controlled dairy plant.

DDM – 311 Quality and Safety Monitoring in Dairy Industry

3 (2+1)

Theory

Consumer Awareness about Microbiological Quality and Safety of Dairy Foods: Changing scenario; Concepts of quality control, quality assurance and food safety; Global quality and food safety standards, Integrated food law, its main features and functions. *Introduction to Food Safety Management System*: Concepts of Quality Management System (QMS)–ISO: 9000:2000; Principles of QMS; Standard requirements for QMS; HACCP concept and principle with special reference to biological hazards in dairy foods, TQM tools and techniques. *Microbiological Risk Analysis Concepts*: Risk assessment, risk management and risk communication; risk profiling of dairy products; Microbiological criteria and two and three class sampling plan / guidelines; Bio-safety concepts in handling of dairy pathogens and setting up of a microbiological/ pathogen lab in a dairy plant. *Rapid Enumeration Techniques*: Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli* (*E. coli* 0157:H7), *Salmonella*, *Shigella*, *Staphylococcus aureus*, *Bacillus cereus* and *Listeria monocytogenes*. *Role of Biosensors for monitoring hygiene and safety of dairy foods*: Detection of antibiotic residues in milk –Delvo SP, MDR test, penzyme test, charm assay, lateral flow assay (ROSA test) etc. Detection of aflatoxins, pesticides other inhibitors etc. and their public health importance in dairy foods. *Plant and equipment hygiene*: Concepts of hygiene and sanitation, microbial quality of water and environmental hygiene in dairy plant, chlorination of dairy water supply, quality of air, personnel hygiene, treatment and disposal of waste water and effluents.

Practical

Rapid detection of total plate count, yeast and mold counts, Coliform, *E. coli*, Enterococci, Enterobacteriaceae count using D- count and 3M Petrifilm kits. Rapid detection of pathogenic bacteria based on antigen antibody principle: *Staphylococcal enterotoxins*, *E. coli* O157:H7, *Listeria monocytogenes* and *Salmonella* using VIDAS system. Rapid detection of antibiotic residues in milk using Delvo SP, MDR test, Charm assay, Lateral flow assay (ROSA test). Rapid detection of aflatoxin M1/ pesticides residues in milk using Charm Assay, Lateral Flow Assay (ROSA test) / Enzyme Inhibition Assay using Luminometer. Evaluation of common sanitizing agents used in dairy plants by a) suspension b) capacity test. Microbiological tests

for assessing Environmental, equipment and personnel hygiene by swab and rinse methods, Determination of BOD in dairy waste water. Quality evaluation by HACCP in the preparation of dairy products.

DDT – 311 By Product Technology

3 (2+1)

Theory

Status, availability and utilization of dairy by-products in India and Abroad. Associated economic and pollution problems, Physico-chemical characteristics of whey, butter milk and ghee residue, *By-products from skim milk: Casein:* types of commercial casein, their specifications, manufacturing processes with basic principles involved. b) Industrial and food uses of caseins c) Manufacture of sodium and calcium caseinates their physico-chemical and functional properties and food applications d) Manufacture of casein hydrolysates and its industrial application e) *Cooprecipitates:* types, their specifications, manufacturing processes with basic principles involved, functional properties and food applications. *Whey processing:* a) Fermented products from whey, b) Beverages from whey c) Deproteinized and demineralized whey d) Condensed whey e) Dried whey, types and their specification, manufacturing techniques. F) Utilization of whey products. Application of membrane processing for whey processing. *Whey protein concentrates:* a) Methods of isolation with basic principles involved, physico-chemical properties of whey proteins concentrates b) Functional properties and food applications of WPC. *Lactose:* methods for the industrial production of lactose, refining of lactose, uses of lactose and hydrolysis of lactose. Butter milk processing: a) Condensed butter milk b) Dried butter milk c) Utilization of butter milk products. *Ghee residue:* Composition, processing and utilization. Nutritional characteristics of by products.

Practical

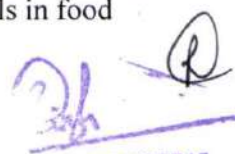
Manufacture of edible casein from cow and buffalo milk. Manufacture of rennet casein. Manufacture of sodium caseinate. Manufacture of calcium caseinate. Manufacture of co-preceinate. Isolation of whey proteins by cold precipitation technique. Manufacture of whey proteins, concentration by ultra filtration process. Manufacture of whey drinks. Manufacture of dried whey. Manufacture of lactose. Incorporation of whey protein concentrates in processed cheese foods. Manufacture of coffee whitener.

DDT – 312 Packaging of Dairy Products

3 (2+1)

Theory

Introduction, Importance of Packaging, History of Package Development, Packaging materials, a) Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product informatio. Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweetmeades, concentrated and dried milks including baby foods. Packaging of functional dairy/food products. Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP, Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food


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Practical

Identification of packaging materials, Flame Hot wire test, Testing of papers/paperboards: Percentage moisture, Grease resistance, Water absorptiveness, Grammage, Tearing resistance, Bursting strength. Testing of glass bottle – resistance to thermal shock. Testing of plastics and laminates – Thickness, Water vapour transmission rate (WVTR), Grease resistance. Packaging of different dairy products by using prepak and vacuum packaging machines.

DDC – 311 Chemical Quality Assurance

2 (1+1)

Theory

Importance of chemical quality control, quality assurance and total quality management in dairy industry. Role of national and international food regulatory systems and standards with respect to quality and safety of milk and milk products: FSSAI, PFA, AGMARK, BIS ISO, IDF, Codex, etc., Application of food safety management system (ISO: 22000). Hazard analysis and critical control points (HACCP) system and its application in dairy industry with respect to chemical quality. Setting up of testing facilities and analytical laboratories; concept of mobile testing laboratories. Accreditation of analytical laboratories. Preparation and standardization of reagents required in the analysis of milk and milk products. Sampling procedures; labeling of samples for analysis; choice of analytical tests for milk and milk products for chemical analysis and instrumental methods of analysis. Calibration of dairy glassware; including butyrometer, pipettes, burettes, hydrometers, lactometers and thermometer. Testing methods for the detection of adulterants, preservatives and neutralizers in milk and milk products. Environmental contaminants such as pesticides, antibiotics, heavy metals in milk and milk products and their chemical testing methods. Importance of milk contact surfaces, metallic contamination in dairy industry. Chemical quality of water in dairy industry. Prediction of shelf life behavior of milk and milk products.

Practical

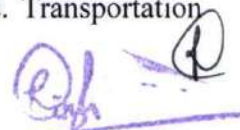
Calibration of dairy glassware such as pipette, burette, volumetric flasks, hydrometer, butyrometers. Preparation and standardization of dairy reagents such as acids, alkalies, sodium thiosulfate, silver nitrate, Fehlings, EDTA solutions etc. Preparation and testing of Gerber sulfuric acid used in fat determination. Testing the amyl alcohol used for fat determination. Chemical analysis of permissible additives used in milk and milk products. Chemical analysis of detergents and sanitizers. Detection of adulterants, preservatives, and neutralizers in milk and milk products. Detection of vegetable oils and animal body fat adulteration in ghee. Analysis of market samples of milk and milk products. Determination of temporary and permanent hardness of water. Estimation of available chlorine from bleaching powder.

DBM – 311 ICT in Dairy Industry and Introduction to Operations Research

4 (2+2)

Theory

Introduction–Elementary concepts, objectives of operations research, Applications of OR in decision-making. Modeling in Operation Research. Linear Programming: Introduction, mathematical formulation of the problem, Graphical solution, Simplex technique for solving simple LP problems. Inventory Control – Introduction and general notations, Economic lot size models with known demand. Replacement – Introduction, Replacement of items whose efficiency deteriorates with time. Queuing – Introduction and general notions, Classification of queues and their problems, Probability distribution of queues. Various models in the queuing system. Sequencing – Statement of the problem, notations and assumptions, Problems with 'n' jobs and two machines. Generalization to 'm' machines. Transportation



model – Definition and application of transportation model, Formulation of transportation problems and their solutions. Assignment problems and their solutions. Framework of PERT and CPM, Activities, events and network, PERT and activity time estimates, probability of project completion Critical path analysis.

Practical

LP problems, Inventory Control problems, Replacement model problems, problems on queuing theory, sequencing, transportation, assignment, PERT/CPM.

DBM – 312 Marketing Management and International Trade

2 (2+0)

Theory

Concept of marketing; Functions of marketing; concepts of marketing management; scope of marketing management; marketing management. Process; concepts of marketing- mix, elements of marketing- mix. Market Structure and Consumer Buying Behaviour: Concept of market structure, marketing environment, micro and macro environments. Consumers buying behaviour, consumerism. Marketing Opportunities Analysis: Marketing research and marketing information systems; Market measurement- present and future demand; Market forecasting; market segmentation, targeting and positioning. Allocation and marketing resources. Marketing Planning Process. Product policy and planning: Product-mix; product line; product life cycle. New product development process. Product brand, packaging, services decisions. Marketing channel decisions. Retailing, wholesaling and distribution. Pricing Decisions. Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry. Promotion-mix decisions. Advertising; How advertising works; Deciding advertising objectives, advertising budget and advertising message; Media Planning; Personal Selling, Publicity; Sales Promotion. Food and Dairy Products Marketing. International Marketing and International Trade. Salient features of International Marketing. Composition & direction of Indian exports; Trends in International Dairy Trade, International marketing environment; Deciding which & how to enter international market; Exports- Direct exports, indirect exports, Licensing, Joint Ventures, Direct investment & internationalization process, Deciding marketing Programme; Product, Promotion, Price, Distribution Channels. Deciding the Market Organization; World Trade Organization (WTO)

DDE – 321 Food Engineering

3 (2+1)

Theory

Rheology: Rheology of processed food, properties of fluid foods, Rheological method, Measurement of rheological parameters, properties of granular food and powders, Properties of solids foods, Viscoelastic models. Measurement of food texture. *Food Freezing*: Thermal properties of frozen foods. Predication of freezing rates. Plank's equation, Design of food freezing equipment, Air blast freezers, Plate freezers, spiral freezers, and immersion freezers, IQF, storage of frozen foods. Freeze concentration. *Food dehydration*: Estimation of drying time for food products, constant rate period and falling rate period dehydration. Diffusion controlled falling rate period. Use of heat and mass balanced in analysis of continuous dryers, Classification of driers, tray, vacuum, vacuum band, tunnel, bin, solar, drying, freeze drying, spin flash. *Freeze dehydration*: Heat and mass transfer, Calculation of drying time, Industrial freeze drying. *Other food processing operations and equipments*: Equipment for pulping, fruit juice extraction, blanching, dehulling, size reduction, milling, extrusion and distillation.


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Practical

To determine physical properties of food product. To determine viscosity of food product. To study food freezers. To study freeze drier. To determine drying characteristics of food product. To compare various drying methods. To determine juice yield. To compare hot water and steam blanching. To study construction and working of distillation system. To study various size reduction equipments. Visit to cold storage. Visit to food processing plant.

DDE – 322 Material Strength & Dairy Machine Design

3 (2+1)

Theory

Strength of Materials: Basic concepts in Statics and Dynamics. Force Systems. Equilibrium condition, friction, Law of friction, Second moments of inertia, Parallel axis theorem. Dynamics: Equation of motion. Translation and rotation of a Rigid body, work and mechanics of materials: Stress-Axial Load classification Strain-Hooke's law, stress-strain diagram, Poisson's Ratio: Shearing Stresses. Torsion, Torsion formula, Angle to Twist of circular members. Power transmission shear force and bending moments, Shear in Beams, Bending Moment in beams. Pure bending of beams, Flexural stress shearing stresses in beams relations between centre, Torsional and flexural loads. *Dairy Machine Design:* Procedures, Specification, strength, design factor, factor of safety selection of factor of safety. Materials and properties. Static strength, ductility, hardness, fatigue, designing for fatigue conditions. Theories of failure, Stresses in elementary machine parts, Design of a drive system. Design of length and thickness of belt. *Bearing:* Journal and Anti-friction bearings. Selection of ball, tapered roller and thrust bearing. Springs, helical and leaf springs. Energy stored in springs. Design and selection of springs.

Practical

Design problems on applications of engineering statics and dynamics. Design problems on applications of work and energy. Design problems on applications of linear and angular momentum. Design problems on stress-strain diagram evaluation of elastic constants. Study on shear force and bending moment diagrams and its applications. Design problems on applications of flexural stresses. Design problems on applications of shearing stresses in beams. Study on system of limits, fits and tolerances and their applications. Design stresses in elementary machine parts. Design features and applications of shafts. Design features and applications of axles. Design features and applications of keys. Design features and applications of couplings. Design problems on various types of power transmission systems. Design features and applications of bearings. Design features and applications of springs. Design problems on agitator/stirrer. Design features of milk silo.

DDE – 323 Dairy Plant Design And Layout

2 (1+1)

Theory

Introduction of Dairy Plant design and layout: Type of dairies, perishable nature of milk, reception flexibility. Classification of dairy plants, Location of plant, location problems, selection of site. Hygienic design considerations for dairy processing plants. *Planning:* Dairy building planning, Process schedule, basis of dairy layout, importance of planning, principles of dairy layout. Space requirements for dairy plants, estimation of service requirements including peak load consideration. *Dairy plant design aspects:* General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design. Arrangement of different sections in dairy, sitting the process sections, utility/service sections, offices and workshop. Arrangement of equipment, milk piping, material handling in dairies, Common problems, office layouts-flexibility.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Development and presentation of layout, model planning, use of planning table in developing plot plan and detailed layout. *Building construction materials*: Floors, general requirement of dairy floor finishes, floors for different section of dairy. Foundations, walls doors and windows. *Other design aspects*: Drains and drain layout for small and large dairies. Ventilation, fly control, mold prevention, illumination in dairy plants. *Computer aided Design*: Introduction to CAD software.

Practical

Building symbols and convention. Symbols for equipments. Study of process schedule. To draw layout of collection/chilling centre. Visit to dairy processing plant for understanding of layout of different sections. To draw layout of small dairy plant. To draw layout of small dairy plant using CAD. To draw layout of medium dairy plant. To draw layout of large dairy plant. To draw layout of cheese plant. To draw layout of ice-cream plant. To draw layout of butter manufacturing unit. To draw layout of ghee plant. To draw layout of composite dairy plant

DDM – 321 Food and Industrial Microbiology

3 (2+1)

Theory

Scope of food microbiology: Basic aspects, history and scope of food microbiology. Intrinsic and extrinsic factors that affect microbial growth in different foods.

Microbial Spoilage of foods: Microbial spoilage of fruits, fruit juices, vegetables, cereals, meat, poultry, sea foods, carbonated soft drinks, canned foods; Sources of contamination; Control of spoilage. *Food preservation*: Principles of food preservation : physical methods viz. low temperature and high temperature preservation (D, Z and F Values); Drying Methods; Chemical preservatives, Natural antimicrobial compounds and bio- preservation; Mode of action of various preservation methods on microbes. *Fermentation processes*: Fermentation processes : Historical development, the range, components and types (i.e. submerged, surface and solid state fermentation); criteria for selection of industrially important microorganisms; preservation and improvement of industrially important micro-organisms using metabolic engineering/genetic engineering; media for industrial process; upstream and downstream processing. *Types of fermenters*: Fermenters: types (batch, fed batch and continuous), functions, design and control; sterilization; growth rate analysis, estimation of biomass; difference in chemostat and turbidostat. *Microbial production of industrial products*: Immobilization of enzymes/cells; Microorganisms and processes involved in the production of single cell protein and industrial alcohol, beer and wine; organic acids (citric and lactic), enzymes (protease, lipase and rennet), vitamin (B₁₂), antibiotics and bacteriocins; and fermented whey beverages.

Practical

Microbiological examination of: 1) fresh and canned fruits, vegetables and juices; 2) flour and bread; and 3) eggs and meat. Isolation of psychophilic, salt and sugar tolerant microorganisms from foods. Isolation of industrially important microorganisms from environment. Determination of Z, D and F values. Production and assaying of microbial enzymes (protease/ lipase). Production of lactic acid from whey. Production of nisin and assaying the antimicrobial activity of the culture. Design and control of a table-top and 10 liter lab fermenter (Demonstration). Production of ethyl alcohol from molasses and whey by yeasts. Production of fermented whey beverages. Educational tour to food processing/ fermentation industries.


REGISTRAR
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Theory

Introduction, definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects. Terminology related to sensory evaluation. Design and requirements of a sensory evaluation laboratory. Basic principles: senses and sensory perception. Physiology of sensory organs. Classification of tastes and odours, threshold value. Factors affecting senses, visual, auditory, tactile and other responses. Fundamental rules for scoring and grading of milk and milk products. Procedure and types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, hedonic scale and descriptive tests. Panel selection, screening and training of judges. Requirements of sensory evaluation, sampling procedures. Factors influencing sensory measurements. Milk: score card and its use. Judging and grading of milk, defects associated with milk. Cream: desirable attributes and defects in cream, Score card for cream, sensory evaluation of different types of cream. Butter: Specific requirements of high grade butter, undesirable attributes of butter, butter score-card, sensory evaluation of butter. Ghee: grades of ghee, special requirements of quality ghee, defects in ghee, sensory evaluation of ghee. Fermented milks: desirable and undesirable characteristics of fermented milks, sensory evaluation of dahi, yoghurt, chakka, srikhand, lassi and other fermented drinks. Frozen dairy products: desirable and undesirable characteristics of frozen dairy products. Sensory evaluation of ice cream, kulfi and milk sherbets. Cheese: sensory Quality attributes of some common cheese varieties and their defects, score card for cheese. Sensory evaluation and grading for cheddar, cottage and other varieties of cheeses. Dried dairy products: desirable and undesirable characteristic of dried milks. Sensory evaluation and grading of dry milk products. Concentrated milks: desirable attributes and defects. Sensory evaluation and grading of evaporated and condensed milk. Heat desiccated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of khoa and khoa based sweets. Acid coagulated Indian milk products: desirable and undesirable characteristics. Sensory evaluation of paneer, chhana and chhana based sweets. Consumer acceptance studies: Objectives, methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and consumers studies, limitations. Interrelationship between sensory properties of dairy products and various instrumental and physico-chemical tests.

Practical

Determination of threshold value for basic tastes. Determination of threshold value for various odours. Selection of sensory evaluation panel. Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests. Sensory evaluation of milk and cream. Sensory evaluation of butter and ghee. Sensory evaluation of condensed and evaporated milk. Sensory evaluation of milk powders. Sensory evaluation of cheese and related products. Sensory evaluation of frozen products. Sensory evaluation of khoa and khoa-based sweets. Sensory evaluation of chhana and chhana based sweets. Sensory evaluation of dahi and fermented dairy products. Preparation of milk and milk products with defects, techniques for simulation. Novel techniques of sensory evaluation.

Theory

Status of food processing industries in India and abroad, magnitude and inter-dependence of dairy and food industry, prospects for future growth in India. Harvesting, transportation and storage of fruits and vegetables. *Post harvest processing of fruits and vegetables*: Peeling, sizing, blanching, *Canning of fruits and vegetables*, *Drying and freezing of fruits and vegetables*. *Juice processing*: General steps in juice processing, role of enzymes in fruit.

Juice extraction, equipments and methods of fruit juice extraction, preservation of fruit juices, fruit juice clarification, concentration of fruit juices, fruit juice powders. Fruit juice processing; Orange and tangerine, Lemon and lime juice, Apple juice, Grape juice, Nectars, pulpy juices, tropical blends, Vegetable juices. *Manufacture of Jam, Jelly and Marmalade*: Role played by pectin, sugar and acid in jellied fruit products. Fruits and vegetable preserves, Glazed, Crystallized fruits. Tomato based products: Juice, puree, paste, sauce, ketchup. Pickles: Principle of pickling, technology of pickles. *Beverages*: Classification, scope, carbonated non-alcoholic beverages and their manufacture. Fruit beverages and drinks, additives for fruit based beverages. *Coffee*: Production practices, structure of coffee/cherry, Coffee processing including roasting, grinding, brewing extraction, dehydration, aromatization, instant coffee. *Tea*: Tea leaf processing, green, red, yellow, instant tea. *Technology of confectionery foods*: Candies, Chewing gums and bubble gums, Toffees, Caramels, Standards of confectionery products. *Chocolate products*: Cocoa bean processing, chocolate liquor, Standards of confectionery products. *Functional foods*: Introduction, Phytochemicals, Milk ingredients as nutraceuticals, fiber-rich food products etc.

Practical

Manufacture of toffees and caramels, Testing the efficacy of blanching process, Drying of fruits and vegetables, Preparation of fruit based drinks and beverages: Ready-to-serve drink, Nectar, Squash, Whey-fruit based beverages. Manufacture of fruit jam. Manufacture of fruit jelly. Manufacture of chocolate confections. Manufacture of tomato ketchup/tomato sauce. Manufacture of soups. Manufacture of fruit preserve. Manufacture of candied fruits. Manufacture of fruit bar; Manufacture of pickles

DDC – 321 Food Chemistry

3 (2+1)

Theory

Water: Water binding and chemical reaction mediated by water. *Food proteins*: Classification and physico-chemical and structural properties. *Lipids*: Definition, classification of lipids, Unsaponifiable matter contents in various fats and oils, classification and chemical composition. *Carbohydrates*: Classification of carbohydrates, polysaccharides, viz. linear, branched and modified. Properties and utilization of common polysaccharides, viz. cellulose, glycogen, hemicelluloses, pectin. *Food Enzymes*: Hydrolases and lipases, utilization in food chemistry. *Minerals in foods*: Main elements, trace elements in eggs, cereals and cereal products, vegetables and fruits. *Aroma compounds in foods*: Threshold value, off-flavours. *Food additives*: Vitamins and Amino acids, Minerals, Aroma Substances/flavour enhancers- Monosodium glutamate, 5-nucleotides sugar substitutes, sorbitol sweeteners- saccharin, and cyclamate, *Food colours and food preservatives*. *Antinutritional factors and Food contaminants*: Toxic trace elements, radio nucleotides. Cereal and cereal products: Individual constituents like proteins, lipids, carbohydrates and vitamins in cereals flour and their relationship in dough making, influence of additives /minor ingredients on *baking properties*: physico-chemical changes during baking. *Legumes*: Classification, general composition and physico-chemical properties. *Vegetables and Fruits*: Classification, general composition, chemical changes during ripening and storage. *Jams, Jellies and Pickles*: Classification, composition and preservation. Preservation of foods, general principles of food preservation.

Practical

Determination of the order of hydrolysis of an ester/carbohydrate and measurement of activation energy; determination of the progress curve obtained during the hydrolysis of P-nitrophenyl phosphate by milk alkaline phosphatase; determination of the Michaelis constant for the digestion of casein by trypsin; Measurement of pH and buffering capacity of different

types of milk; To study the gel formation and gel stability of milk proteins; preparation of a Tris/phosphate/citrate buffer of a given molarity/ionic strength and pH; determination of pH of the buffer; measuring the stability of an oil-in-water emulsion stabilised by milk proteins; foaming capacity and foam stability of caseins/whey proteins; drawing of an adsorption isotherm of water on casein

DDE – 324 Energy Conservation and Management

2 (1+1)

Theory

Introduction: Potential and opportunities of industrial energy conservation in dairy and food processing. Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE). Electricity Act 2003, Integrated energy policy. Energy management & audit: Definition, energy audit, need, types of energy audit. Energy audit approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution. Energy balances and computation of efficiencies of equipment. Role of Energy inspectors and Auditors in energy management. Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques. Quality of power, Power factor and its improvement. Transformers, losses in transformers. Energy savings in transformers. Electric motor-selection and application, Energy efficient motors. Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy. Bureau of Energy Efficiency (BEE): Power saving guide with "Star Ratings" of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters. Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls.

Energy efficiency and conservation in utilities:

High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities. Energy conservation in steam distribution systems, efficient piping layouts, protective & insulation coverings in utility pipes. Steam conservation opportunities. Upkeep and maintenance of steam auxiliaries and fittings. Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors. Maintenance and upkeep of Vacuum lines and Compressed air pipe lines. Conservation and reuse of water, water auditing. Energy conservation opportunities in Wastewater treatment.

Processing equipments: Improving efficiency and energy conservation opportunities in few important food processing operations like Thermal processes, Evaporation, Drying & Freezing. Role of steam traps in energy saving. Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator.

Energy conservation in buildings: Concepts of "Green Buildings". Waste-heat recovery and thermal energy storage in food processing facilities. Condensate recovery and reuse. Application of recuperator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc. Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets, Fuel and Oil conservation; important regular maintenance aspects. Carbon credits and carbon trade: Concepts of CDM, economic and societal benefits. Cleaner energy sources: Introduction to Solar, and Bio-mass Energy; Solar thermal and photo-voltaic energy options for food processing industries. Role of automation in conservation of energy in dairy and food processing: Incorporation of enhanced PLC based computer controls and SCADA.


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Practicals

Study of Energy Conservation Act 2001. Study of schemes of BEE. Study of concepts of Energy Balance in Unit Operations and System boundaries. Solving examples on energy balances. Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve. Determination of Load factor of an installation. Study of use of power factor meter and determination of true power and wattless power using pf meters, Watt meter, Ammeter and Volt meter. Study of performances of a general type of induction motor and an energy efficient induction motor. Study of use of VSD. Study of various types of electrical appliances classified under different BEE Star Ratings. Drawing Energy Balance on a boiler: Collection of data, Analysis of results and determination of efficiency. Exercise on energy audit of Students Experimental Dairy Plant (SEDP-DSc College, Hebbal).

Student READY Rural Dairy Work Experience Program*

20

Student READY Rural Dairy Work Experience Program-I (Summer Break after II semester) of 5 weeks with credit load of 0+5 credit hours to provide exposure to the students to the areas on Milk Production & Procurement to be taken up in State Dairy Federations/Dairy Development Departments/Private Dairies/Animal Husbandry Department/Cattle farm/Progressive dairy farmers.

Student READY Rural Dairy Work Experience Program-II (Summer Break after IV semester) of 5 weeks with credit load of 0+5 credit hours for exposure on Preliminary Dairy Operations to be taken up in Experimental Dairy/Referral lab/Dairy Plants / Exposure to Product manufacturing operations in Dairy & Food Industry.

Semester-VII

Student READY In-Plant Training in Seventh Semester of 24 weeks with credit load of 0+20 credit hours. Plant visits and involvement in processing and manufacturing of value added products in each Dairy Technology course to have Industrial exposure in specialized products like Market Milk, Ice Cream, Milk Powders, Cheese, By-products etc. should be made compulsory

Note - * Course number for Student Ready Programme is given in concerned semesters.

DDT – 421 Dairy Plant Management

2 (1+1)

Theory

Production Management: Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement motion and time study. *Efficiency of plant operation:* product accounting, setting up norms for operational and processing losses for quantity, fat and SNF, monitoring efficiency. *Plant Operations:* Energy conservation and Auditing, Product and process control, Control charts, Process Sigma, Efficiency factors losses, Financial and Managerial efficiency. Provision for Industrial Legislation in India, particularly in dairy industry, Factory Act & Regulations. *Human Resource Management:* Personnel Management, Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions. *Safety hazards:* hazards prevention, security for plant machinery and the employees, Plant Maintenance. *Prevention & Break-down maintenance:* Spare parts inventory, tools & lubricants, etc. *Food hygiene:* personnel hygiene, plant hygiene, water quality, etc.


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Practical

Flow process charts of different milk products. Identification of steps of material losses on dairy plants. Identification of hazardous processes and equipments, safety and precautions. Identification and uses of common lubricants.

DDT – 422 Waste Disposal and Pollution Abatement

2 (1+1)

Theory

Wastes discharged from dairy plants: An overview. Wastewater discharged from a) Milk reception dock b) Liquid milk processing section, c) Butter and ghee manufacturing, d) Ice-cream and condensed milk manufacturing, e) Milk powder manufacturing, f) Cheese and paneer manufacturing. Packaging wastes. *Environmental issues in effluent discharge:* a) Effects on waterways, b) Effects on land c) Effects on the atmosphere d) Solid waste. *Waste treatment process in a dairy processing plant:* Wastewater treatment options for A Dairy Processing Plant. Calculation of wastes discharged and the economics thereof.

Practical

Waste Utilization processes. Various treatments in waste disposal. Analysis of cleaning agents and sanitizers. Reports and records maintenance of dairy plant. Operational precautions. CIP cleaning.

DDT – 423 Food Technology-II

3 (2+1)

Theory

Cereal grains, legumes and oilseeds: Structure and composition of cereals, legumes and oilseeds, Milling of paddy, quality factors of rice grains, processing of rice bran oil, Instant rice, quick cooking rice, canned rice, Milling technology of wheat, Criteria of wheat flour quality, improvers for wheat flour, Types of wheat flour, Milling technology of maize, wet milling of corn, Milling technology of barley, malting of barley and its utilization in manufacture of value added food products including malted milk foods, Dehulling and processing technology of important pulses, Dehulling and extraction of oil in major oilseed crops like soy bean, mustard, sunflower, ground nut, *Vegetable protein concentrates/isolates*, Utilization of oil cake in food formulation. *Bakery and Snack technology:* Technology of bread, biscuits, crackers and cakes, Technology of manufacturing process of Pasta foods- Macaroni, Noodles and Spaghetti, Technology of breakfast cereals: corn flakes, puffed, extruded snacks, *Potato chips*. *Meat, fish and egg technology:* Development of meat, poultry, egg and fish industry in India, Pre-slaughter care, handling and ante-mortem inspection of animal, Stunning and slaughtering techniques, Postmortem inspection, rigor mortis and conversion of muscle to meat *Slaughterhouse sanitation, meat hygiene and zoonotic diseases*, Processing of poultry meat, Egg and egg products – quality assessment of egg, Types, handling, transportation and marketing of fish, Preservation of fish., Manufacturing process of dehydrated fish and fish pickles. *Cleaning and sanitation*, Waste management of food processing plants.

Practical

Manufacture of barley malt. Determination of cooking quality of rice. Manufacture of bread and bun. Manufacture of biscuits. Preparation of noodles. Preparation of cake. Manufacture of potato chips. Preparation of malt based food products. Manufacture of malted milk foods, Manufacture of soy beverage and tofu, Preparation of salami. Preparation of chicken soup. Manufacture of chicken pickle.

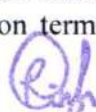

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DBM – 421 Entrepreneurship Development and Industrial Consultancy**2 (2+0)****Theory**

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business/entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs)/SSIs. Export and Import. Policies relevant to dairy sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of dairy inputs industry. Characteristics of Indian dairy processing and export industry. Social Responsibility of Business. *Industrial Consultancy:* Dairy plant management system- milk procurement from the rural milk producer, milk processing and products manufacturing. Pricing and marketing of milk and milk products. Survey on milk production potential and marketed surplus of milk for setting up of milk plants. Recruitment and training of manpower, Estimation of costs of product manufacture and energy utilization in food processing plants. Sources of finance for setting up of dairy farms and processing plants/ units. Guidelines for obtaining ISO/HACCP certification for dairy plants. Assessment of entrepreneurial skills and characteristics for successful entrepreneur. Consumer opinion surveys. Pricing of milk and milk products. Preparation of feasibility reports for setting of dairy farms, composite milk plants, collection centers, chilling units and processing units.

DBM – 422 Financial Management and Cost Accounting**3 (2+1)****Theory**

Introduction: Definition, scope and objectives of financial management. Different Systems of Accounting: Financial Accounting, Cost accounting, Management Accounting. Doubles entry system of Book-Keeping. Preparation of Accounting Records: Journal, Purchases and Sales Book and Posting in Ledger, Cash Book. Preparation of Final Accounts and adjustments at the end of trading period. Preparation of Trial Balance Banking Transactions and Bank reconciliation statements. Statements of Financial Information: Accounting system: A source of financial statements, Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making. *Financial Analysis:* Nature and uses of financial analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Utility of Ratio analysis. Cost Volume – Profit analysis and operating leverage, Break-even analysis, Profit analysis and operating analysis, Utility of CVP analysis. Capital Structure: C.S Planning, risk return trade off, financial leverage. Cost of capital: Management of cost of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital. *Investment decision:* Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting: Complex Investment Decisions: Investment timing & duration Investment decisions under inflation, Investment decisions under capital rationing. *Project Report:* Feasibility Report Valuation. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method. Introduction, Definition, Objectives, Common terms.


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Costing: Essentials of sound costing system. Different methods of costing, elements of cost: Labour- recording of time, idle time, methods of remunerating labour, Premium & Bonus Plans, Materials, Overheads. **Cost classification:** Direct and Indirect expenses, fixed and variable costs. Various methods of apportioning indirect expenses. Inventory Management: Planning, control and costing. Stores & storekeeping, scope & importance, purchase procedure, types of purchase, location of stores & materials, procedure for the movement of stores, different methods of pricing materials, store records. Cost Sheets-Different methods, Statement of cost and statement of profit estimates, Tenders or Quotations. Contract or Terminal costing. Process Costing: Process losses and inter-process profits, joint products and by products costing. Ascertainment of cost of milk production. Preparation of Cost Account Information for managerial decisions.

Practical

Preparation of Profit and Loss account. Preparation of Balance Sheet. Preparation of Cash flow statements. Preparation of Funds flow statements. Problems on Ratio analysis. Problems on Break-Even Analysis. Problems on Profit analysis. Problems on Operating Analysis. Problems on Financial leverage. Problems on Cost of Capital. Problems on Investment decisions. Problems on Capital budgeting

DBM – 423 Industrial Statistics

2 (1+1)

Theory

Definition and scope; sources of animal husbandry and dairy statistics. Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis. Elementary notions of probability, Laws of addition and multiplication probability. Theoretical frequency distributions: Binomial, Poisson and Normal distribution and their application. Concepts of sampling methods, Introduction to testing of hypotheses, Tests of significance-Z, t, F tests, and their application in the field of dairying. Analysis of variance- One-Way and two-way classification. Simple correlation coefficient and its test of significance, Linear regression, rank correlation. Basic concepts of statistical quality control, Control charts for variables and attributes, Fundamental concepts of acceptance sampling plan.

Practical

Measures of central tendency, Measures of dispersion, Moments, Skewness and Kurtosis Fitting of binomial and Poisson distribution. Application of 'Z' test for one and two sample problems. Application of 't' test for one and two sample problems. Application of Chi-square test and F-test. Correlation and regression. Rank correlation coefficient. Control chart for variables & attributes


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

College of Technology

SARDAR VALLABHBHAI PATEL UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY, MEERUT- 250 110

B.Tech Agri. Engg.

Duration

Four academic years (8 semesters)

Minimum Eligibility, Curriculum

<http://www.svpuat.ac.in/>

Structure & other details:

PROGRAMME OUTCOMES (POs)

1. To provide students with a comprehensive knowledge in mathematical, scientific and agricultural engineering fundamentals to solve the engineering and farmers related problems and also to pursue higher studies.
2. To provide students experience for planning as well as conducting experiments/ projects in modern engineering laboratories including farmer's friendly technologies and computer based simulation experiments, integrating the significance of experimental data and properly reporting the results.
3. To develop ability of the students to analyze data and technical concepts for application to product design and/or solving real field problems.
4. To make the students familiar with latest and contemporary professional knowledge in the field of agricultural engineering including managerial skills and ethics required for emerging technologies, global economy and also to foster other skills required for grooming them into good professionals.
5. To prepare the students for their successful career in industry/scientific institutions/ technology transfer organizations and also to meet the challenges at national and international levels.
6. Developing Critical and Analytical Thinking Abilities: Critical thinking in academics, presentations, research and professional alliances relies heavily on one's ability to be creative.
7. Developing Entrepreneurship Acumen: Helps to prepare students for research/ managerial roles and as entrepreneurs.
8. Developing skills to solve real-world Engineering problems: Equips students to demonstrate the capabilities required to apply cross-functional knowledge and technologies in solving real-world engineering problems.
9. Appropriate techniques: Enables students to demonstrate use of appropriate techniques to effectively manage academic and research challenges.
10. Practical exposure: Providing an opportunity for the students to gain practical exposure towards the workplace of engineering laboratory and make them industry ready.
11. Decision Making: Equip students with techniques of analyzing and interpretation of the research data which is used in Decision Making.
12. To develop students with the ability to analyze various functional issues affecting the engineering. Organization and acquiring conceptual clarity of various functional areas of engineering field.
13. The students understand the ethical challenges and choices in a engineering unit setting and develop ability to evolve strategies for research/ organizational benefits.
14. To inculcate in students the ability to gain multidisciplinary knowledge through seminar reports, case study analysis, Research projects and industrial training and Organizational visits.
15. Demonstrate ability to work in Groups and acquire leadership quality required in their career.


REGISTRAR
S.V.S.P.U.A.&T., MEERUT

COURSE OUTCOMES (COT)

Subject	Subject Code	Course Outcomes
Engineering Mathematics-I	TBS- 111	The objective of this course is to familiarize agricultural engineers with techniques in Statistics, Differentiation with its applications and Matrices. It aims to equip the students with standard concepts and tools from intermediate to advanced level that will enable them to tackle the more advanced level of mathematics and applications that they would find useful in their disciplines.
Engineering Physics	TBS -112	1.To explain the distribution of energy in black body radiation and to understand the difference in particle and wave nature with explanation of Compton effect and Schrodinger wave equation. 2.To understand the behavior of waves through various examples/applications of interference and diffraction phenomenon and the concept of grating and resolving power. 3.To know the functioning of optical fiber and its properties and applications. To understand the concept, properties and applications of Laser. 4.To know the properties and applications of superconducting materials and nano materials.
Engineering Chemistry	TBS- 113	1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, nano materials, Graphite & fullerenes and Green Chemistry. 2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc..
Principles of Soil Science	TAG -111	1. Understanding the concept of soil and soil profile. 2. Understanding the concept of physico-chemical properties of soil. 3. Analyzing the effect of pH on soil nutrient availability. 4. Identifying the macro and microorganisms and their effect on soil. 5. Evaluating the physical and chemical properties of soil.
Surveying and Leveling	CED- 111	1. Describe the function of surveying and work with survey instruments, take observations, and prepare plan, profile, and cross-section and perform calculations. 2. Calculate, design and layout horizontal and vertical curves. 3. Operate a total station and GPS to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system.
Engineering Mechanics	CED- 112	After completing this course, the students should be able to understand the various effect of force and motion on the engineering design structures.
Engineering Drawing	MED- 111	1.Use scales and draw projections of objects. 2. Explain views of solids and their sectional surfaces. 3. Analyze and draw isometric projections of objects. 4. Demonstrate orthographic representation of perspective views using modern tools. 5. Apply AutoCAD software for creation of engineering drawing and models
Heat and Mass Transfer	MED- 112	Upon completion of the course, the student will be able to: 1: Understand the basic modes of heat and mass transfer. 2: Apply principles of heat and mass transfer to predict transfer coefficients 3: Analyze working of various heat transfer equipment 4: Design heat and mass transfer equipment.
Engineering Mathematics-II	TBS-121	1. Understand and apply the tools of differentiation of functions of complex variables that are used in various techniques dealing with engineering problems. 2. To deal with vector calculus that is required to graduate engineers. 3. Understand and apply the effective mathematical tools for the solution of differential equations of model physical processes 4. Apply the tool of Fourier series and multivariable partial Differential equations for learning advanced Engineering Mathematics 5. Apply the application of


 REGISTRAR
 B.T.P.U.A.&T., MEERUT

		partial Differential equations in heat and wave equations
Environmental Science and Disaster Management	TAG-122	Upon completion of this course, students will acquire knowledge about 1. Understand the natural environment and its relationships with human activities. 2. Characterize and analyze human impacts on the environment. 3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. 4. Capacity to integrate knowledge and to analyses, evaluate and manage the different public health aspects of disaster events at a local a and global levels. 4. Capacity to obtain, analyses, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.
Entrepreneurship Development and Business Management	TAG-121	Clarity about the business idea. Market potential for the product or service. Skills in preparing business plan. Conducting project feasibility study.
Fluid Mechanics and Open Channel Hydraulics	CED-121	1. Understand the broad principles of fluid statics, kinematics and dynamics 2. Understand definitions of the basic terms used in fluid mechanics 3. Understand classifications of fluid flow 4. Apply the continuity, momentum and energy principles 5. Apply dimensional analysis
Strength of Materials	CED-122	1. Describe the concepts and principles of stresses and strains 2. Analyze solid mechanics problems using classical methods and energy methods 3. Analyze structural members subjected to combined stresses 4. Calculate the deflections at any point on a beam subjected to a combination of loads 5. Understand the behavior of columns, springs and cylinders against loads.
Workshop Technology and Practices	MED-121	1. Use various engineering materials, tools, machines and measuring equipments. 2. Perform machine operations in lathe and CNC machine. 3. Perform manufacturing operations on components in fitting and carpentry shop. 4. Perform operations in welding, moulding, casting and gas cutting. 5. Fabricate a job by 3D printing manufacturing technique
Theory of Machines	MED-122	1. To identify and enumerate different link based mechanisms with basic understanding of motion 2. To understand and illustrate various power transmission mechanisms using suitable methods 3. To understand and illustrate various power transmission mechanisms using suitable methods 4. To design and evaluate the performance of different cams and followers.
Web Designing and Internet Applications	CSE-121	1. Understand principle of Web page design and about types of websites 2. Visualize and Recognize the basic concept of HTML and application in web designing. 3. Recognize and apply the elements of Creating Style Sheet (CSS). 4. Understand the basic concept of Java Script and its application. 5. Introduce basics concept of Web Hosting and apply the concept of SEO
Principles of Horticultural Crops and Plant Protection	TAG-211	1. Understanding the concepts of horticulture including the management of water, weed, fertility, and market chain. 2 Explaining the vegetable gardens, orchards and their management practices. 3 Analyzing the weed management, fertility management in production of Horticultural crops.
Principles of Agronomy	TAG-212	1. Understanding the scope and practices of Agronomy. 2. Demonstrating the methods of irrigation, crop rotation and weeding in different crops. 3. Applying the method of seed sowing, tillage, weeding, irrigation, and crop management in problematic areas. 4. Analyzing the effect of weed-crop competition on agricultural productivity.
Communication Skills and Personality Development	TBS-211	1. Write professionally in simple and correct English. 2. Demonstrate active listening with comprehension, and the ability to write clear and well structured emails and proposals. 3. Learn the use of correct body language and tone of voice to enhance communication.


 REGISTRAR
 S.V.S.P.U.A.&T., MEERUT

		<p>4. Acquire the skills necessary to communicate effectively and deliver presentations with clarity and impact</p> <p>5. Understand and apply some important aspects of core skills, like Leadership and stress management.</p>
Engineering Mathematics-III	TBS- 212	<p>1. Remember the concept of Laplace transform and apply in solving real life problems. 2. Understand the concept of Fourier and Z – transform to evaluate engineering problems 3. Remember the concept of Formal Logic, Group and Rings to evaluate real life problems 4. Apply the concept of Set, Relation, function and Counting Techniques 5. Apply the concept of Lattices and Boolean Algebra to create Logic Gates and Circuits, Truth Table, Boolean Functions, Karnaugh Map</p>
Soil Mechanics	CED-211	<p>1. Classify the soil and determine its Index properties. 2. Evaluate permeability and seepage properties of soil. 3. Interpret the compaction and consolidation characteristics & effective stress concept of soil. 4. Determine the vertical and shear stress under different loading conditions and explain the phenomenon of soil liquefaction. 5. Interpret the earth pressure and related slope failures.</p>
Design of Structures	CED-212	<p>1. Explain type of structures and method for their analysis. 2. Analyze different types of trusses for member forces. 3. Compute slope and deflection in determinate structures using different methods. 4. Apply the concept of influence lines and moving loads to compute bending moment and shear force at different sections. 5. Analyze determinate arches for different loading conditions.</p>
Machine Design	MED-211	<p>1. To identify and enumerate different link based mechanisms with basic understanding of motion 2. To understand and illustrate various power transmission mechanisms using suitable methods 3. To understand and illustrate various power transmission mechanisms using suitable methods.</p>
Thermodynamics, Refrigeration and Air Conditioning	MED-212	<p>1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system. 2. Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems 3. Present the properties, applications and environmental issues of different refrigerants. 4. Calculate cooling load for air conditioning systems used for various 5. Operate and analyze the refrigeration and air conditioning systems.</p>
Electrical Machines and Power Utilization	ECE-211	<p>1. Analyze the various principles & concepts involved in Electromechanical Energy conversion. 2. Demonstrate the constructional details of DC machines as well as transformers, and principle of operation of brushless DC motor, Stepper and DC Servo motors. 3. Evaluate the performance and characteristics of DC Machine as motor and as well as generator. 4. Evaluate the performance of transformers, individually and in parallel operation. 5. Demonstrate and perform various connections of three phase transformers.</p>
Building Construction and Cost Estimation	CED-221	<p>1. Identify various building materials and to understand their basic properties. 2. Understand the use of non-conventional civil engineering materials. 3. Study suitable type of flooring and roofing in the construction process. 4. Characterize the concept of plastering, pointing and various other building services. 5. Exemplify the various fire protection, sound and thermal insulation techniques, maintenance and repair of buildings.</p>
Auto CAD Applications	MED-221	<p>Upon completion of the course, the student will: Become familiar with the Auto CAD user interface. Understand the fundamental concepts and features of Auto CAD. Use the precision drafting tools in Auto CAD to develop accurate technical drawings.</p>


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Applied Electronics and Instrumentation	ECE-221	1. Recognize the evolution and history of units and standards in Measurements. 2. Identify the various parameters that are measurable in electronic instrumentation. 3. Employ appropriate instruments to measure given sets of parameters. 4. Practice the construction of testing and measuring set up for electronic systems. 5. To have a deep understanding about instrumentation concepts which can be applied to Control systems. Relate the usage of various instrumentation standards.
Tractor and Automotive Engines	FME- 221	1. Understand the working and operating principles of different systems of I.C. engines. 2. Identify the different components of I.C. engines. 3. Relate and analyze the working of different systems of engine. 4. Comprehend the terminologies and efficiency of I.C. engines with numerical specific to tractor engine.
Engineering Properties of Agricultural Produce	PFE- 221	1. Understand the basics of engineering properties of foods. 2. Analyse the design concepts for different food instruments / equipment 3. Implement the engineering properties in processing machines.
Watershed Hydrology	SWE- 221	1. Understand the basic concept of hydrological cycle and its various phases. 2. Understand the concept of runoff and apply the knowledge to construct the hydrograph. 3. Apply the various methods to assess the flood. 4. Assess the quality of various forms of water and their aquifer properties. 5. Understand the well hydraulics and apply ground water modelling techniques.
Irrigation Engineering	IDE- 221	1. Compute the discharge at the head of distributaries required in its command, capacity of a reservoir, evapo-transpiration, irrigation requirement of crop, water requirement of crop, irrigation interval, irrigation period and irrigation efficiencies by applying the knowledge of crop period, crop area, duty, delta and irrigation intensity. 2. Analyse the data related to irrigation water measurement through irrigation water measuring structures to estimate the discharge of water measuring structures such as weirs, flumes and notches. 3. Design the field channels, Regime Channels, border irrigation, fundamentals of check basin and furrow irrigation. 4. Solve the real world problem of land grading by calculating the formation levels of grid points of a particular area where land grading operation is to be done
Sprinkler and Micro Irrigation Systems	IDE-222	1. Apply: basic understanding of Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems. Micro Irrigation Systems: chemical treatment, Fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection. 2. Compute: uniformity coefficient and pattern efficiency, wetting patterns, irrigation requirement, emitter selection. 3. Analyse: performance evaluation of sprinkler and drip irrigation systems: necessary steps for proper operation of a drip irrigation system. 4. Design: sprinkler and drip irrigation system: Main, Sub-main, Lateral
Fundamentals of Renewable Energy Sources	REE-221	1. Understand the fundamentals of various Renewable Energy Sources and their applications 2. Analyze the different approaches of solar energy collection, storage and power generation. 3. Compute the power generation from solar energy and wind power systems 4. Explain the construction and working principle of different Bio energy conversion systems
Skill Development Training-I summer Break June-July after 4 th		Effectively communicate through verbal/oral communication and improve the listening 1. Skills Write precise briefs or reports and technical documents 2. Actively participate in group discussion / meetings / interviews and prepare 3. Deliver presentations . Become more effective individual through goal/target setting, self motivation 4. Practicing creative thinking. Function

Semester (Student READY)		effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality
Tractor Systems and Controls	FME- 312	1. Understand construction & working of different systems of tractor clutch transmission & power flow in a tractor. 2. Analyze problems related clutch, gear box, traction, traction mechanics. 3. Relate human factors that are considered for the design of controls on tractors. 4. Explain construction, operation and working principles of different systems of tractor in general.
Farm Machinery and Equipment-I	FME- 311	1. Apply the knowledge of various farm machines used for farming operations and land development works including their material of constructions 2. Calculate the forces acting on the tillage machine components, draft requirement of the various machines and economics of operating these machines 3. Compute the size of tractor required to operate the machines 4. Select the types of machines required for specific field operations and material for their construction
Agricultural Structures and Environmental Control	PFE- 311	1. To know basics of design of various agricultural structures for animals and human beings. 2. Analyze impact of environmental, ecological and sanitation on livestock and human beings. 3. Compute cost of agricultural structures related to animals and human beings. 4. Apply real world problems of planning, design and execution of agricultural structures related to animals and human beings
Post Harvest Engineering of Cereals, Pulses and Oil Seeds	PFE- 312	1. To impart knowledge on various process technologies for cereals, pulses, oilseeds and their handling and conveying equipment 2. To understand the working principles and selection procedure of different machineries used for processing of cereals, pulses and oilseeds 3. To compute different unit operations in processing, storage and value addition of cereals, pulses and oilseeds 4. To analyze the different uses of byproducts obtained from cereals, pulses and oilseed
Soil and Water Conservation Engineering	SWE- 311	1. Understand the importance of soil & water conservation (SWC) measures for the control of soil erosion and thereby enhancing agricultural productivity 2. Compute various design components of terraces, bunds etc. 3. Select appropriate soil and water conservation measures at a location 4. Apply the knowledge on engineering for design of SWC projects in watersheds
Watershed Planning and Management	SWE- 312	1. Understand the concept of watershed as a unit of planning and development of agriculture on a watershed scale to enhance agricultural productivity 2. Compute various parameters of hydrologic and geomorphologic characteristics of watershed 3. Formulate the appropriate watershed management plan for implementation 4. Apply the engineering knowledge and skill for designing various SWC projects in watersheds
Drainage Engineering	IDE- 311	1. Apply: basic understanding of impact of Water logging objectives of drainage, familiarization with drainage problems of India and state; sub-surface drainage: purpose and benefits, 2. Compute: different drainage design parameters-hydraulic conductivity, drainable porosity, water table observation wells and piezometers. 3. Analyse Hooghoudt, Ernst drain spacing equations drainage materials, drainage pipes, drain envelope layout, construction & installation of drains; drainage structures; vertical drainage; bio-drainage; mole drains reclamation of saline & alkaline soils. Cost analysis of surface & sub-surface systems 4. Design: surface and subsurface drainage systems as well as gravel envelop for different soil and water conditions and conjunctive use of fresh and saline water
Renewable Power Sources	REE- 311	1. Understand the working and operating principles of different Renewable Energy Sources. 2. Explain the construction, operation and working principle

		of biomass/MSW based power generation systems. 3. Design the power generation systems from solar energy, wind energy and small hydropower. 4. Analyze the working of different alternative energy sources
Skill Development Training-I (Student READY) Registration only	AGE-311	Effectively communicate through verbal/oral communication and improve the listening 1. skills Write precise briefs or reports and technical documents 2. Actively participate in group discussion / meetings / interviews and prepare 3. & deliver presentations . Become more effective individual through goal/target setting, self motivation and 4. practicing creative thinking. Function effectively in multi-disciplinary and heterogeneous teams through the knowledge 5. of team work, Inter-personal relationships, conflict management and leadership quality
Computer Programming and Data Structures	CSE-321	1. Perform operations on various discrete structures such as sets, functions, relations, and sequences. 2. Ability to solve problems using Counting techniques, Permutation and Combination, Recursion and generating functions. 2. Apply algorithms and use of graphs and trees as tools to visualize and simplify Problems.
Farm Machinery and Equipment-II	FME-321	1. Understand the principles & types of cutting mechanisms. Construction & adjustments of shear and Impact-type cutting mechanisms. 2. Crop harvesting machinery: Mower, Reaper, windrower, reaper binder & forage harvester. Forage chopping & handling equipment. 3. Apply threshing mechanics & various types of threshers. Straw combines & grain combines, Maize harvesting & shelling equipment, Root crop harvesting equipment - potato, Groundnut etc. 4. Understand Cotton picking & Sugarcane harvesting equipment. Principles of fruit harvesting tools & machines.
Dairy and Food Engineering	PFE-322	1. Apply the knowledge of different unit operations in dairy industries 2. Analyses the dairy plant design problems 3. Compute the problems based on different unit operations. 4. Understand the change in product behavior during different unit operations
Post Harvest Engineering of Horticultural Crops	PFE-321	Use the different types of sorting, grading, peeling, slicing, blanching and other equipment for processing of fruits and vegetables. 1. Identify the suitable equipment, materials, and methods for storage, processing, packaging, and value addition of fruits and vegetables. 2. Develop at least types of value-added products from fruits and vegetables. 3. Understand the technical and management aspects of the operation of fruits and vegetable processing industries.
Water Harvesting and Soil Conservation Structures	SWE-321	1. Understand the procedures/steps for designing various water harvesting and soil conservation structures/measures 2. Design various components of drop, inlet spillways, farm pond, earth embankments etc. 3. Select appropriate water harvesting and soil conservation structures at a location. 4. Apply the knowledge on engineering for design of water harvesting and soil conservation structures in watersheds
Groundwater, Wells and Pumps	IDE- 321	1. Study of the Occurrence and movement of ground water and their classification; water lifting devices and their classification. 2. Apply the knowledge of ground water movement and pumps in computation of aquifer parameters and pumping, parameters, respectively. 3. Analyze well test data for determination of aquifer parameters; and pumping data for Efficiencies, performance, power requirement of different types of pumps. 4. Analyze well test data for determination of aquifer parameters; and pumping data for Efficiencies, performance, power requirement of different types of pumps. 5. Design of wells (open and tube well); different types of pumps (radial pump impeller, volute and diffuser casings)


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Tractor and Farm Machinery Operation and Maintenance	FME-322	Students will be able to identify different systems of tractor and know about their functioning. 1. Students will be able attach various agricultural machinery with the tractor and can do the adjustments required for operation. 2. Students will be able to do periodic maintenance of various components of tractor and machinery. 3. Student will be able to learn how to replace the agricultural machinery components like furrow opener, plough bottom and rotavator blade
Bio-energy Systems: Design and Applications	REE-321	1. Apply the knowledge of various design perspectives in construction and working of different bio energy systems and their applications. 2. To study biomass production techniques. 3. Analyze the working of different power generation system. 4. Understand the biodiesel and bio-hydrogen production techniques and Assessment of environmental aspect of bio energy
Skill Development Training-II (Student READY) Registration only	AGE-411	Effectively communicate through verbal/oral communication and improve the listening 1. skills Write precise briefs or reports and technical documents 2. Actively participate in group discussion / meetings / interviews and prepare 3. & deliver presentations . Become more effective individual through goal/target setting, self motivation and 4. practicing creative thinking. Function effectively in multi-disciplinary and heterogeneous teams through the knowledge 5. of team work, Inter-personal relationships, conflict management and leadership quality
10- weeks Industrial Attachment /Internship (Student READY)	AGE-412	Understand the Organizational Structure of a company. Develop work habits and attitudes necessary for job success (technical competence, professional attitude, organization skills etc.) Develop written communication and technical report writing skills.
10- weeks Experiential Learning On campus (Student READY)	AGE-413	Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative and constructing meaning. Learners are engaged intellectually, emotionally, socially, soulfully and/or physically.
Educational Tour (Registration only)	AGE-414	Enhances knowledge and understanding. ... Promotes teamwork and social skills. ... Encourages independent learning. ... Promotes creativity and critical thinking. ... Provides a break from the monotony of classroom learning. ... Exposure to new cultures and environments.
Remote sensing & GIS applications (Elective course)	SWE-424	1. Understand the basic concepts of RS, GIS & Photogrammetry. 2. Acquaint with components & scanning techniques of RS & GIS. 3. Analyse digital images & classifications using various principles. 4. Apply the knowledge of RS & GIS techniques for natural resource management
Farm Machinery Design & Production (Elective course)	FME-423	1. To identify the need of timely harvesting of crops in India. Also equip the students with technical knowledge and skills required for the operation, maintenance and evaluation of harvesting, threshing and land preparation (heavy) machinery needed for agricultural farms. 2. To abreast the students with mathematical, experimental and computational skills for solving different field problems. 3. To develop skills in the students required to develop and modification of indigenous harvesting machines/methods as per the need of the area and farmers 4. give a brief introductory idea of importance of testing of agricultural machines and tractor


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Management of Canal Irrigation Systems (Elective course)	IDE-421	1. Have knowledge and skills on crop water requirements. 2. Understand the methods and management of irrigation. 3. Gain knowledge on types of impounding structures.
Project Planning and Report Writing (Student READY)	AGE-421	Recognise how to plan and complete reports for maximum impact. Understand the Who, What, When, Where, Why and How. Identify the different measures of readability. Know how to tailor a report for a specific audience.


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COLLEGE OF HORTICULTURE

	Local
	Regional
	Global
	National

Undergraduate

Degree Programme :- B.Sc. (Hons.) Horticulture

PROGRAMME OUTCOMES (POS)

- PO-1: To promote professional skills and knowledge through meaningful hands on experience.
- PO-2: To provide an opportunity to the students to understand the rural setting in relation to agriculture and allied activities.
- PO-3: To make the students familiar with socio-economic conditions of the farmers and their problems.
- PO-4: To impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training.
- PO-5: To develop communication skills in students using extension teaching methods in transfer of technology.
- PO-6: To acquaint students with on-going extension and rural development programmes.

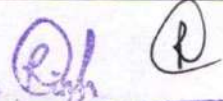
PROGRAMME SPECIFIC OUTCOMES (PSOS)

- PSO-1: To impart knowledge in various aspects of horticulture through theory and practical knowledge.
- PSO-2: To expose the students to industrial environment, which cannot be simulated in the university.
- PSO-3: To familiarize the students with various materials, machines, processes products and their applications along with relevant aspects of shop management.
- PSO-4: To make the students understand the psychology of the workers and approach to problems along with the practices followed at factory.
- PSO-5: To make the students understand the scope, functions and job responsibility-ties in various departments of an organization.
- PSO-6: Understand the impact of the professional agricultural solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PSO-7: To understand and analyze the current events and issues that are occurring in agriculture and how they affect futuristic agriculture.
- PSO-8: This programme will also help students to enhance their employability for jobs in different sectors.

Course Outcomes (COs)


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Discipline / Course title	Course No	Course Outcomes
Fundamentals of Horticulture	HFS-111	CO1. After completion of the degree programme, the students will be able to transfer knowledge of horticulture in the field of agriculture research especially in horticulture including fruits plants and their management.
Tropical and sub-tropical fruits	HFS-121	
Plant Propagation and Nursery Management	HFS-123	
Growth and Development of Horticultural Crops	HFS-124	
Temperate Fruit crops	HFS-211	CO2. The students will be acquainted with the production technology of tropical and dryland fruit production.
Weed Management in Horticultural Crops	HFS-212	
Plantation Crops	HFS-221	CO3. To make them aware of the intercultural operation of fruit crops and also to study the economics these tropical and dryland fruit crops along with the knowledge of diseases, pests and physiological disorders, mineral deficiency problems maturity indices for harvesting the crops and economics of the tropical and dryland fruit crops.
Breeding of Fruit and Plantation Crops	HFS-222	
Dryland Horticulture	HFS-223	
Introductory Agro-forestry	HFS-311	
Orchard and Estate Management	HFS-312	CO4. The students will know about the package and practices of subtropical and temperate fruit crops along with the knowledge of diseases, pests and physiological disorders, mineral deficiency problems maturity indices for harvesting the crops and economics of the subtropical and temperate fruit crops.
Apiculture, Sericulture and Lac culture	HFS-322	
Tropical and Subtropical Vegetable crops	HVS-121	
Temperate Vegetable crops	HVS-211	
Spices and Condiments	HVS-221	CO5. Development innovative agro-techniques to enhance the production and productivity of subtropical and temperate fruit crops.
Precision Farming and Protected Cultivation	HVS-222	
Breeding of Vegetable Tuber and Spice Crops	HVS-311	
Potato and Tuber Crops	HVS-312	
Seed Production of Vegetable Tuber and Spice Crops	HVS-321	CO6. After gaining experience, they will increase farmers' income through adopting hi-tech horticulture.
Fundamentals of Food Technology	HPT-211	
Postharvest Management of Horticultural Crops	HPT-321	CO7. The students will know about biodiversity, conservation issues and exploitation of biological diversity through crop management.
Processing of Horticultural Crops	HPT-322	
Principles of Landscape Architecture	HFL-111	CO8. The students will be acquainted understanding the biodiversity, centres of origin of cultivated fruit crops.
Commercial Floriculture	HFL-211	
Ornamental Horticulture	HFL-221	
Medicinal and Aromatic Crops	HFL-311	
Breeding and Seed Production of Flower and Ornamental Crops	HFL-321	
Fundamentals of Entomology	HPP-211	
Diseases of Fruit, Plantation and Medicinal and Aromatic Crops	HPP-212	
Fundamentals of Plant Pathology	HPP-213	
Nematode Pests of Horticultural Crops and their Management	HPP-214	


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Insect Pests of Fruit, Plantation, Medicinal and Aromatic Crops	HPP-221	CO9. The students will be acquainted with the quantify economic importance of plants in managed ecosystems and the impact of horticultural crops in food systems.
Diseases of Vegetable, Ornamental and Spice Crops	HPP-311	CO10. To make them aware about interculture operation for setting up of model nurseries in rural areas for availability of quality planting material.
Insect Pests of Vegetable, Ornamental and Spice Crops	HPP-321	CO11. The students will know about life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony and chimeras.
Fundamentals of Soil Science	HNM-111	CO12. The students will know about the principles, theoretical aspects and developing skills in biotechnology of horticultural crops.
Environmental Studies and Disaster Management	HNM-121	CO13. To make them aware about callus culture, cell division, differentiation, morphogenesis, organogenesis, embryogenesis and physiology of hardening.
Water Management in Horticultural Crops	HNM-122	CO14. To make them aware about canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruit and tropical or subtropical fruit crops.
Soil Fertility and Nutrient Management	HNM-123	
Farm Power and Machinery	HNM-221	
Soil, Water and Plant Analysis	HNM-222	
Organic Farming	HNM-311	
Introduction to Major Field Crops	HNM-312	
Agro-meteorology and Climate Change	HNM-313	
Introductory Crop Physiology	HBS-111	
Introductory Microbiology	HBS-112	
Elementary Statistics and Computer Application	HBS-113	
Principles of Plant Breeding	HBS-114	
Principles of Genetics and Cytogenetics	HBS-121	
Elementary Plant Biochemistry	HBS-115	
Elementary Plant Biotechnology	HBS-211	
Economics and Marketing	HSS-111	
Communication Skills and Personality Development	HSS-112	
Information and Communication Technology	HSS-121	
Fundamentals of Extension Education	HSS-323	
Horti-Business Management	HSS-321	
Entrepreneurship Development and Business Management	HSS-322	
Physical and Health Education (NC)	NSO-121	
NSS/NCC(NC)	NSO-114/ NSO-115	


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Programme Outcomes (POs), Programme Specific Outcomes (PSOs) and Course Outcomes (COs)

(2018-19 to 2022-23)



Masters & Doctoral Programmes

**Sardar Vallabhbhai Patel University of Agriculture &
Technology, Meerut-250110**

website: <https://svpuat.edu.in>

AGRONOMY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
AGRON 501*	Modern concepts in crop production	3+0
AGRON 502*	Principles and practices of soil fertility and	2+1
AGRON 503*	Nutrient management Principles and practices of weed management	2+1
AGRON 504*	Principles and practices of water management	2+1
AGRON 505	Agrometeorology and crop weather forecasting	2+1
AGRON 506	Agronomy of major cereals and pulses	2+1
AGRON 507	Agronomy of oilseed, fibre and sugar crops	2+1
AGRON 508	Agronomy of medicinal, aromatic and under	2+1
AGRON 509	Utilized crops Agronomy of fodder and forage crops	2+1
AGRON 510	Agrostology and agroforestry	2+1
AGRON 511	Cropping systems	2+0
AGRON 512	Dryland farming	2+1
AGRON 513	Principles and practices of organic farming	2+1
AGRON 591	Master's seminar	1+0
AGRON 599	Master's research	20
AGRON 601	Current trends in agronomy	3+0
AGRON 602	Crop ecology	2+0
AGRON 603	Crop production and system modeling	2+1
AGRON 604	Advances in crop growth and productivity	2+1
AGRON 605	Irrigation management	2+1
AGRON 606	Advances in weed management	2+0
AGRON 607	Integrated farming systems	2+0
AGRON 608	Soil conservation and watershed management	2+1
AGRON 609	Stress crop production	2+1
AGRON 691	Doctoral seminar I	1+0
AGRON 692	Doctoral seminar II	1+0
AGRON 699	DOCTORAL RESEARCH	45


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AGRICULTURE ECONOMICES
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
AG ECON 501*	Micro economic theory and applications	2+0
AG ECON 502*	Macro economics and policy	2+0
AG ECON 503*	Evolution of economic thought	1+0
AG ECON 504*	Agricultural production economics	1+1
AG ECON 505*	Agricultural marketing & price analysis	2+1
AG ECON 506*	Research methodology for social sciences	1+1
AG ECON 507*	Econometrics	2+1
AG ECON 508*	Linear programming	1+1
AG ECON 509*	Agricultural finance and project management	2+1
AG ECON 511	International economics	1+1
AG ECON 512	Institutional economics	1+0
AG ECON 513	Agricultural development policy analysis	2+0
AG ECON 514	Natural resource and environmental economics	1+1
AG ECON 515	Intellectual property management	1+0
AG ECON 516#	Computer applications for agricultural economics	2+1
AG ECON 517	Rural marketing	2+0
AG ECON 518	Commodity futures trading	2+0
AG ECON 591	Master's seminar	1+0
AG ECON 599	Master's research	20
AG ECON 601**	Advanced micro-economic analysis	1+1
AG ECON 602**	Advanced macro-economic analysis	2+0
AG ECON 603**	Advanced econometrics	2+1
AG ECON 604**	Advanced production economics	2+1
AG ECON 605**	Quantitative development policy analysis	1+1
AG ECON 606**	Advanced agricultural marketing and price analysis	2+1
AG ECON 608	Commodity futures trading	2+0
AG ECON 609	Natural resource management	1+1
AG ECON 610	Environmental economics	2+0
AG ECON 691	Doctoral seminar I	1+0
AG ECON 692	Doctoral seminar II	1+0
AG ECON 699	DOCTORAL RESEARCH	45

Compulsory for Master's programme; ** Compulsory for Doctoral programme # Cross-listed with Statistics
The following Basic Supporting courses (5 credits) are recommended for M. Sc. / Ph. D. programmes


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PLANT PATHOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
PL PATH 501*	Mycology	2+1
PL PATH 502*	Plant virology	2+1
PL PATH 503*	Plant bacteriology	2+1
PL PATH 504*	Principles of plant pathology	3+0
PL PATH 505*	Detection and diagnosis of plant diseases	0+2
PL PATH 506	Principles of plant disease management	2+1
PL PATH 507	Diseases of field and medicinal crops	2+1
PL PATH 508	Diseases of fruits, plantation and ornamental crops	2+1
PL PATH 509	Diseases of vegetable and spices crops	2+1
PL PATH 510	Seed health technology	2+1
PL PATH 511	Chemicals in plant disease management	2+1
PL PATH 512	Ecology of soil-borne plant pathogens	2+1
PL PATH 513	Disease resistance in plants	2+0
PL PATH 514/ ENT 514\$	INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS	1+1
PL PATH 515	Biological control of plant diseases	2+1
PL PATH 516	Integrated disease management	2+1
PL PATH 517	Mushroom production technology	2+1
PL PATH 518	Epidemiology and forecasting of plant diseases	2+1
PL PATH 519 PL PATH 520/ ENT 520\$	Post harvest diseases Plant quarantine	2+1 2+0
PL PATH 591	Master's seminar	1+0
PL PATH 599	Master's research	20
PL PATH 601	Advanced mycology	2+1
PL PATH 602	Advanced virology	2+1
PL PATH 603	Advanced bacteriology	2+1
PL PATH 604**	Molecular basis of host-pathogen interaction	2+1
PL PATH 605	Principles and procedures of certification	1+0
PL PATH 606	Plant biosecurity and biosafety	2+0
PL PATH 691	Doctoral seminar I	1+0
PL PATH 692	Doctoral seminar II	1+0
PL PATH 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Ph. D. programme; \$ Cross-listed with Entomology


 REGISTRAR
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AGRICULTURE EXTENSION
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
EXT 501*	Development perspectives of extension education	1+1
EXT 502*	Development communication and information management	2+1
EXT 503*	Diffusion and adoption of innovations	2+1
EXT 504*	Research methods in behavioral sciences	2+1
EXT 505*	E-extension	2+1
EXT 506*	Entrepreneurship development and management in extension	2+1
EXT 507*	Human resource development	2+1
EXT 508	Visual communication	2+1
EXT 509	Participatory methods for technology development and transfer	1+1
EXT 510	Gender sensitization for development	2+1
EXT 511	Perspectives of distance education	2+0
EXT 512	Market-led extension	2+0
EXT 591	Master's seminar	1+0

ANIMAL HUSBANDRY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
AAH-410	Poultry breeding	2+1
AAH-420	Poultry feeding	2+1
AAH-430	Egg and meat technology	1+1
AAH-440	Poultry farm management	2+1
AAH-450	Hatchery and brooding management	0+2
AAH-460	Broiler and layer management	0+2
AAH-470	Sheep goat and swine production	4+0
AAH-480	Sheep goat and swine breeding	4+0
AAH-490	Feed additives	2+0
AAH-510	Dairy cattle breeding	2+1
AAH-520	Dairy cattle feeding	2+1
AAH-530	Dairy farm management	2+1
AAH-540	Nutritional physiology of animals	3+0
AAH-550	Speciation and Evolution as Applied to Livestock Population	3+0
AAH-560	Livestock physiology	3+0
AAH-570	Application of selection theory	2+1
AAH-580	Diseases of dairy animals	2+0


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AAH-590	Experimental techniques in animal nutrition	1+1
AAH-630	Population genetics	3+1
AAH-640	Quantitative genetics as applied to animal breeding - i	1+1
AAH-650	Quantitative genetics as applied to animal breeding - ii	1+1
AAH-660	Non-ruminant nutrition	2+1
AAH-670	Feed stuff evaluation	0+2
AAH-680	Ruminant nutrition	3+1
AAH-710	Advances in dairy animal production	3+0
AAH-720	Commercial dairy herd management	2+1
AAH-730	Feed and Fodder Technology	2+1
AAH-740	Energy nutrition	2+0
AAH-750	Protein nutrition	2+0
AAH-760	Vitamin nutrition	2+0
AAH-770	Mineral nutrition	2+0
AAH-780	Advanced animal breeding	2+1

ENTOMOLOGY
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
ENT 501*	Insect morphology	1+1
ENT 502*	Insect anatomy, physiology and nutrition	2+1
ENT 503	Principles of taxonomy	2+0
ENT 504*	Classification of insects	2+1
ENT 505*	Insect ecology	1+1
ENT 506	Insect pathology	1+1
ENT 507*	Biological control of crop pests and weeds	1+1
ENT 508*	Toxicology of insecticides	2+1
ENT 509	Plant resistance to insects	1+1
ENT 510*	Principles of integrated pest management	1+1
ENT 511*#	Pests of field crops	1+1
ENT 512*#	Pests of horticultural and plantation crops	1+1
ENT 513	Storage entomology	1+1
ENT 514	Insect vectors of plant viruses and other pathogens	1+1
ENT 515	General acarology	1+1
ENT 516	Soil arthropods and their management	1+1
ENT 517	Vertebrate pest management	1+1
ENT 518*	Techniques in plant protection	0+1
ENT 519	Commercial entomology	1+1
ENT 520	Plant quarantine	2+0
ENT 591	Master's seminar	1+0
ENT 599	Master's research	20
ENT 601	Advanced insect systematics	1+2
ENT 602	Immature stages of insects	1+1
ENT 603	Advanced insect physiology	2+0
ENT 604	Advanced insect ecology	1+1
ENT 605	Insect behaviour	1+1
ENT 606	Recent trends in biological control	1+1


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 S.V.B.P.U.A.&T., MEERUT

ENT 607	Advanced insecticide toxicology	2+1
ENT 608	Advanced host plant resistance	1+1
ENT 609	Advanced acarology	1+1
ENT 610	Agricultural ornithology	1+1
ENT 611**	Molecular approaches in entomological research	1+1
ENT 612**	Advanced integrated pest management	2+0
ENT 613/		
PL PATH 606\$ Plant biosecurity and biosafety 2+0		
ENT 691	DOCTORAL SEMINAR I	1+0
ENT 692	DOCTORAL SEMINAR II	1+0
ENT 699	DOCTORAL RESEARCH	45
*Compulsory for Master's programme; ** Compulsory for Ph.D. programme		

#One out of 511 or 512 is compulsory; \$ Cross-listed with Plant Pathology

GENETICS AND PLANT BREEDING Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
GP 501*	Principles of genetics	3 (2 + 1)
GP 502*	Principles of cytogenetics	3 (2 + 1)
GP 503*	Principles of plant breeding	3 (2 + 1)
GP 504*	Principles of quantitative genetics	3 (2 + 1)
GP 505	Mutagenesis and mutation breeding	3 (2 + 1)
GP 506	Population genetics	2 (1 + 1)
GP 507*	Heterosis breeding	2 (1 + 1)
GP 508*	Cell biology and molecular genetics	3 (2 + 1)
GP 509*	Biotechnology for crop improvement	3 (2 + 1)
GP 510	Breeding for biotic and abiotic stress resistance	3 (2 + 1)
GP 511	Breeding cereals, forages and sugarcane	3 (2 + 1)
GP 512	Breeding legumes, oilseeds and fibre crops	3 (2 + 1)
GP 513	Breeding for quality traits	2 (1 + 1)
GP 514	Gene regulation and expression	2 (2 + 0)
GP 515	Maintenance breeding, concepts of variety release	2 (1 + 1)
	And seed production	
GP 516	Germplasm collection, exchange and quarantine	3 (2 + 1)
GP 517	Database management, evaluation and utilization of pgr	3 (2 + 1)
GP 591	Master's seminar	1 (1 + 0)
GP 599	Master's research	20
GP 601	Plant genetics resources and pre-breeding	2 (2 + 0)
GP 602	Advanced biometrical and quantitative genetics	3 (2 + 1)
GP 603**	Genomics in plant breeding	3 (2 + 1)
GP 604**	Molecular and chromosomal manipulations for	2 (2 + 0)
	Crop breeding	
GP 605**	Advanced plant breeding systems	2 (2 + 0)
GP 606	Crop-evolution	3 (2 + 1)

GP 607	Breeding designer crops	2 (1 + 1)
GP 608	Advances in breeding of major field crops	3 (3 + 0)
GP 609	Microbial genetics	3 (2 + 1)
GP 610**	In situ and ex situ conservation of germplasm	3 (2 + 1)
GP 691	Doctoral seminar I	1 (1 + 0)
GP 692	Doctoral seminar II	1 (1 + 0)
GP 699	DOCTORAL RESEARCH	45

Note : *Compulsory for Master's Programme; ** Compulsory for Ph.D. Programme

HORTICULTURE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
APH-503	Systematic horticulture	2+1
APH-511	Plant propagation and nursery management	2+1
APH-513	Orchard management	2+1
APH-515	Advance pomology	2+1
APH-516	Advance olericulture	2+1
APH-521	Advance floriculture	2+1
APH-531	Medicinal and aromatic plant	2+1
APH-711	Nutrition of horticultural crops	3+1
APH-731	Post harvest physiology of horticultural crops	2+1
APH- 733	Research methods in horticulture	0+2
EXT 599	Master's research	20
EXT 601**	Advances in agricultural extension	2+1
EXT 602**	Advanced design and techniques in social science research	2+1
EXT 603**	Advances in training technology	2+1
EXT 604**	Organizational development	2+1
EXT 605**	Advanced instructional technology	2+1
EXT 606	Theory construction in social sciences	2+0
EXT 607	Advanced management techniques	2+1
EXT 608	Media management	2+1
EXT 609	Transfer of technology in agriculture	2+1
EXT 691	Doctoral seminar I	1+0
EXT 692	Doctoral seminar II	1+0
EXT 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

The following Basic Supporting courses (5 credits) are recommended for M. Sc. / Ph. D. programmes
M. Sc.

STAT	STATISTICAL METHODS FOR SOCIAL SCIENCES	2+1
STAT	NON-PARAMETRICS	2+0
Ph. D.		
STAT	STATISTICS	2+1
STAT	COMPUTER APPLICATION	1+1


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SOIL SCIENCE
Course Structure – at a Glance



CODE	CREDITS	COURSE TITLE
SOILS 501*	2+1	SOIL PHYSICS
SOILS 502*	3+1	Soil fertility and fertilizer use
SOILS 503*	2+1	SOIL CHEMISTRY
SOILS 504*	2+1	Soil mineralogy, genesis, classification and survey
SOILS 505	2+1	Soil erosion and conservation
SOILS 506*	2+1	Soil biology and biochemistry
SOILS 507	2+0	Geomorphology and geochemistry
SOILS 508	1+1	radioisotopes in soil and plant studies
SOILS 509	2+1	Soil, water and air pollution
SOILS 510	2+1	Remote sensing and GIS techniques for soil and crop studies
SOILS 511	0+2	Analytical techniques and instrumental methods in Soil and Plant Analysis
SOILS 512	2+1	System approaches in soil and crop studies
SOILS 513	2+1	Management of problematic soils and waters
SOILS 514	1+0	Fertilizer technology
SOILS 515	1+0	Land degradation and restoration
SOILS 591	1+0	Master's seminar
SOILS 599	20	MASTER'S RESEARCH
SOILS 601	2+0	Advances in soil physics
SOILS 602	2+0	Advances in soil fertility
SOILS 603	2+0	Physical chemistry of soils
SOILS 604		Soil genesis and micropedology 2+0
SOILS 605		Biochemistry of soil organic matter 2+0
SOILS 606		Land use planning and watershed management 2+0
SOILS 691		Doctoral seminar I 1+0
SOILS 692	1+0	DOCTORAL SEMINAR II
SOILS 699	45	DOCTORAL RESEARCH


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*Compulsory for Master's programme

BASIC SCIENCE

MCA 502	introduction to networking and internet applications	1+1
STAT 511 / BST 511	statistical methods for applied sciences	3+1
STAT 563 /BST 563	multivariate analysis	2+1
PGS 501	LIBRARY AND INFORMATION SERVICES	
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	
0+1		
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	
1+0		
PGS 504 (e-Course)	BASIC CONCEPTS IN LABORATORY TECHNIQUES	
0+1		
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	
1+0		
PGS 504 (e-Course)	BASIC CONCEPTS IN LABORATORY TECHNIQUES	
0+1		
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	
1+0		
PGS 506 (e-Course)	DISASTER MANAGEMENT	



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*** AGRICULTURE ENGINEERING AND FOOD TECHNOLOGY PROCESSING AND FOOD ENGINEERING**

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
PFE 501*	Transport phenomena in food processing	2+1
PFE 502*	Engineering properties of food materials	2+1
PFE 503*	Advanced food process engineering	2+1
PFE 504*	Unit operations in food process engineering	2+1
PFE 505	Energy management in food processing industries	2+1
PFE 506	Processing of cereals, pulses and oilseeds	2+1
PFE 507	Food processing equipment and plant design	2+1
PFE 508	Fruits and vegetables process engineering	2+1
PFE 509	Meat processing	2+1
PFE 510	Food packaging	2+1
PFE 511	Food quality and safety engineering	2+1
PFE 512	Farm structures and environmental control	1+1
PFE 513	Storage engineering and handling of agricultural products	2+1
PFE 514	Seed drying, processing and storage	2+1
PFE 515	Biochemical and process engineering	2+1
PFE 591	Master's seminar	1+0
PFE 592	Special problem	0+1
PFE 595#	Industry/ institute training	
PFE 599	Master's research	20
PFE 601**	Textural & rheological characteristics of food materials	2+1
PFE 602**	Advances in food processing	3+0
PFE 603	Mathematical models in food processing	3+0
PFE 604	Advances in drying of food materials	2+1
PFE 605	Agricultural waste and by –products utilization	2+1
PFE 691	Doctoral seminar I	1+0
PFE 692	Doctoral seminar II	1+0
PFE 693	Special problem	0+1
PFE 694	Case study	0+1
PFE 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Doctoral programme # PFE 595 – Minimum of Three Weeks Training

Note: Some of the identified Minor/Supporting fields are Mechanical Engineering, Processing & Food Engineering, Energy in Agriculture, Civil Engineering, Computer Science, Electrical Engineering, Mathematics and Statistics; The contents of some of the identified Minor/Supporting courses have been given.


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Department of Agronomy: College of Agriculture

Name of Programme: M.Sc. (Ag.) Agronomy

AGRON 501 **MODERN CONCEPTS IN CROP PRODUCTION** **3+0**

Objective

- To teach the basic concepts of soil management and crop production

Learning outcomes:

- The student will learn the advance knowledge of their particular subjects and they learn about how to conduct research in agriculture field particularly to the field crops
- Knowledge and concept of different techniques of crop production
- Basics of crop growth in relation to environment and sustainability
- Knowledge of tillage (zero and minimum tillage)
- Basic concepts of crop modelling for maximizing crop yield cropping and farming systems for sustainable agriculture

AGRON 502 PRINCIPLES AND PRACTICES OF SOIL FERTILITY **2+1**

AND NUTRIENT MANAGEMENT

Objective

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

Learning outcomes:

- To gain basic knowledge of soil fertility and productivity
- Importance or Significance of soil macronutrient and micronutrients
- Develop importance of soil physical and chemical properties
- About soil pollution and mitigation process

AGRON 503 PRINCIPLES AND PRACTICES OF WEED MANAGEMENT **2+1**

Objective

To familiarize the students about the weeds, herbicides and methods of weed control

Learning outcomes:


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- Knowledge and concept of weeds (classification and characters)
- Basics of weed growth in relation to environment and sustainability
- Classification of herbicides, bio-herbicides and biological control of weeds
- Basic concepts and effect of degradation of herbicides in soil and plants, weed management weed shifts in cropping systems and control of weed in non-cropped situations

AGRON 504 PRINCIPLES AND PRACTICES OF WATER MANAGEMENT

2+1

Objective

To teach the principles of water management and practices to enhance the water productivity

Learning outcomes:

- Knowledge about the water resources of India
- Knowledge about the different irrigation projects, soil water plant relationship
- To know about the water management crop and cropping systems and management of crops
- To know the effect of excess water on plant growth, drainage requirements of crop, layout and special irrigability of lands

AGRON 505 AGROMETEOROLOGY AND CROP WEATHER FORECASTING

2+1

Objective

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions

Learning outcomes:

- Characteristics of solar radiation
- Photosynthesis and efficiency of radiation utilization by field crops
- Environmental temperature: soil, air and canopy temperature
- Evapo- transpiration and meteorological factors determining evapotranspiration
- Modification of plant environment: artificial rain making, heat transfer, controlling heat load,
- heat trapping and shading
- Weather forecasting in India – short, medium and long range; aerospace science and weather forecasting
- Climate change and its impact on agriculture

AGRON 506

AGRONOMY OF MAJOR CEREALS AND PULSES

2+1


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Objective

To teach the crop husbandry of cereals and pulse crops

Learning outcomes:

- Knowledge and concept of major field crops (including cereals, pulses, oilseeds and fiber crops)
- Basics of soil requirements for field crops including fertilizers, manures, Farm yard manures
- Knowledge of seed rates, morphology phenology, varietal improvement of crops
- Basic concepts of origin, history, distribution, adaptations of different crops according to the environment sustainable agriculture and cropping and farming systems



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AGRON 507 AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS

2+1

Objective

To teach the crop husbandry of oilseed, fiber and sugar crops.

Learning outcomes:

- Area and production
- Classification and improved varieties
- Soil, water and cultural requirements
- *Rabi* oilseeds – Rapeseed and mustard, linseed, etc
- *Kharif* oilseeds - Groundnut, sesame, castor, sunflower, soybean etc
- Fiber crops - Cotton, jute, sunhemp etc
- Sugar crops – Sugar-beet and sugarcane

AGRON 509 AGRONOMY OF FODDER AND FORAGE CROPS

2+1

Objective

To teach the crop husbandry of different forage and fodder crops along with their processing

Learning outcomes:

- Knowledge about the adaptation, distribution, agro techniques, anti-quality factors of improvement of fodder crops
- Knowledge about the preservation and utilization of forage and pasture crops
- To know about the use of physical and chemical enrichment and biological methods for improvement nutrition
- To know about the economics of forage cultivation, grassland of India and their improvement
- To know about the principles of grassland ecology, economic aspect of grassland, problems and their management

AGRON 511 CROPPING SYSTEMS

2+0

Objective

To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity

Learning outcomes:


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- Importance-physical resources and its management in cropping systems
- Multiple cropping-intercropping, sequential cropping, alley cropping-advantages-interactions in cropping systems
- Assessment of yield advantage in intercropping system-assessment of land use- indices-economic evaluation of cropping systems
- Important cropping systems of India and Kerala-multi storied cropping
- Advantages- IFS models for different situations
- Organic farming- crop diversification for sustainability-role of organic matter in sustainability
- Residue management-sustainable technologies in crop production and management

AGRON 513 PRINCIPLES AND PRACTICES OF ORGANIC FARMING 2+1

Objective

To study the principles and practices of organic farming for sustainable crop production

Learning outcomes:

- Knowledge and concept of organic farming
- Basics of soil fertility, nutrient cycle manures and soil biota
- Knowledge of weeds and their control in agricultural crops
- Basic concepts of marketing and export potential, certification and labeling

NAME OF PROGRAMME: Ph.D. AGRONOMY

AGRON 601 CURRENT TRENDS IN AGRONOMY 3+0

Objective

To acquaint the students about recent advances in agricultural production

Learning outcomes:

- Basics of crop growth in relation to environment and sustainability
- Knowledge of tillage (zero and minimum tillage)
- Basic concepts of crop modelling for maximizing crop yield cropping and farming systems for sustainable agriculture

AGRON 602

CROP ECOLOGY

2+0

Objective

- To acquaint the students about the agricultural systems, agro-ecological

 
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regions, and adaptation of crops to different agro-climatic conditions.

Learning outcomes:

- Concept and dynamics of ecosystems- Ecosystem characteristics, types and functions of ecosystem
- Aquatic and terrestrial ecology
- Ecological pyramids, Trophic levels, and food chain ecosystem
- Moisture and solar radiation
- Effect of global climate change on crop production
- Vertical distribution of temperature
- Environmental pollution, ecological basis of environmental management and environment manipulation

AGRON 604

ADVANCES IN CROP GROWTH AND PRODUCTIVITY

2+1

Objective

To study the physiology of vegetative and reproductive growth in relation to productivity of different crops in various environment

Learning outcomes:

- Plant density and crop productivity-plant and environment factors, yield- plant distribution-strategies for maximizing solar energy utilization-leaf area
- Interception of solar radiation and crop growth
- Growth analysis concept-CGR, RGR, NAR, LAI, LAD, LAR: validity and limitations in interpreting crop growth and development
- Growth curves: sigmoid, polynomial and asymptotic- Growth expressions and Agrobiolgy -root systems
- Mixed cropping-criteria for assessing yield advantages- resource use efficiency in cropping systems
- Management strategies to improve the growth parameters contributing to yield

AGRON 605

IRRIGATION MANAGEMENT

2+1

Objective

To teach students about optimization of irrigation in different crops under variable agro-climatic conditions

Learning outcomes:


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- Knowledge about the water resources of India
- Knowledge about the different irrigation projects, soil water plant relationship
- To know about the water management crop and cropping systems and management of crops
- To know the effect of excess water on plant growth, drainage requirements of crop, layout and special irrigability of lands

AGRON 606

ADVANCES IN WEED MANAGEMENT

2+0

Objective

To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems

Learning outcomes:

- Knowledge and concept of weeds (classification and characters)
- Basics of weed growth in relation to environment and sustainability
- Classification of herbicides, bio-herbicides and biological control of weeds
- Basic concepts and effect of degradation of herbicides in soil and plants, weed management weed shifts in cropping systems and control of weed in non-cropped situations

AGRON 607

INTEGRATED FARMING SYSTEMS

2+0

Objective

To apprise about different enterprises suitable for different agroclimatic conditions for sustainable agriculture.

Learning outcomes:

- Farming systems: definition and importance; sustainability indices-LEIA, LEISA, HEIA classification of farming systems according to type of rotation
- Intensity of rotation, degree of commercialization, water supply, enterprises
- Efficient farming systems; natural resources - identification and management
- Choice and size of Enterprise in IFS – IFS for different agro ecosystems- Resource allocation to different components in the system and its management Preparation
- Farming system research for different situations - New concepts and approaches of farming systems and cropping systems



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**SOIL CONSERVATION AND WATERSHED MANAGEMENT 2+1
AGRON 608**

Objective

To teach about different soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach in watershed management.

Learning outcomes:

- Soil erosion: definition, nature and extent of erosion in India and Kerala- types of erosion, phases of erosion, factors affecting erosion
- Research works undertaken at international, national and state level for controlling erosion
- International, national and state level agencies and programmes for controlling erosion
- Soil conservation: definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; vegetative barriers
- Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed management
- Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed management, delineation, codification, classification of watersheds
- Drainage considerations and agronomic management; rehabilitation of abandoned jhum lands and measures to prevent soil erosion and improve productivity of such lands

Name of Programme: M.Sc. (Ag.) Agronomy

The department offered 9 courses of 21 credit hours to M.Sc. (Ag.) Agronomy students. The courses covered broad areas like crop production, weed management nutrient management, water management, cropping system etc. The objectives and learning outcomes are as under:

Objectives:

- To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility
- To familiarize the students about the weeds, herbicides and methods of weed control
- To teach the principles of water management and practices to enhance the water productivity
- To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions

Learning outcomes:

- After passing master degree course students have further teaching and research studies option. They can also become agricultural scientist who can also work as consultants to



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business firms, private clients or to the government. The candidate can also pursue for Doctorate Programme

- Students will be able to gather, assimilate, and process information to reach sound logical conclusions in their chosen career pathway
- Students will be able to apply economic principles of accounting, marketing and budgeting to agronomy enterprises

PG courses

S. No.	Course Name	Course No.	Credit (hrs)
I Semester			
1.	Principles and practices of weed management	AGRON-503	3(2 + 1)
2.	Principles and Practices of Water Management	AGRON-504	3(2 + 1)
3.	Agronomy of Major, Cereals & Pulses	AGRON-506	3(2 + 1)
4.	Seminar	AGRON 591	1
II Semester			
1.	Modern Concepts of Crop Production	AGRON 501	3(3 + 0)
2.	Principles and Practices of Soil Fertility and Nutrient Management	AGRON 502	3(2 + 1)
3.	Agronomy of Oilseed, Fiber & Sugar Crops	AGRON 507	3(2 + 1)
4.	Cropping System	AGRON 511	2(2+0)
5.	Seminar	AGRON 591	01

Name of Programme: Ph.D. Agronomy

The department offered 8 courses of 22 credit hours to Ph.D. Agronomy students. The courses covered broad areas like crop ecology, advances weed management, Integrated farming system, irrigation management, soil conservation and watershed management etc. The objectives and learning outcomes are as under:

Objectives:

- To acquaint the students about recent advances in agricultural production
- To acquaint the students about the agricultural systems, agro-ecological regions, and adaptation of crops to different agro-climatic conditions
- To teach students about optimization of irrigation in different crops under variable agro-climatic conditions
- To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems
- To apprise about different enterprises suitable for different agroclimatic conditions for sustainable agriculture

Learning outcomes:


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- Advanced insight into the means of providing options for sustainable agriculture for both the wellness of the environment and humans who consume agricultural produce.
- Students are taught the proper ways to communicate with the public, farmers and fellow scientists through a wide range of methods. With an increase in the need of new ways for improving sustainable agricultural practices, the discipline is fast gaining popularity in the country, in both government and private sectors

Ph.D. courses

S. No.	Course Name	Course No.	Credit (hrs)
I Semester			
1.	Current trends in Agronomy	AGRON-601	3(3 + 0)
2.	Advances in Crop Growth and Productivity	AGRON-604	3(2 + 1)
3.	Integrated Farming System	AGRON-607	2(2 + 0)
4.	Crop Ecology	AGRON-602	2(2 + 0)
5.	Seminar	AGRON 691	1
II Semester			
1.	Crop Ecology	AGRON-602	2(2 + 0)
2.	Advances in Weed Management	AGRON 606	2(2+0)
3.	Irrigation Management	AGRON 605	3(2 + 1)
4.	Soil Conservation & Watershed Management	AGRON-608	3(2 + 1)
5.	Seminar	AGRON 692	01

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Head
Department of Agronomy,
S.V.P. Uni. Agri. & Tech., Meerut-250110

Modern Concepts in Crop Production

Students become familiar with fundamental concepts of crop growth related to ideal plant type for **organic farming and sustainable agriculture**.

Principles and Practices of Weed Management

Students acquaint the role and importance of research in the field of weed management and understand the appropriate management practices for weed control.

Principles and Practices of Water Management

Students gain information about the role of water in plants and understand appropriate management practices for **water in controlled environment for increasing water use efficiency**.

Soil Fertility Management and Fertilizer Use

To acquaint the role and importance of soil fertility, productivity and understand symptoms of nutrient deficiency and toxicity symptoms.

Agronomy of Major Field Crops (Kharif)

Students learn about the role and importance of **origin and varietal improvement of major kharif crops**. To understand the quality improvement and industrial uses of major products of crops.

Crop Ecology and Geography

Students acquaint the basic concepts of crop ecology to Identify **adverse climatic effects on crop productivity for controlling** adverse effects on crop ecology.

Soil Conservation and Watershed Management

Students study about different type of soil erosion, field studies of different soil conservation measure runoff and soil loss measurement, laying out runoff plot.

Fodder and Forage Crops

Students familiar with the importance of fodder forage crops and understand the **biochemical changes** and factors affecting of fodder crops.

Agronomic Field Experimentation

To gain knowledge about the principles and objectives of field experimentation.

Agronomy of Major Filed Crops (Rabi)

Students acquaint the role and importance of origin and varietal improvement of major Rabi crops.

Dry land Farming


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Students acquaint the concept of dryland, rainfed farming and understand types of droughts and adaptation of plants to droughts.

Management of Problem Soils

Students gain knowledge about the concept of nutrient imbalance in problem soils and understand the crop tolerance to saline, sodicity, acidic and water logging.

Medicinal and Aromatic Plants

Students learn about the role and importance of medicinal and aromatic plants in human health. Acquaint knowledge about the medicinal and aromatic plants according to botanical characteristics and uses.

Seed Production Agronomy

Students familiar with the role of seed industry in country and understand the concept of seed purity and seed health.

Organic Farming

Students will be able to understand the role of organic farming and its relevance in India and understand different farming systems, Integrated Pest management, land and water management.

Principle of Management and Organizational Behaviour

Students acquaint the learner with meaning and concepts of management and organizational behaviour. Understanding the concepts, processes, significance, and role of management and organizational behaviour.

Agribusiness Environment and Policy

Students will be able to understand the role of agriculture in Indian economy, structure of agriculture, trend of production, processing and marketing as well as help in making Agricultural price and marketing policies. Reforms in policies related to liberalization, privatization globalization and export of agricultural commodities.

Managerial Economics

Familiarize the Students with the fundamental economic concepts and principles in the context of managerial decision making.

Managerial Accounting and Control

Students will be able to understand the concept and applications of financial, double entry system, cost accounting and management accounting.

Communication for Management and Business

Make Students proficient in written as well oral communication. The focus will be on business related communication.


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Business Laws and Ethics

Students will be able to acquire knowledge the various business laws and also ethical practices to conduct the business properly. This course helps in addressing various issues related to farmers and consumer like APMC act, MRTP act, consumer protection act etc.

Marketing Management

Students will be able to understand the basic concepts, tools, and functions of marketing.

Human Resource Management

Students study about the Human Resources Management, Recruitment and Selection Process and Quality of work life, employee welfare measure

Financial Management

Students gain knowledge about the application of Financial and investment decisions.

Production and Operations Management

Students gain knowledge about the basic concepts, tools, and functions of production management. The focus will be on imparting knowledge of the basic concepts, tools, and functions of TQM, quality assurance and ISO as per need of national and international standards.

Research Methodology in Business Management

Students identify the appropriate research design for different research problem

Project Management and Entrepreneurship Development

To train the students to develop new projects and encouraging them to start their own ventures. This course is to expose the learner in the fields of starts-ups based on need of society.

Computers for Managers

To acquaint the students with the knowledge and use of computers and simple applications of computers in managerial decisions.

Management Information Systems

Students will develop an understanding and utility of MIS. The focus will be on imparting knowledge of the basic concepts, development, functions and usage of MIS.

Operations Research


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Students gain knowledge how to minimize the cost and maximize the profit. Techniques help in solving business problems by making decision in risk and uncertainty.

Rural Marketing

Students will be able to understand the issues in rural markets like marketing environment, consumer behaviour, distribution channels, marketing strategies, etc.

Agricultural Marketing Management

Students will be able to understand the concept about various policies, strategies and decisions relating to marketing that can be developed by agribusiness firms.

Food Technology and Processing Management

To acquaint the students with different food processing techniques and their management.

Fertilizer Technology and Management

To acquaint the students in latest advances in fertilizer technology management

Management of Agro Chemical Industry

To familiarize the students with the agrochemicals, their structure, classification and development and also how to manage the agro-chemical industries.

Farm Business Management

To acquaint the students with the basic principles of farm management dealing with the analysis of farm resources having alternatives within the framework of resource restrictions.

Seed Production Technology and Management

To apprise students regarding principles and efficient management of seed production technology.

Technology Management for Livestock Products

To impart knowledge about management of livestock products, product development, quality control, preservation and marketing strategies for livestock products.

Fruit Production and Post-Harvest Management

To impart knowledge into the students regarding agro-techniques of fruit crops on the basis of their respective climatic zones & their post-harvest management.


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Farm Power & Machinery Management

To acquaint the Students with the farm mechanization status in the country and various techniques for farm machinery management and marketing

International Trade & Sustainability Governance

To impart knowledge to the Students of international trade in agriculture and various provision under WTO in the new trade regime.

Management of Agribusiness Cooperatives

To provide the students an understanding about the agribusiness cooperative organizations and their management.

Agribusiness Financial Management

To impart trainings to the students regarding various aspects of financial management for agribusiness.

Food Retail Management

To assist students in understanding the structure and working of food marketing system in India, to examine how the system affects farmers, consumers and middlemen and to illustrate the response of this dynamic marketing system to technological, socio-cultural, political and economic forces over time

Management of Agricultural Input Marketing

Students will be able to understand the different marketing concept and marketing system in context of agricultural inputs.

Feed Business Management

To acquaint the students with the role and importance of feed industry and the production of feed for livestock and poultry

Agri Supply Chain Management

The course introduces Students to the concepts and processes of agricultural supply chain management, framework for structuring supply chain drivers; network designs, demand forecasting, inventory planning, sourcing decisions and IT enablement of supply chain.

Management of Veterinary Hospitals

The objective of this course is to acquaint the students about the designing, planning, organizing and controlling the veterinary hospitals for optimizing the use of space, capital, skill and other resources.

Poultry and Hatchery Management


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Students will be able acquire knowledge about the importance of management in poultry industry, managing a poultry and hatchery enterprise, planning production of poultry products, financial, personnel and marketing management.

Management of Floriculture and Landscaping

To expose the Students with floriculture technology and its Agri-business implications including international trade

• Fundamental of Extension Education

Students will be able understand the concepts and application of rural development programmes.

Process and method of Communication

Students gain information about the role and importance of communication process and familiar with the method of Communication.

Agricultural Journalism

Students are expected to understand the role and technique of collection of material of Rural development for journalism.

Fundamental of Rural Sociology

To acquaint Students about the specialized topics and advances in field of genomics and genomics assisted molecular breeding

Communication media and information technology

Students are expected to learn about use of media in agricultural development and prospect of new communication and information technology

• Psychological of Human Behavior

This course aims to build capacities of Students to understand the fundamental psychological processes which guide human behaviour at individual, group and community levels in specific contexts, to develop sound extension strategies.

Diffusion and Adoption of Innovation

This course aims to equip Students to conduct outcome-oriented social and behavioural science research and to develop novel and effective field focused extension strategies followed by adoption of such novel models with adequate replicability, while advancing knowledge on processes governing success of those strategies.

Entrepreneurship Development

This course is aimed to develop a critical understanding among extension Students about how the technology commercialization process is linked to entrepreneurship development.


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Management in Extension

Students are made aware about the nature extension organization and the role of qualities, coordination of management in extension.

Process of Photography

Students are familiar with the concept of photography in which expected to learn about the role of camera and film.

Rural Community and Work Experience

Students are familiar with the social and economic component of village.

Managerial skill for extension professional

Students understand the nature, importance of extension professional and familiar with the concept the learning skill

Visual and Graphics communication

Students are understand the role and importance of communication. And familiar with the method for designing the visual and graphics communication.

Methods of Social Research

Students gain knowledge about the concept of science, design of social research and conduct of research including data collection analysis, interpretation and report writing.

Programme planning in Extension

Students are familiar with organizational structure for planning at various level of extension programme.

Training for human resource development

Students understand the concept of Human resource development and basic assumption of training.

Training Methodology

Students are gain knowledge about the principle of learning and understand the training method of training programme.

Basic Biochemistry

Students are expected to learn about Acid, base buffer and their role in biological reaction

Techniques in Biochemistry

Students can learn about the different techniques involved in detection and quantification of various biomolecules in in vitro experiments as well in natural systems


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Soil Biochemistry

Students are introduced with soil biochemistry.

Seed Biochemistry

Consultancy/training at block/district headquarters of Agriculture/Agriclinics for creating awareness & remedies about seed germination, seed viability and reasons of seed spoilage with precautions.

Biochemistry of intermediary metabolism

Students are gain knowledge about the biochemistry of higher plant and bacterial photosynthesis; biosynthesis of fat; biochemistry and function of hormone and vitamin in intermediary metabolism

Plant Biochemistry

Students can explore knowledge about hormones, alkaloids, toxic substances to the NGO's, block headquarters, farmers training centres, processing industries, food diet centres.

Biochemistry of food grain, fruits and vegetable

Students gain information about the importance of fruit and vegetable in human diet.

Human Nutrition

Students are estimation of nutritive value of food protein, essential amino acid.

Animal Biochemistry

Students are gain knowledge about glucose, calcium, iron and total serum cholesterol in the blood of cow, buffalo and goat, Determination of urea, uric acid in the animal and human preparation of blood slide and determination of cholesterol human blood and bird egg.

Research Methodology

Students are familiar with seminar paper presentation and how to write thesis?

Insect Morphology

Students will be able to understand the concept about insect integument, head, thorax, wings, legs and abdomen

Insect Ecology

Students get the concept and construction of life table, computer simulation, modelling, estimates of population density, sampling methods and plans, estimation of dispersal and migration

Integrated Pest Management


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To familiarize the Students with principles of insect pest management, including concept and philosophy of IPM.

International Agricultural Research and research ethics

Students get familiar with the history of agriculture research and ethics.

Insect Pest of Field Crop

Students will be able to study about life cycle of two insect pest one each from hemi and holometabolous group.

Insect Pests of Fruits, Vegetables, Spices and Medicinal Plants

To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history, their integrated management.

Storage Pests and their Management

To impart knowledge about Storage pests – insects, mites, rodents and their development, their economic importance; and strategies for their management

Toxicology of insecticides

Students are expected to gain information about the principles of toxicology

Insect Resistance in Crop Plants

To orient the Students with structure and mode of action of important insecticides belonging to different groups, development of resistance to insecticides by insects, environmental pollution caused by toxic insecticides and their toxicological aspects.

Insect Systematics

Students will be able to learn about the relationship of systematics and taxonomy.

Insect Anatomy, Physiology and Nutrition

To impart knowledge in students about the anatomy and physiology of insect body systems; nutritional physiology; and their applications in entomology

Forest Entomology

Students are familiar with insect damage in forest trees and their products.

Insect Vectors of plant viruses and other pathogens

Students will be able to understand the important insect vector of plant pathogens.

Biological control


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Students are expected to learn about the history and importance of biological control.

Applied acarology

Students are expected to acquire knowledge about the mite population and to learn the Method of testing pesticide against mites.

Soil arthropods and their management

Students are study about various harmful and beneficial soil invertebrates and microorganism.

Principle of Seed Technology

Students introduced about the seed technology

Seed Legislation & Certification

Students gain information on seed legislation in relation to seed certification and quality control systems

Floral Biology, Seed Development and Maturation

Students study about the floral types, structure and biology in relation pollination mechanisms sporogenesis microsporogenesis and megasporogenesis; gametogenesis - development of male and female gametes and their structures; effect of environmental factors on floral biology.

Seed Production in Field Crops

Students gain information about Basic principles in seed production and importance of quality seed. Floral structure, breeding and pollination mechanism in self - pollinated cereals and millets

Seed Physiology

Students study about the Physiology of seed development and maturation; chemical composition , synthesis and accumulation of seed reserves , induction of desiccation tolerance hormonal regulation of seed development .

Seed Pathology

Students familiar with the history and economic importance of seed pathology in seed industry and plant quarantine

Seed Legislation and Certification

Students gain knowledge about the Historical development of Seed Industry in India.

Seed Processing and Storage


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To impart knowledge on principles, techniques and methods of seed processing, treatment and storage including methods for Seed extraction, Seed processing sequence for different crops; Seed drying methods, etc.

Seed Quality Testing

To impart knowledge on principles, techniques and methods of seed testing and seed quality enhancement including Seed Germination test, Genetic purity assessment; application of tolerance in seed testing; advanced non-destructive techniques of seed quality analysis etc.

Seed Entomology

To impart knowledge on Collection, identification and familiarization with the stored grains/ seed insect pests and nature of damage caused by them

Seed Marketing and Management

To empower the students to become seed entrepreneurs by imparting knowledge on seed industry management and marketing strategies.

Principles of Genetics

Students gain knowledge about the basic perspective on genetics.

Principles of Cyto-Genetics

Students are getting information about the chromosome structure; prokaryotes and eukaryotes; function and replication.

Principles of Plant Breeding

Students are introduced with principles of plant breeding.

Method of Plant Breeding

Students gain knowledge about method of breeding self-pollinated, cross pollinated and asexually propagated crop, pure line and mass selection.

Principles of Quantitative Genetics

Students gain theoretical knowledge and computation skills regarding components of variation and variances, scales, mating designs and gene effects.

Improvement of field crop

Students getting information about breeding work of important crop.

Seed production, testing & certification

Students will be able to understand the importance of seed technology; general technique of seed production in important, agricultural and vegetable crop.

Breeding for stress resistance



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To acquainted the students about the nomenclature and classification of stress.

Genetics Engineering and Biotechnology

Students getting information about vitro technique, nuclear, plasmid and bacteriophage.

Breeding for crop Quality

Students are expected to getting information about quality traits in field crop needs and prospect for genetic improvement.

Molecular Genetics

Students would be taught basics of genome structure and organization, generation of molecular markers-basic principles, molecular marker techniques, data handling and analysis of GM crops.

Heterosis Breeding

Prediction of Hybrid performance, BLUP, Genetic diversity and heterosis.

Theory and advance plant breeding

Students getting information about component of variation and their estimation in single gene.

Mutagenesis

Students are expected to learn about the history of experimental mutagenesis.

Population Genetics

Students are getting information about foundation of theoretical population genetics.

Plant Genetics Resource

Students are expected to learn about the basics of genetic resource.

Soil mineralogy, genesis and classification

Students learn about the Structural chemistry, taxonomy of soil of India, soil morphology. And also know about the crystal system and crystal structure of soil minerals, minerals identification.

Soil Chemistry

Students are expected to know concepts of chemicals in soils, soil colloids, solubility relationship of important nutrients, nutrients dynamics, chemical and electrochemical properties of submerged soil, chemistry of acid and salt affected soils.

Soil biology and Biochemistry


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Students gain knowledge about the soil biota, soil microbial ecology, soil microbial biomass, bio fertilizer, soil enzymes, microbial transformation, production of biogas and manures.

Soil Physics

Students will be able to acquire knowledge about the soil water behaviour, water management practices, soil physical environment, soil structure, puddling and its effects, soil air characterization in relation to plant growth.

Soil fertility and plant nutrition

Students develop the skills in balanced use of nutrients, nutrients uptake mechanism, nutrients release and carry over effects

Soil Technology

Students are expected to learn about technology scope, extent, distribution and chemistry of problem soils. Also know about the quality of irrigation water and management of saline water for irrigation.

Soil survey and land use planning

Students study about the soil survey procedures, remote sensing techniques, criteria for classification at different of soil resource information for agricultural and non-agricultural uses.

Soil water plant relationships

Students gain the knowledge about soil plant atmosphere continuum pathways of water movement. Models for water use, plant growth and yield in term of water availability.

Manures and fertilizers

Students develop the skills in role of manures in sustainable agriculture, rural urban enriched composts preparation, and sustainable agriculture.

Soil Water and Air Pollution

Students are expected to know pollution problems and hazards, nature and sources of pollutants, meta-toxicity, effect on nutrient availability and plant growth.

Instrumental techniques in soil and plant analysis

Students learn about the principles of visible ultraviolet and infrared spectrophotometry, tracer techniques in soil and plant research.

Land degradation and restoration

Students study about the basic concepts, types, factors and processes of soil degradation, policy consideration.

System approach in soil research


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Students develop the skills in system concepts its characteristics and significance in soil research, use of model for decision support system.

Molecular genetics

Students gain the knowledge in model genetic system, principles of inheritance, qualitative and quantitative traits, DNA structure, DNA as genetic material, gene transfer in prokaryotes, eukaryotic genome.

Celi biology

Students study about the cell theory, origin and its concepts, membrane lipids: types and its function, **structure and function of ribosomes**, role of auxin and gibberellins in regulation of cellular function.

Plant tissue culture

Students learn about the **plant tissue culture**, laboratory organization and equipment, sterilization techniques, mutagenesis and selection of mutants in vitro.

Enzymology

Students develop skill in enzyme general introduction and historical resume, specificity of enzyme substrate binding site, factor affecting enzyme activity, active site mapping, clinical application of enzyme.

Protein engineering

Students know about the protein structure and functional relationship, post transitional, modification, fusion protein stability and delectability, alteration in biological properties.

Molecular biology

Students are expected to know about the historical development of molecular biology, biosynthesis in purines, mitochondrial genome, repetitive and non-repetitive **DNA, DNA sequencing method and approaches**.


Genetic engineering principle and method

Students will be able to acquire knowledge about recombinant DNA technology, DNA ligases, various method of gene isolation, animal transgenic, intellectual properties.

Introduction of industrial biotechnology

Students learn about the concept and scope of industrial biotechnology, single cell protein and vitamins, industrial production of commercially important bio fertilizer, phyto-remediation.

Biotechnology and society



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Students develop skill by know benefit of biotechnology, biotech and world economy, biotech and food safety, risk assessment, management and labelling, Indian initiative on human genome mapping.

Principles of immunology

Students know about the history and scope of immunology, immunoglobulins, chemistry and structure and their biological functions, immune regulation, immunological application in plant science.

Plant pathological techniques

Students learn about the laboratory equipments, their use, cleaning and sterilization of glassware, molecular techniques, chromatography and spectrophotometry, use of EM an SEM.

Mycology- 1

Students are expected to know introduction and importance of fungi milestones in mycology general characteristics, kingdom – Stramenopila: general characteristics of Phylum-Oomycota.

Introductory Bacteriology

Students learn about the nutritional growth factors, Classification and identification: group of bacteria including metabolism, Prokaryotic inhibitors, bacteriocins, fermentation, respiration, biological oxidation and variability. Important bacterial diseases: blight of rice, blight of cotton, wilt of solanaceous crops, soft rot of vegetables.

Diseases of Field Crops

Students study about the white rust of crucifers, Smut of wheat, barley, sorghum, maize, bajra and sugarcane, Bunt of wheat and rice, Wilts of chickpea, Grassy stunt of sugarcane and phyllody of Til. Ear cockle of wheat and Khaira disease of rice.

Seed Pathology

Students learn about the seed infection routes, location of inoculum, outcome of infection. Immunodiagnostic methods, nucleic acid-based methods including PCR.

Biological Control of Plant Diseases and Weeds

Students gain knowledge about the principles of biological control and factors affecting biological control.

Principles of plant pathology

Students will be able to develop skills by Concept, nature and classification of diseases with examples. Phenomenon of plant infection losses.

Diseases of plantation spices and medicinal plant


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Students are expected to know importance, losses, disease symptoms, disease cycle, epidemiology, and integrated management of following diseases, disease of different crops and forest trees.

Introductory virology

Students gain knowledge about history of plant virology and economic importance of plant virus, **symptomatology, taxonomy of plant viruses**, crop fruits, disease management, general control measure.

Chemicals in plant disease control

Students study about the definition of pesticide and related terms. History and development of chemical advantage, residue and health hazard, fungicidal resistance of plant pathogens.

Diseases of fruits and ornamental crops

Students develop the skills in symptomatology and life cycles of pathogen, epidemiology and management of fruits and ornamental crops.

Diseases of vegetable crops

Students will be able to gain knowledge about the vegetable diseases, diseases of solanaceous crops, causal organism, favourable condition and management of causal organism.

Plant disease management

Students learn about the history, principle and concepts of plant disease control, alteration of soil PH, chemical systemic and non-systemic fungicides, integrated disease management.

Plant disease clinic

Students study about the role and importance of plant disease clinic, survey, collection of disease samples from farmer's fields, disease diagnosis and management.

Mycology- 2

Students will be able to gain knowledge about the phylum- Chytridiomycota, general characteristics of phylum, life cycle of genus.

Essential Statistical Methods

Students will be able to understand and apply fundamental concepts of statistics in agriculture and allied disciplines.

Statistical Methods

Students will acquire theoretical knowledge and practical applications of descriptive statistical measures and coefficients, probability theory, sampling theory, and testing of hypothesis. .


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Computer Application

Students will acquire knowledge about the utility of MS-Office, Multimedia and File management, and gain skill full knowledge about word processing, power point presentations, and data entry in excel.

Mathematical Methods

Students will be able to understand and apply fundamental concepts of mathematics in problem solving.

Design of Experiments-I

Students will be able to understand the basic principles of Design of Experiments. Students will acquire knowledge about the layout and analysis of various experimental designs to analyze the experimental data.

Sampling Techniques-I

This course aims at exploring the various methods for data collection, analysis and interpretation of data. The students are familiarized with the various probability and non-probability sampling designs.

Economic Statistics

This course is meant for training the students in econometric methods and their applications in agriculture. This course would enable the students in understanding the economic phenomena through statistical tools and economics principles.


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Doctor of Philosophy

Advanced Micro Economics

Students will be able to gain knowledge of core concepts and models in the field of microeconomics, and to apply micro economic models to analyze real-world microeconomic phenomena and to evaluate issues of microeconomic policy. .

Advanced Production Economics

Students will be able to understand the concepts of resource allocation, and to analyze agricultural production functions and their characteristics.

Advanced Agricultural Marketing

Students will be able to understand the concepts of market organization, and to gain knowledge of the marketing efficiency and agricultural prices.

Advanced Econometrics

This course is meant to acquaint the students with optimization of resources with the help of Econometric models.

Mineral Nutrition of Field Crops

Students gain knowledge about historical background and scope of mineral nutrition. And understand deficiencies and role of elements in plant metabolism.

Advances in Agronomy

Students acquaint the concepts of recent trends in problems on production of agronomy.

Farming System

Students understand the methodology of farming approaches and acquainted farming system research for different agro climatic zones of India.

Soil Fertility Management

Students gain knowledge about the concepts of soil fertility and productivity in relation to soil fertility, bio-fertilizers and their significance in crop production.

Advances in Dry land Farming

Students understand the nature and extent of dry land farming. Identify special problems of dry land agriculture. Assess crop planning and management practices.

Crop Adaptation and Distribution

Students gain knowledge about the scope, climatic and soil factors determining the crop distribution.

Management of Saline and Alkali Soils


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Students acquainted the nature of saline soil, sodic soil, alkali soils and understand harmful effects of salts and responses to soil reaction.

Advances in Extension Education

Students will be able to know about the modern techniques of extension education

Advances in Training Technology

The aim of this course is to introduce the new perspectives related to "innovation" and help learners to apply the AIS framework especially in dealing with scaling up knowledge.

Advanced Research Designs and Techniques in Extension Education

Students are familiar with research design and understand the concept of scaling techniques.

Advanced Instructional Technology

Students are able to understand the role and importance of agriculture education in India.

Gender Issues in Rural Development

To familiarise the Students with the gender issues.

Transfer of Technology in Agriculture

Students are familiar with the concept of technology in agriculture and the methods of transferring the technology in agriculture.

Entrepreneurship Development

Developing the skills under entrepreneurial development

Organizational Development

Students are gain knowledge about organizational structure of development departments.

Media Management

Students gain information about Mass communication and the principal of media management.

Enzymology

Students gain information about the nature and function of enzyme, factor affecting enzyme action, enzyme system and coupled reaction.

Inorganic Nitrogen Metabolism


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Students acquire knowledge about the nitrogen cycle in the nature, biological nitrogen fixation, carbon assimilation in chemotrophs, oxidation of ammonia to nitrate and phosphorylation involved in denitrification.

Advance in Insect pest management

Students gain detailed information about the physiology of insect.

Advances in Insect Physiology

Detailed physiology of nervous and endocrine systems of Insects.

Advanced Insect Ecology

To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics. Study insect-plant interactions; get acquainted with biodiversity and conservation

Advance Insect Systematics

Students acquaint with the concept of supra specific and intra specific categories.

Advance in biological control

Students acquire knowledge about the mass culturing of biological control agents. Effect of semio- chemical on natural enemies.

Advances in Toxicology of Insecticides

To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.

Quarantine entomology

Students are familiar with insect pest quarantine- domestic and international.

Molecular Approaches in Entomological research

To acquaint the Students with the isolation of DNA/RNA, Purity determination, base pair estimation, restriction mapping of DNA, demonstration of PCR, RFLP technique.

Hybrid Seed Production

Students understand the methods of hybrid seed production in major agricultural and horticultural crops

Planning, Seed Movement and Quality Control


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Students gain information about the seed production programme for small, medium and big entrepreneurs demand forecasting preparation discussion with seed village programming producers, growers on farm plan working out models on seed quality.

Seed Vigour and Crop Productivity

Students will be able to understand the theory terminology and concept - genetic and physiological importance of seedling vigour to seed technology.

Testing for Genuineness and Purity of Cultivars

Students familiar with the objective of cultivar purity test, general principles and methods involved.

DUS Testing for Plant Variety Protection

Imparts training on differentiating the normal and abnormal morphology of any organ and thus is important to be a good clinician

Advances in Seed Science Research

The Students acquainted with knowledge about Physiological and molecular aspects of seed development and control of germination and dormancy: gene expression during development tolerance and conservation, etc.

Advances in Post Harvest Management of Seed

Trains Students on laboratory assessment of organ functioning

Seed Senescence

Concepts indices for measuring seed deterioration physiological and bio - chemical manifestations of seed deterioration, changes in respiration, enzymes.

Advances in Seed Science Research

Students are expected to learn physiological and molecular aspects of seed development and **control of germination and dormancy**.

Advances in Post-Harvest Management of Seed

Students gain information about economic seed processing and storage plant

Advanced Biotic resistance breeding

Screening of germplasm against various biotic factor, demonstration of breeding techniques management of **insecticide and fungicide**.

Advanced quality breeding


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Students getting information about the quality concept and quality consciousness of the crop

Advanced heterosis breeding

Students understand the concept of heterosis and inbreeding depression, approaches and method in exploitation of heterosis.

Advance Genetics

Students are used to develop trend in genetical research, development genetics, differentiation and development, **genetics cause of aggressiveness and abnormal behavior.**

Special Breeding Technique

Students use to learn the modification of conventional breeding technique improvement of pedigree and SSD method.

Advance Crop breeding

Students getting information about current problem, scope and future strategy of breeding cereals, pulses, oilseed, forage and fiber crop.

Quantitative Genetics

Students gain knowledge about quantitative systems/ techniques related to genetic improvement of crops, G x E Interaction etc.

Advance Abiotic Resistance Breeding

Screening of **germplasm against various abiotic factors** related to resistance, demonstration of breeding techniques of resistance breeding, management of herbicides, survey of field crops

Advance Production Breeding

Students are expected to gain information about biological, genetic and physiological ceiling in productivity improvement, physiological approaches to productivity, plant type concept, growth analysis parameters, sustained growth vigour.

Advance Seed Technology

To impart knowledge on the recent developments in various frontier areas of seed science and their application in seed technology.

Advanced soil physics

Students gain the knowledge about Stock's law synthetic soil conditioners, law of plastic flow, cohesive and adhesive forces in soil, air flow equation and air capacity of the soil.


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Chemistry of submerged soil

Students are expected to know changes taking place on submerged of soil, reduction products, decomposition of organic matter under submerged conditions and availability of nutrients.

Soil geology, pedology and micro pedology

Students learn about the geology in soil studies, relation between geology and soil mineralogy, petrology and petrography, mineral analysis in soil genesis and classification.

Techniques of soil research and instrumentation

Students study about the techniques of pots and sand culture and field experimentation. Atomic absorption spectro photometry, RF value, polargraphy and its application in soil.

Advances in soil fertility

Students develop the skills in historical development, concept of soil fertility, plant response to nutrients and function. Soil fertility evaluation, fertilizer reaction in soil.

Physical chemistry of soil

Students gain the knowledge about nature of organic and inorganic soil colloids , amphoteric nature and dynamic concept of soil colloids, ion activity concepts, ion diffusion, ion fixation, transport of ion.

Radioisotopes in soil research

Students learn about the radioactive isotopes and their application in agriculture, principles of radiotracer methodology.

Gene cloning theory

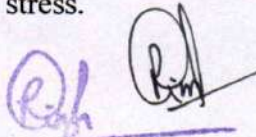
Students are expected to know about the concept of gene cloning, restriction in enzymes, modifying enzyme list, in vitro packaging, EMBL family and vector, binary vector for foreign DNA, new trends and future prospects.

Transformation technology

Students learn about the introduction of plant transformation, direct gene transfer method, quality improvement, recombinant antibody and downstream processing, trans gene position, trans gene features, future prospect of plant transformation.

Molecular biology and plant genetics stress

Students study about the abiotic stress, molecular mechanism of drought submergence, plant defence mechanism in response to abiotic stress.


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Genes of agronomic importance and its application

Students develop the knowledge by know about the present and potential application of genetic engineering crop production, chitinase, 1-3 beta glucanase, RIP fungal Protein, thionin, PR proteins, polymers and foreign protein in seed.

Advances in molecular market technology

Students learn about the market morphological, biochemical and molecular markers, double haploids PCR techniques, gene pyramidic, association mapping SNP.

Advances in plant genetic engineering

Students are expected to know about the promoter/tissue specific promoter, gene silencing, gene therapy, gene interaction, genome editing, terminator technology.

Advanced virology

Students are expected to know virus taxonomy, structure and physicochemical characterization of viruses, structure and functions of virus domains, phylogenetic relationship, origin, evaluation and interrelation with animal viruses.

Advanced bacteriology

Students learn about the bacterial classification, bacterial taxonomy, host pathogen interaction, primary disease determinants toxin and enzymes, type of bacterial polysaccharides.

Advanced mycology

Students gain knowledge about international code of botanical nomenclature, morphology of conidia and conidiogenous, classification of phylum Zygomycota, use of PCA and RELP for identification of fungi.

Bacterial virus and virus like diseases of plants

Students study about the different types of bacterial diseases and virus diseases commonly found in different types of crops, their management, treatment and control.

Insect's vectors of plant viruses and other pathogen

Students learn about the important insect vectors and their characteristics, transmission of plant viruses and other pathogens.

Advanced techniques in plant protection

Students are expected to know about the pest control equipment, principles operation, maintenance, selection, application of pesticides and biological agents, seed dressing, soaking, root deep treatment.


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International agricultural research and research ethics

Students study about the history of agriculture in brief, global agricultural research system, need, scope opportunities, research integrity, computer ethics, standards and problems in research ethics.

Plant quarantine and pest risk analysis

Students develop the skill by know about the WTO regulations, symptomatic diagnosis of disease, external and internal, contamination of food with toxigenic microorganism and their eliminations.

Molecular and biotechnological plant pathology

Students learn about the biotechnology definition, history, scope and importance of bio technology, use of tissue culture technique in plant pathology, PCR, RAPD, RFLP, AHLP to study the pathogenic biodiversity.

Epiphytology forecasting and assessment of losses

Students are expected to know epiphytology, phytoepidemics of the past and present, importance and selected literature, forecasting analysis, factor affecting virus disease epidemics.

Host plant resistance

Students study about the definition of resistance, immunity, and tolerance, history and importance of host plant, type of resistance, matching technique change in virulence pattern, host gene centers.

Linear Models and Regression Analysis

This course aims at providing the basics of linear estimation theory, along with the testing of hypothesis in linear models.

Advance Statistical inference

This is an advanced course in Statistical Inference that aims at describing some advanced level topics related to research such as robust estimation and Bayesian inference.

Advance Design of Experiments-I

This is an advanced course in design of experiments that aims at describing some advanced level topics to the students who wish to pursue research in experimental designs.

Advance Design of Experiments-II


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This is an advanced course in design of experiments that aims at describing some advanced level topics to the students who wish to pursue research in experimental designs.

Advance Sample Surveys-I

This is an advanced course in sampling theory that aims at describing some advanced level topics to the students who wish to pursue research in Sampling Theory.

Advance Sample Surveys-II

This is an advanced course in sampling theory that aims at describing some advanced level topics to the students who wish to pursue research in Sampling Theory.

Plant Nutrition and Metabolism

It provides knowledge on basic physiological processes governing nutrient uptake, physiological role of elements, factors influencing uptake, internal remobilization of nutrient element during starvation and adaptation strategies.

Advances in Production Physiology

The course provides a comprehensive theoretical and hands on experience and expertise to students on various aspects of Crop production

Physiological and Biochemistry of growth regulators

The course provides knowledge about Experiments on quantitative analysis of hormones, interaction of growth regulators and morphogenetic response of growth substances

Advances in Photosynthesis and Respiration

To acquaint the students with the practical knowledge about measurement of photosynthetic gas exchange. Infra-red gas analysis. Field monitoring of photosynthesis and respiration

Advances in Stress Physiology

To acquaint the students with the practical knowledge about Experiments related to drought, excess moisture, salinity, alkalinity, ionizing radiations and pollutions

Bioenergetics of Plant Processes

The course provides knowledge about Gibbs free energy and chemical potential, law of thermodynamics, energy fluxes, conversion of chemical and electrical energy.


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COLLEGE OF BIOTECHNOLOGY

SYLLABUS - II

PG (M.Tech/M.Sc)/ Ph.D
(Plant Molecular Biology & Biotechnology)



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OF AGRICULTURE AND TECHNOLOGY,
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College of Biotechnology
Course Structure- PG/ Ph.D. Program in

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Code	Course Title	Credits	Pages
BTF 501	Principles of Biotechnology**	2+1	07
BTM 502	Fundamentals of Molecular Biology**	3+0	08
BTC 503	Molecular Cell Biology**	3+0	08
BTF 504	Plant Tissue Culture & Genetic Transformation	1+2	09
BTA 505	Techniques In Molecular Biology I**	0+3	10
BTO 506	Microbial/ Industrial Biotechnology	2+1	10
BTF 507	Molecular Breeding	2+0	11
BTR 508	Genomics & Proteomics	2+0	12
BTA 509	Techniques In Molecular Biology II	0+3	13
BTO 510	Biosafety, IPR and Bioethics*	2+0	13
BTI 511	Animal Biotechnology*	3+0	14
BTI 512	Immunology and Molecular Diagnostics*	2+1	15
BTB 513	Nano-Biotechnology*	3+0	16
BTM 551	Principles of Genetics*	2+1	17
BTB 552	Basic Biochemistry*	2+1	17
BAS 553	Biostatistics and Computers*, **	2+1	18
BTP 554	Principles of Microbiology*	2+1	19
BTI 555	Introduction to Bioinformatics	2+1	20
BTC 556	Environmental Biotechnology	3+0	20
BTS 591	Master's Seminar	1+0	-
BTS 599	Master's Research	20	-
BTM 601	Advances in Plant Molecular Biology	3+0	21
BTM 602	Advances in Genetic Engineering	3+0	22
BTP 603	Advances in Microbial Biotechnology	3+0	22
BTF 604	Advances in Crop Biotechnology	3+0	23
BTR 605	Advances in Functional Genomics and Proteomics	2+0	23
BTO 606	Commercial Plant Tissue Culture	2+0	24
BTI 607	Advances in Animal Biotechnology	2+0	24
BTS 691	Doctoral Seminar I	1+0	-
BTS 692	Doctoral Seminar II	1+0	-
BTS 699	Doctoral Research	45	-

*May be taken as minor/ supporting course (07 course: 22 credit), **Compulsory for M.Sc./M.Tech. Program (05 course: 15 credit)


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ORGANIZATION OF COURSE CONTENTS & CREDIT REQUIREMENTS

Code Numbers

- All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level.
- A Ph.D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's program.
- Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
- Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Minimum Credit Requirements

S.	Subject	Master's Program	Doctoral Program
1.	Major	20	15
2.	Minor	09	08
3.	Supporting	05	05
4.	Seminar	01	02
5.	Research	20	45
6.	Total Credits	55	75
7.	Compulsory Non Credit Courses	PGS 501- PGS 506	

Major subject: The subject (department) in which the students takes admission

Minor subject: The subject closely related to students major subject (e.g., if the major subject is Entomology, the appropriate minor subjects should be Plant Pathology or Nematology).

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work.

Non-Credit Compulsory Courses: Please see the relevant section for details. Six courses (PGS 501-PGS 506) are of general nature and are compulsory for Master's program. Ph. D. students may be exempted from these courses if already studied during Master's degree.

CODE	COURSE TITLE	CREDITS
PGS 501	Library and Information Services	0+1
PGS 502	Technical Writing and Communications Skills	0+1
PGS 503	Intellectual Property and Its Management in Agriculture	1+0
PGS 504	Basic Concepts in Laboratory Techniques	0+1
PGS 505	Agricultural Research, Research Ethics and Rural Development Programs	1+0
PGS 506	Disaster Management	1+0



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List of Course
M.Sc/ M.Tech. (Pl. Mol. Biol. & Biotech.)

M-Tech. (I Sem: PMBB New)

S.	Type of Course	Course Code	Course	Credit
1	Major/ Compulsory	BTF- 501	Principles of Biotechnology**	2+1
2	Major/ Compulsory	BTM- 502	Fundamentals of Molecular Biology**	3+0
3	Major/ Compulsory	BTC- 503	Molecular Cell Biology**	3+0
4	Major/ Supporting	BTI- 555	Introduction to Bioinformatics	2+1
5	Minor/ Supporting	BTM- 551	Principles of Genetics*	2+1
6	Major/ Supporting	BTF-504	Plant Tissue Culture & Genetic Transformation	1+2
7.	Minor/ Supporting	BTP- 554	Principles of Microbiology*	2+1
8.	Non credit	PGS- 501-506	Compulsory Non Credit Courses (06 PGS courses)	

*

Major 20 credit (Major/ compulsory, Major/ supporting), Minor 09 credit, Supporting 05 credit

M-Tech. (II Sem: PMBB New)


S.	Type of Course	Code	Course Name	Credit
1	Major/ Compulsory	BTA-505	Techniques In Molecular Biology I**	0+3
2	Major/ Compulsory	BAS 553	Biostatistics and Computers*, **	2+1
3	Seminar	BTS 591	Master's Seminar	1+0
4	Major/ Supporting	BTM 507	Molecular Breeding	2+0
5	Major/ Supporting	BTC 556	Environmental Biotechnology	3+0
6	Minor/ Supporting	BTB-522	Basic Biochemistry*	2+1
7	Minor/ Supporting	BTI- 512	Immunology and Molecular Diagnostics*	2+1
8	PGS 501-506	Compulsory Non Credit Courses (06 PGS courses)		

* Major 20 credit (Major/ compulsory, Major/ supporting), Minor 09 credit, Supporting 05 credit

M-Tech. (III Sem: PMBB New)

S.	Type of Course	Course Code	Course	Credit
1.	Major/ Supporting	BTR- 508	Genomics & Proteomics	2+0
2.	Major/ Supporting	BTO- 506	Microbial/ Industrial Biotechnology	2+1
3.	Minor/ Supporting	BTI- 511	Animal Biotechnology*	3+0
4.	Minor/ Supporting	BTB- 513	Nano-Biotechnology*	3+0
5.	Minor/ Supporting	BTO- 510	Biosafety, IPR and Bioethics*	2+0
6.	PGS 501-506	Compulsory Non Credit Courses (06 PGS courses)		

* Major 20 credit (Major/ compulsory, Major/ supporting), Minor 09 credit, Supporting 05 credit


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List of Course
Ph.D. (Pl. Mol. Biol. & Biotech.)

Ph.D. (I Sem: PMBB New)

S.	Type of Course	Course Code	Course	Credit
1.	Major/ Supporting	BTM 601	Advances in Plant Molecular Biology	3+0
2.	Major/ Supporting	BTP 603	Advances in Microbial Biotechnology	3+0
3.	Major/ Supporting	BTI 607	Advances in Animal Biotechnology	2+0
4.	Seminar	BTS 692	Doctoral Seminar I	1+0
5.	Major/ Supporting	BTA 509	Techniques In Molecular Biology II	0+3
6.	Non credit	PGS 501-506	Compulsory Non Credit Courses (06 PGS courses)	

* A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's program. Non Credit courses must be taken if not studies during PG.

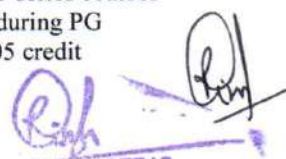
* Major 15 credit (Major/ compulsory, Major/ supporting), Minor 08 credit, Supporting 05 credit.

Ph.D. (II Sem: PMBB New)

S.	Type of Course	Code	Course Name	Credit
1.	Major/ Supporting	BTM 602	Advances in Genetic Engineering	3+0
2.	Major/ Supporting	BTF 604	Advances in Crop Biotechnology	3+0
3.	Major/ Supporting	BTR 605	Advances in Functional Genomics and Proteomics	2+0
4.	Major/ Supporting	BTO 606	Commercial Plant Tissue Culture	2+0
5.	Seminar	BTS 691	Doctoral Seminar II	1+0
6.	PGS 501-506	Compulsory Non Credit Courses (06 PGS courses)		

* A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's program. Non Credit courses must be taken if not studies during PG

* Major 15 credit (Major/ compulsory, Major/ supporting), Minor 08 credit, Supporting 05 credit


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PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Contents

Course Contents

The contents of each course have been organized into:

- Objective – to elucidate the basic purpose.
- Theory units – to facilitate uniform coverage of syllabus for paper setting.
- Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
- A list of journals pertaining to the discipline is provided at the end, which may be useful as study material for 600-series courses as well as research topics.
- E-Resources - for quick update on specific topics/events pertaining to the subject.
- Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

BTF 501 PRINCIPLES OF BIOTECHNOLOGY 2+1

Objective

To familiarize the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.

Theory

UNIT I

History, scope and importance; DNA structure, function and metabolism.

UNIT II

DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications.

UNIT III

Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics.

UNIT IV

General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

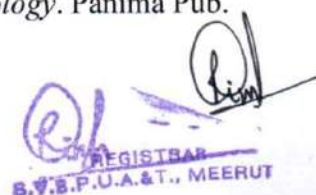
Practical

- i. Isolation of genomic and plasmid DNA
- ii. Gel electrophoresis techniques
- iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
- iv. PCR and molecular marker analysis
- v. Plant tissue culture: media preparation, cell and explant culture, regeneration and transformation.

Suggested Readings

Becker JM, Coldwell GA & Zachgo EA. 2007. *Biotechnology – a Laboratory Course*. Academic Press.

Brown CM, Campbell I & Priest FG. 2005. *Introduction to Biotechnology*. Panima Pub.


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Brown TA. *Gene Cloning and DNA Analysis*. 5th Ed. Blackwell Publishing.
Dale JW & von Schantz M. 2002. *From Genes to Genomes: Concepts and Applications of DNA Technology*. John Wiley & Sons.
Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publications.
Sambrook J, Fritsch T & Maniatis T. 2001. *Molecular Cloning – a Laboratory Manual*. 2nd Ed. Cold Spring Harbour Laboratory Press.
Singh BD. 2007. *Biotechnology Expanding Horizon*. Kalyani Publishers.

BTM 502 FUNDAMENTALS OF MOLECULAR BIOLOGY 3+0

Objective

To familiarize the students with the basic cellular processes at molecular level.

Theory

UNIT I

Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA.

UNIT II

Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms.

UNIT III

Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases.

UNIT IV

Translation and post-translational modifications; Operon concept; Attenuation of *trp* operon; important features of gene regulation in eukaryotes.

Suggested Readings

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.
Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publishers.
Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. W.H. Freeman & Co.
Primrose SB. 2001. *Molecular Biotechnology*. Panima.
Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education International.

BTC 503 MOLECULAR CELL BIOLOGY 3+0

Objective

To familiarize the students with the cell biology at molecular level.

Theory

UNIT I

General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions.

UNIT II


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Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc.

UNIT III

Organelle genomes and their manipulation; Ribosomes in relation to cell growth and division; Cyto-skeletal elements.

UNIT IV

Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

Suggested Readings

Gupta PK. 2003. *Cell and Molecular Biology*. 2nd Ed. Rastogi Publ.

Lodish H. 2003. *Molecular Cell Biology*. 5th Ed. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panima.

BTF 504 PLANT TISSUE CULTURE AND GENETIC 1+2 TRANSFORMATION

Objective

To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

Theory

UNIT I

History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; *In vitro* differentiation: organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on *in vitro* culture and regeneration; Molecular basis of plant organ differentiation.

UNIT II

Micropropagation; Anther and microspore culture; Somaclonal variation; *In vitro* mutagenesis; *In vitro* fertilization; *In vitro* germplasm conservation; Production of secondary metabolites; Synthetic seeds.

UNIT III

Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc.

UNIT IV

Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

Practical

i. Laboratory set-up.

ii. Preparation of nutrient media; handling and sterilization of plant material; inoculation, subculturing and plant regeneration.

iii. Anther and pollen culture.

iv. Embryo rescue.

v. Suspension cultures and production of secondary metabolites.

vi. Protoplast isolation, culture and fusion.

vii. Gene cloning and vector construction

viii. Gene transfer using different methods, reporter gene expression, selection of transformed tissues/plants, molecular analysis.


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Suggested Readings

- Bhojwani SS. 1983. *Plant Tissue Culture: Theory and Practice*. Elsevier.
Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.
Dixon RA. 2003. *Plant Cell Culture*. IRL Press.
George EF, Hall MA & De Klerk GJ. 2008. *Plant Propagation by Tissue Culture*. Agritech Publ.
Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publ.
Herman EB. 2005-08. *Media and Techniques for Growth, Regeneration and Storage*. Agritech Publ.
Pena L. 2004. *Transgenic Plants: Methods and Protocols*. Humana Press.
Pierik RLM. 1997. *In vitro Culture of Higher Plants*. Kluwer.
Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani.

BTA 505 TECHNIQUES IN MOLECULAR BIOLOGY-I 0+3

Objective

To provide hands on training on basic molecular biology techniques.

Practical

UNIT I

Good lab practices; Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography).

UNIT II

Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Growth of bacterial culture and preparation of growth curve; Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Restriction digestion of plasmid and phage DNA; Isolation of high molecular weight DNA and analysis.

UNIT III

Gene cloning – Recombinant DNA construction, transformation and selection of transformants; PCR and optimization of factors affecting PCR.

UNIT IV

Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

Suggested Readings

- Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. John Wiley.
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.

BTO 506 MICROBIAL/ INDUSTRIAL BIOTECHNOLOGY 2+1

Objective

To familiarize about the various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.

Theory

UNIT I



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Introduction, scope and historical developments; Isolation, screening and genetic improvement (involving classical approaches) of industrially important organisms.

UNIT II

Primary metabolism products, production of industrial ethanol as a case study; Secondary metabolites, bacterial antibiotics and non ribosomal peptide antibiotics; Recombinant DNA technologies for microbial processes; Strategies for development of industrial microbial strains with scale up production capacities; Metabolic pathway engineering of microbes for production of novel product for industry.

UNIT III

Microbial enzymes, role in various industrial processes, production of fine chemicals for pharmaceutical industries; Bio-transformations, Bioaugmentation with production of vitamin C as a case study; Bioreactors, their design and types; Immobilized enzymes based bioreactors; Microencapsulation technologies for immobilization of microbial enzymes.

UNIT IV

Industrial biotechnology for pollution control, treatment of industrial and other wastes, biomass production involving single cell protein; Bioremediation of soil; Production of eco-friendly agricultural chemicals, biopesticides, bio-herbicides, bio-fertilizers, bio-fuels, etc.

Practical

- i. Isolation of industrially important microorganisms, their maintenance and improvement.
- ii. Production of industrial compounds such as alcohol, beer, citric acid, lactic acid and their recovery.
- iii. Study of bio-reactors and their operations.
- iv. Production of biofertilizers.
- v. Experiments on microbial fermentation process, harvesting purification and recovery of end products.
- vi. Immobilization of cells and enzymes, studies on its kinetic behavior, growth analysis and biomass estimation.
- vii. Determination mass transfer co-efficients.

Suggested Readings

- Huffnagle GB & Wernick S. 2007. *The Probiotics Revolution: The Definitive Guide to Safe, Natural Health*. Bantam Books.
- Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
- Primrose SB. 2001. *Molecular Biotechnology*. Panima.

BTF 507 MOLECULAR BREEDING 2+0

Objective

To familiarize the students about the use of molecular biology tools in plant breeding.

Theory

UNIT I

Principles of plant breeding; Breeding methods for self and cross pollinated crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding.

UNIT II

Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits.

UNIT III


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QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding.

UNIT IV

Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding; MAS for specific traits with examples.

Suggested Readings

Chittaranjan K. 2006-07. *Genome Mapping and Molecular Breeding in Plants*. Vols. I-VII. Springer.

Newbury HJ. 2003. *Plant Molecular Breeding*. Blackwell Publ.

Weising K, Nybom H, Wolff K & Kahl G. 2005. *DNA Fingerprinting in Plants: Principles, Methods and Applications*. Taylor & Francis.

BTR 508 GENOMICS AND PROTEOMICS 2+0

Objective

To familiarize the students with recent tools used for genome analysis and their applications.

Theory

UNIT I

Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

UNIT II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

UNIT III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

UNIT IV

Applications of genomics and proteomics in agriculture, human health and industry.

Suggested Readings

Azuaje F & Dopazo J. 2005. *Data Analysis and Visualization in Genomics and Proteomics*. John Wiley & Sons.

Brown TA. 2007. *Genome III*. Garland Science Publ.

Campbell AM & Heyer L. 2004. *Discovery Genomics, Proteomics and Bioinformatics*. Pearson Education.

Gibson G & Muse SV. 2004. *A Primer of Genome Science*. Sinauer Associates.

Jollès P & Jönrvall H. 2000. *Proteomics in Functional Genomics: Protein Structure Analysis*. Birkhäuser.

Kamp RM. 2004. *Methods in Proteome and Protein Analysis*. Springer.

Primrose SB & Twyman RM. 2007. *Principles of Genome Analysis and Genomics*. Blackwell.

Sensen CW. 2005. *Handbook of Genome Research*. Vols. I, II. Wiley CVH.


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BTA 509 TECHNIQUES IN MOLECULAR BIOLOGY-II 0+3

Objective

To provide hands on training on various molecular techniques used in molecular breeding and genomics.

Practical

UNIT I

Construction of gene libraries; Synthesis and cloning of cDNA and RTPCR analysis; Real time PCR and interpretation of data.

UNIT II

Molecular markers (RAPD, SSR, AFLP etc) and their analysis; Case study of SSR markers (linkage map, QTL analysis etc); SNP identification and analysis; Microarray studies and use of relevant software.

UNIT III

Proteomics (2D gels, mass spectrometry, etc.); RNAi (right from designing of construct to the phenotyping of the plant); Yeast 1 and 2-hybrid interaction.

UNIT IV

Generation and screening of mutants; Transposon mediated mutagenesis.

Suggested Readings

Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA & Struhl K. 2002. *Short Protocols in Molecular Biology*. Wiley.

Caldwell G, Williams SN & Caldwell K. 2006. *Integrated Genomics: A Discovery-Based Laboratory Course*. John Wiley.

Sambrook J, Russel DW & Maniatis T. 2001. *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.

BTO 510 BIOSAFETY, IPR AND BIOETHICS 2+0

Objective

To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.

Theory

UNIT I

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT II

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

UNIT III

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and nonradio isotopic procedure; Benefits of transgenics to human health, society and the environment.

UNIT IV


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The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Suggested Readings

Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani.

<http://patentoffice.nic.in>

www.wipo.org

www.dbtindia.nic.in

www.dbtbiosafety.nic.in

BTI 511 ANIMAL BIOTECHNOLOGY 3+0

Objective

Intended to provide an overview and current developments in different areas of animal biotechnology.

Theory

UNIT I

Structure of animal cell; History of animal cell culture; Cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT II

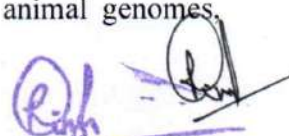
Introduction to immune system, cellular and hormonal immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

UNIT III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

UNIT IV

Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes.


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SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

Suggested Readings

- Gordon I. 2005. *Reproductive Techniques in Farm Animals*. CABI.
Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.
Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.
Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.
Twyman RM. 2003. *Advanced Molecular Biology*. Bios Scientific.

BTI IMMUNOLOGY AND MOLECULAR DIAGNOSTICS 2+1

Objective

To discuss the application of various immunological and molecular diagnostic tools.

Theory

UNIT I

History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin chemistry, structure and functions; Molecular organization of immunoglobulins and classes of antibodies.

UNIT II

Antibody diversity; antigens, haptens, antigens- antibody interactions; immuno-regulation and tolerance; Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques.

UNIT III

Immunological application in plant science, monoclonal antibodies and their uses, molecular diagnostics. Introduction to the basic principles of molecular technology and techniques used in pathogen detection, Principles of ELISA and its applications in viral detection.

UNIT IV

Basics and procedures of PCR, Real time PCR, PCR based and hybridization based methods of detection, microarrays based detection, multiplexing etc, detection of soil borne and seed born infections, transgene detection in seed, planting material and processed food, molecular detection of varietal impurities and seed admixtures in commercial consignments.

Practical

- i. Preparation of buffers and reagents.
- ii. Immunoblotting, immunoelectrophoresis and fluorescent antibody test.
- iii. Enzyme immunoassays including ELISA western blotting.
- iv. Extraction and identification of DNA/RNA of pathogenic organisms.


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- v. Restriction hybridoma technique and production of monoclonal antibodies.
- vi. Immunogenic proteins, expression and immunogenicity studies, purification of immunogenic protein and immunization of laboratory animals.

Suggested Readings

- Bloom BR & Lambert P-H. 2002. *The Vaccine Book*. Academic Press.
- Elles R & Mountford R. 2004. *Molecular Diagnosis of Genetic Disease*. Humana Press.
- Kindt TJ, Goldsby RA & Osbrne BA. 2007. *Kuby's Immunology*. WH Freeman.
- Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
- Lowrie DB & Whalen R. 2000. *DNA Vaccines*. Humana Press.
- Male D, Brostoff J, Roth DB & Roitt I. 2006. *Immunology*. Elsevier.
- Rao JR, Fleming CC & Moore JE. 2006. *Molecular Diagnostics*. Horizon Bioscience.
- Robinson A & Cranage MP. 2003. *Vaccine Protocols*. 2nd Ed. Humana Press.
- Springer TA, 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

BTB 513 NANO-BIOTECHNOLOGY 3+0

Objective

Understanding the molecular techniques involved in structure and functions of nano-biomolecules in cells such as DNA, RNA and proteins.

Theory

UNIT I

Introduction to Biomacromolecules: The modern concepts to describe the conformation and dynamics of biological macromolecules: scattering techniques, micromanipulation techniques, drug delivery applications etc.

UNIT II

Cellular engineering: signal transduction in biological systems, feedback control signaling pathways, cell-cell interactions etc. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

UNIT III

Chemical, physical and biological properties of biomaterials and bioresponse: biomineralization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins);

Aerosol properties, application and dynamics; Statistical Mechanics in Biological Systems,

UNIT IV

Preparation and characterization of nanoparticles; Nanoparticulate carrier systems; Micro- and Nano-fluidics; Drug and gene delivery system; Microfabrication, Biosensors, Chip technologies, Nano- imaging, Metabolic engineering and Gene therapy.

Suggested Readings

- Nalwa HS. 2005. *Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology*. American Scientific Publ.
- Niemeyer CM & Mirkin CA. 2005. *Nanobiotechnology*. Wiley Interscience.


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BTM 551 PRINCIPLES OF GENETICS 2+1

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problemsolving skills from classical to molecular genetics.

Theory

UNIT I

Early concepts of inheritance; Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sexlimited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics.

UNIT II

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes; Mutations and mutagenic agents.

UNIT III

Genetic code and protein biosynthesis; Gene regulation, Genes in development; Extra chromosomal inheritance, Male sterility and incompatibility; Recombination in bacteria, fungi and viruses, tetrad analysis.

UNIT IV

Inheritance of quantitative traits; Concepts in population genetics; Genes and behavior; Genetics and evolution; Recombinant DNA technology; Genetic fine structure analysis, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families; An overview of some recent discoveries in the field of genetics.

Practical

- i. Laboratory exercises in probability and chi-square.
- ii. Demonstration of genetic principles using laboratory organisms.
- iii. Chromosome mapping using three point test cross.
- iv. Tetrad analysis.
- v. Induction and detection of mutations through genetic tests.
- vi. Pedigree analysis in humans.
- vii. Numerical problems on Hardy Weinberg Equilibrium, Quantitative inheritance and Molecular genetics.

Suggested Readings

- Klug WS & Cummings MR. 2003 *Concepts of Genetics*. Peterson Education.
Lewin B. 2008. *Genes IX*. Jones & Bartlett Publ.
Russell PJ. 1998. *Genetics*. The Benzamin/Cummings Publ. Co.
Strickberger MW. 1990. *Genetics*. Collier MacMillan.
Tamarin RH. 1999. *Principles of Genetics*. Wm. C. Brown Publs.
Uppal S, Yadav R, Subhadra & Saharan RP. 2005. *Practical Manual on Basic and Applied Genetics*. Dept. of Genetics, CCS HAU Hisar.

BTB 552 BASIC BIOCHEMISTRY 2+1

Objective

To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

Theory

UNIT I


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Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to physical techniques for determination of structure of biopolymers.

UNIT II

Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

UNIT III

Structure and biological functions of vitamins, enzymes classification and mechanism of action; regulation, factors affecting enzyme action. Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

UNIT IV

Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation; recombinant DNA technology, Nutritional aspects of carbohydrates, lipids, proteins and minerals.

Practical

- i. Preparation of standard and buffer solutions.
- ii. Extraction and estimation of sugars and amino acids.
- iii. Estimation of proteins by Lowry's method.
- iv. Estimation of DNA and RNA by Diphenylamine and orcinol methods.
- v. Estimation of ascorbic acid.
- vi. Separation of biomolecules by TLC and paper chromatography

Suggested Readings

- Conn EE & Stumpf PK. 1987. *Outlines of Biochemistry*. John Wiley.
Metzler DE. *Biochemistry*. Vols. I, II. Wiley International.
Nelson DL & Cox MM. 2004. *Lehninger's Principles of Biochemistry*. MacMillan.
Voet D & Voet JG. *Biochemistry*. 3rd Ed. Wiley International.

BAS 553 BIOSTATISTICS AND COMPUTERS 2+1

Objective

This is the special course for M.Sc. students of Biotechnology. They are exposed to various statistical methods to analyze their experimental data.

Theory

UNIT I

Aims, scope and idea of elementary statistics; Measures of central tendency and dispersion, skewness and kurtosis.

UNIT II

Concept of probability and probability laws, mathematical expectation, moments, moments generating function; Standard probability distributions- Binomial, Poisson and Normal distributions.

UNIT III

Tests of significance based on Z, χ^2 , t and F statistics; Correlation and regression, curve fitting by least squares methods.

UNIT IV


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Basic principles, organization and operational aspects of computers, operating systems. Introduction to MS-Office, MS-Word, MS-Excel. Statistical Data analysis based on above topics through MS-Excel.

Practical

- i. Data analysis using probability, test of significance
- ii. Correlation and regression analysis
- iii. Usage of MS-Windows
- iv. Exercises on test processing, spreadsheet and DBMS
- v. SPSS

Suggested Readings

Agarwal BL. 2003. *Basic Statistics*. New Age.
Gupta SP. 2004. *Statistical Methods*. S. Chand & Sons.
Dutta NK. 2002. *Fundamentals of Bio-Statistics*. Kanishka Publ.

BTP 554 PRINCIPLES OF MICROBIOLOGY 2+1

Objective

To acquaint the students with history, classification and role of microbiology in agriculture, food and environment.

Theory

UNIT I

Development of Microbiology in the 18th and 19th century. Morphology, structure and function of prokaryotic and eukaryotic cell. Archea. Classification of prokaryotes – Basic principles and techniques used in bacterial classification.

UNIT II

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy. Use of DNA and r-RNA sequencing in classifications.

UNIT III

Study of major groups of bacteria belonging to Gracilicutes, Firmicutes, Tanericutes and Mendosicutes.

UNIT IV

Viruses – morphology, classification and replication of plant, animal and bacterial viruses. Cultivation methods of viruses. Immune response – specific and non-specific resistance. Normal microflora of human body; some common bacterial and viral diseases of humans and animals.

Practical

- i. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
- ii. Enrichment culture technique – isolation of asymbiotic, symbiotic nitrogen fixing bacteria. Isolation of photosynthetic bacteria.
- iii. Use of selective media, antibiotic resistance and isolation of antibiotic producing microorganisms.
- iv. Morphological, physiological and biochemical characterization of bacteria.

Suggested Readings

Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.
Pelczar ML Jr. 1997. *Microbiology*. Tata McGraw Hill.
Stainier RY, Ingraham JL, Wheelis ML & Painter PR. 2003. *General Microbiology*. MacMillan.
Tauro P, Kapoor KK & Yadav KS. 1996. *Introduction to Microbiology*. Wiley Eastern.


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BTI 555 INTRODUCTION TO BIOINFORMATICS 2+1

Objective

To impart an introductory knowledge about the subject of bioinformatics to the students studying any discipline of science.

Theory

UNIT I

Introduction, biological databases – primary, secondary and structural, Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genbank, DDBJ. Specialized genomic resources.

UNIT II

DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment.

UNIT III

Secondary database searching, building search protocol, computer aided drug design – basic principles, docking, QSAR.

UNIT IV

Analysis packages – commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

Practical

- i. Usage of NCBI resources
- ii. Retrieval of sequence/structure from databases
- iii. Visualization of structures
- iv. Docking of ligand receptors
- v. BLAST exercises.

Suggested Readings

Attwood TK & Parry-Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.
Rastogi SC, Mendiratta N & Rastogi P. 2004. *Bioinformatics: Concepts, Skills and Applications*. CBS.

BTC 556 ENVIRONMENTAL BIOTECHNOLOGY 3+0

Objective

To apprise the students about the role of biotechnology in environment management for sustainable eco-system and human welfare.

Theory

UNIT I

Basic concepts and environmental issues; types of environmental pollution; problems arising from high-input agriculture; methodology of environmental management; air and water pollution and its control; waste water treatment - physical, chemical and biological processes; need for water and natural resource management.

UNIT II

Microbiology and use of micro-organisms in waste treatment; biodegradation; degradation of Xenobiotic, surfactants; bioremediation of soil & water contaminated with oils, pesticides & toxic chemicals, detergents etc; aerobic processes (activated sludge, oxidation ditches, trickling filter, rotating drums, etc); anaerobic processes: digestion, filtration, etc.

UNIT III


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Renewable and non-Renewable resources of energy; energy from solid waste; conventional fuels and their environmental impact; biogas; microbial hydrogen production; conversion of sugar to alcohol; gasohol; biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

UNIT IV

Treatment schemes of domestic waste and industrial effluents; food, feed and energy from solid waste; bioleaching; enrichment of ores by microorganisms; global environmental problems: ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation; biotechnological approaches for the management environmental problems.

Suggested Readings

Evans GM & Furlong JC. 2002. *Environmental Biotechnology: Theory and Application*. Wiley International.

Jordening H-J & Winter J. 2006. *Environmental Biotechnology: Concepts and Applications*. Wiley-VCH Verlag.

BTM 601 ADVANCES IN PLANT MOLECULAR BIOLOGY 3+0

Objective

To discuss the specialized topics and recent advances in the field of plant molecular biology.

Theory

UNIT I

Arabidopsis in molecular biology, Forward and Reverse Genetic Approaches, Transcriptional and post-transcriptional regulation of gene expression, isolation of promoters and other regulatory elements.

UNIT II

RNA interference, Transcriptional gene silencing, Transcript and protein analysis, use of transcript profiling to study biological systems.

UNIT III

Hormone regulatory pathways: Ethylene, Cytokinin, Auxin and ABA, SA and JA; ABC Model of Floral Development, Molecular basis of self incompatibility, Regulation of flowering: photoperiod, vernalization, circadian rhythms.

UNIT IV

Molecular biology of abiotic stress responses: Cold, high temperature, submergence, salinity and drought; Molecular Biology of plant-pathogen interactions, molecular biology of *Agrobacterium* Infection, Molecular biology of *Rhizobium* infection (molecular mechanisms in symbiosis), Programmed cell death in development and defense.

Suggested Readings

Buchanan B, Gruissen W & Jones R. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Physiologists, USA.

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panima.

Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publ.

Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. WH Freeman & Co.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008.

Molecular Biology of the Gene. 6th Ed. Pearson Education.


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BTM 602 ADVANCES IN GENETIC ENGINEERING 3+0

Objective

To discuss the specialized topics and advances in field of genetic engineering and their application in plant improvement.

Theory

UNIT I

General overview of transgenic plants; Case studies: Genetic engineering of herbicide resistance, Transgenic plants resistant to insects/pests, Genetic engineering of abiotic stress tolerance, Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in plants.

UNIT II

Molecular farming of plants for applications in veterinary and human medicine systems: Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

UNIT III

Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

UNIT IV

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

Suggested Readings

Christou P & Klee H. 2004. *Handbook of Plant Biotechnology*. John Wiley & Sons.
Specific journals mentioned later.

BTP 603 ADVANCES IN MICROBIAL BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics about industrially important microorganisms.

Theory

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostate cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Down stream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live



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S.V.B.P.U.A.&T., MEEBUT

vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

Suggested Readings

Specific journals and published references.

BTF 604 ADVANCES IN CROP BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics on the application of molecular tools in breeding of specific crops.

Theory

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

UNIT II

Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

UNIT III

Molecular breeding: constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on marker assisted selection of qualitative and quantitative traits.

UNIT IV

Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

Suggested Readings

Specific journals and published references.

BTR 605 ADVANCES IN FUNCTIONAL GENOMICS 2+0 AND PROTEOMICS

Objective

To discuss recent advances and applications of functional genomics and proteomics in agriculture, medicine and industry.

28

Theory

UNIT I

Genome sequencing and functional genomics; Human, animal, plant, bacterial and yeast genome projects; genome annotation; *ab initio* gene discovery; functional annotation and gene family clusters; etc.

UNIT II

Functional analysis of genes; RNA-mediated interference; gene knockoffs; Gene traps/ T-DNA insertion lines; homologous recombination; microarray profiling; SAGE; SNPs/variation; yeast-

two hybrid screening; gene expression and transcript profiling; EST contigs; EcoTILLING; allele/gene mining; synteny and comparative genomics; Genome evolution, speciation and domestication etc.

UNIT II

Proteomics: protein annotation; protein separation and 2D PAGE; mass spectroscopy; protein microarrays; protein interactive maps; structural proteomics: protein structure determination, prediction and threading, software and data analysis/ management, etc.

UNIT IV

Discussion on selected papers on functional genomics, proteomics, integrative genomics etc.

Suggested Readings

Specific journals and published references.

BTO 606 COMMERCIAL PLANT TISSUE CULTURE 2+0

Objective

To discuss the commercial applications of plant tissue culture in agriculture, medicine and industry.

Theory

UNIT I

Micropropagation of commercially important plant species; plant multiplication, hardening, and transplantation; genetic fidelity; scaling up and cost reduction; bioreactors; synthetic seeds; management and marketing.

UNIT II

Production of useful compounds via biotransformation and secondary metabolite production: suspension cultures, immobilization, examples of chemicals being produced for use in pharmacy, medicine and industry.

UNIT III

Value-addition by transformation; development, production and release of transgenic plants; patent, bio-safety, regulatory, environmental and ethic issues; management and commercialization.

UNIT IV

Some case studies on success stories on commercial applications of plant tissue culture. Visits to some tissue culture based commercial units/industries.

Suggested Readings

Specific journals and published references.

BTI 607 ADVANCES IN ANIMAL BIOTECHNOLOGY 2+0

Objective

Intended to provide cutting edge knowledge on advances in different areas of animal biotechnology.

Theory

UNIT I

Advances in animal cell culture technology, suspension culture technology, advances in commercial scale productions of mammalian cells.

UNIT II



REGISTRAR
S.V.B.P.U.A.&T., MEEBVI

Advances in cell cloning and cell hybridization, advances in monoclonal antibody production technology, Advances in diagnostic technology, Computational vaccinology, reverse genetics based vaccines.

UNIT III

Advances in embryo manipulation, knock out and knock in technology, advances in animal cloning technology, stem cell technology, Advances in development of animal models for human diseases using transgenic animal technology.

UNIT IV

Advances in genetic basis for animal disease resistance, Molecular methods for animal forensics, Advances in animal genomics, proteomics,

Suggested Readings

Selected articles from journals.


REGISTRAR
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PG/Ph.D
Plant Molecular Biology & Biotechnology

Duration (PG)	Two academic years (4 semesters)
Duration (Ph.D)	Three academic years (6 semesters)
Minimum Eligibility, Curriculum Structure & other details:	http://www.svpuat.ac.in/

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO1: To equip students with fundamental concepts of core domain subjects of Biological systems, environment and biotechnology and learn how different biotechnological approaches are used around the world to manage various relevant issues in diverse areas of Plant biology.
- PEO2: To encourage students for undertaking various latest and innovative research theme and ideas, which benefit society. The student will develop simulations to think as a biotechnological strategist and design an appropriate solution to diverse problems in areas of Agriculture, Health, Industry etc.
- PEO3: To provide practical experience and exposure of working on diverse biotechnological problems. Students will develop ethical practices and imbibe values for becoming Biotechnology professionals.
- PEO4: To equip students with latest analytical tools and bioinformatics software, which help in analysis of the biological and environmental factors relevant to various segments of Plant biotechnology.

PROGRAMME OUTCOMES (POs)

- PO1: Deeper understanding of Biotechnological Functions: Expertise in learning processes and functions that operates in Biological Organisms with focus on Plant Biotech related aspects.
- PO2: Interpersonal Skill Development: Expertise in communication both spoken as well as written form.
- PO3: Enhance creativity and developing Critical and Analytical Thinking Abilities: Critical thinking in academics, presentations, research and professional alliances relies heavily on one's ability to be creative.
- PO4: Exposure for developing Entrepreneurship Acumen: Helps to prepare students for research/ managerial roles and as entrepreneurs.
- PO5: Develop skills to Identify problems, define objectives collect and analyse information, evaluate alternatives, and leverage technology to enable qualitative and quantitative methods to solve problems. Equips students to demonstrate the capabilities required to apply cross-functional knowledge and technologies in solving real-world biotechnological problems.
- PO6: Appropriate techniques: Enables students to demonstrate use of appropriate techniques to effectively manage academic and research challenges in field of Biotechnology.
- PO7: Practical exposure: Providing an opportunity for the students to gain practical exposure towards various sections of biotechnology, the workplace and make them industry ready.
- PO8: Analytical and Decision Making qualities: Equip students with techniques of analyzing and interpretation of the research data which is used in Decision Making.



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PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: To inculcate students with the ability to analyze various functional issues affecting the biotechnological organization and acquiring conceptual clarity of various functional areas of Plant biotechnology.

PSO2: The students understand the ethical challenges and choices in a biotechnological unit setting and develop ability to evolve strategies for organizational benefits.

PSO3: To incorporate in students the benefits and ability to gain multidisciplinary knowledge through seminar reports, case study analysis, Research projects and industrial training and Organizational visits.

PSO4: Demonstrate ability to work in Groups and leadership in their career.

PSO5: To organize Workshops, Short Term Courses, Conferences, and seminars for students throughout the course for better understanding of the subject expertise, knowledge and skills required to the organization/ industry.

COURSE OUTCOMES (COs)

Subject	Subject Code	Course Outcomes
Principles of Biotechnology**	BTF 501	Familiarizes the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.
Fundamentals of Molecular Biology**	BTM 502	Imparts the students with the basic cellular processes at molecular level.
Molecular Cell Biology**	BTC 503	Develops understanding of the students on the cell biology at molecular level.
Plant Tissue Culture & Genetic Transformation	BTF 504	Familiarizes the students with hands on training on various techniques of plant tissue culture, genetic engineering and transformation.
Techniques In Molecular Biology I**	BTA 505	Provides hands on training on basic molecular biology techniques.
Microbial/ Industrial Biotechnology	BTO 506	Acquaints the students about the various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.
Molecular Breeding	BTF 507	Familiarizes the students about the use of molecular biology tools in plant breeding.
Genomics & Proteomics	BTR 508	Introduces the students with recent tools used for genome analysis and their applications.
Techniques In Molecular Biology II	BTA 509	Provides hands on training on various molecular techniques used in molecular breeding and genomics.
Biosafety, IPR and Bioethics*	BTO 510	Development of awareness about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.
Animal Biotechnology*	BTI 511	Provides an overview and current developments in different areas of animal biotechnology.


REGISTRAR
B.T.S.P.U.A&T., MEERUT

Immunology and Molecular Diagnostics*	BTI 512	Awareness about the application of various immunological and molecular diagnostic tools.
Nano-Biotechnology*	BTB 513	Develops understanding of the molecular techniques involved in structure and functions of nano-biomolecules in cells such as DNA, RNA and proteins.
Principles of Genetics*	BTM 551	Development of understanding about the basic concepts of genetics, students to develop their analytical, quantitative and problem solving skills from classical to molecular genetics.
Basic Biochemistry*	BTB 552	Provides elementary knowledge/overview of structure, functions and metabolism of biomolecules.
Biostatistics and Computers*, **	BAS 553	Exposure of students to various statistical methods to analyze their experimental data.
Principles of Microbiology*	BTP 554	Acquaints the students with history, classification and role of microbiology in agriculture, food and environment.
Introduction to Bioinformatics	BTI 555	Imparts an introductory knowledge about the subject of bioinformatics to the students studying any discipline of science.
Environmental Biotechnology	BTC 556	Apprise the students about the role of biotechnology in environment management for sustainable eco-system and human welfare.
Master's Seminar	BTS 591	1. Demonstrate use of appropriate methodologies and test the strength of their topic statement. 2. Shall be able to show insight on topic, appropriate signposting, and clarity of purpose. 3. Demonstrate problem-solving skills and apply theoretical knowledge.
Master's Research	BTS 599	Research topics providespractical skills and facilitate for appropriate research directions to the PG students.
Advances in Plant Molecular Biology	BTM 601	Understanding and discussions on the specialized topics and recent advances in the field of plant molecular biology.
Advances in Genetic Engineering	BTM 602	Imparts knowledge on specialized topics and advances in field of genetic engineering and their application in plant improvement.
Advances in Microbial Biotechnology	BTP 603	Apprise the students on specialized topics about industrially important microorganisms.
Advances in Crop Biotechnology	BTF 604	Knowledge on specialized topics on the application of molecular tools in breeding of specific crops.
Advances in Functional Genomics and Proteomics	BTR 605	It provides recent advances and applications of functional genomics and proteomics in


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

		agriculture, medicine and industry.
Commercial Plant Tissue Culture	BTO 606	Enables to accomplish the commercial applications of plant tissue culture in agriculture, medicine and industry.
Advances in Animal Biotechnology	BTI 607	Provides cutting edge knowledge on advances in different areas of animal biotechnology.
Doctoral Seminar I	BTS 691	1. To develop understanding on selected topic. 2. Information collection and its organization into a presentation. 3. To develop Effective presentation and communication abilities.
Doctoral Seminar II	BTS 692	1. Demonstrate use of appropriate methodologies and test the strength of their selected topics. 2. Shall be able to show insight on topic, appropriate signposting, and clarity of purpose. 3. Demonstrate problem-solving skills and apply theoretical knowledge.
Doctoral Research	BTS 699	1. Carry out a substantial research-based project. 2. Analyze data and synthesize research findings. 3. Report research findings in written and verbal forms. 4. Use research findings to advance scientific theory and practice.


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POSTGRADUATE PROGRAMME (MVSc & Ph.D)

OF

**PROGRAMME OUTCOMES (POs)
PROGRAMME SPECIFIC OUTCOMES (PSOs)
COURSE OUTCOMES (Cos)**

**College of Veterinary & Animal Sciences
Sardar Vallabhbhai Patel University of Agriculture
& Technology, Meerut-250110**

Department of Veterinary Anatomy

Degree Programme: MVSc (veterinary Anatomy) and PhD (veterinary Anatomy)

Programme Outcomes (POs)



1. Acquired the knowledge with the facts and figures related to Veterinary Anatomy.
2. Understood the concepts related to form and structures of domestic
3. The students acquire knowledge to consider anatomical facts for their application in other branches of veterinary sciences
4. Laboratory sessions emphasize the collection, processing and preservations of specimens for anatomical and histological study

Programme Specific Outcomes (PSOs)

1. The course is emphasized on morphology, histology and embryology of animals and birds
2. The students will gain insight of veterinary anatomy from cellular level to organism level of organization
3. The students will acquire skill in museum specimen preparation, tissue processing, microscopy, histochemistry etc.

Course Outcomes:

S. No.	Course Title	Course Code	Credit Hrs	Course Outcomes
1.	Myology, angiology and neurology and aesthesiology of equine canine and porcine	VAN 701	0+3	<ul style="list-style-type: none"> To impractical practical knowledge about anatomy of muscles, blood vessels, nervous tissue and sense organs in equine, canine and porcine Application of knowledge about muscles, nerves and vessels in surgical treatment of diseases
2.	Principles and applications of biomechanics	VAN 702	2+0	<ul style="list-style-type: none"> To sensitize the student about the importance of biomechanics Analysis animal gaits and movement on biomechanical basis
3.	Avian anatomy	VAN 703	1+2	<ul style="list-style-type: none"> To give detailed overview of poultry anatomy Differences and functional adaptation of birds with respects to mammals
4.	Neuroanatomy	VAN 704	3+1	<ul style="list-style-type: none"> To provide in-depth knowledge of nervous system Hands on training about anatomy and histology of nervous system
5.	Endocrine anatomy	VAN 705	2+1	<ul style="list-style-type: none"> To project the importance and details of endocrine glands Functional significance of endocrine anatomy for pathogenesis and treatment of diseases



 REGISTRAR
 S.V.B.P.U.A.&T., MEEBUT

6.	Theory and applications of electron microscope	VAN 706	2+1	<ul style="list-style-type: none"> To give an overview of the electron microscope To impart knowledge about principles and techniques of electron microscopy
7.	Histoenzymology and immunocytochemistry	VAN 707	2+1	<ul style="list-style-type: none"> To give a student hands-on practice for various advanced histoenzymic and histochemical techniques Gives functional significance about distribution of chemicals and enzymes at tissue level
8.	Applied embryology and teratology	VAN 708	1+2	<ul style="list-style-type: none"> To apprise the students about the current trends in developmental processes To give in-depth knowledge about developmental defects in animals
9.	Functional veterinary anatomy	VAN 709	2+0	<ul style="list-style-type: none"> To make the student understand the functional anatomy of various organs/systems Impart role of form & structure in functional peculiarity of an animal
10.	Gross anatomy of laboratory animals	VAN 710	1+1	<ul style="list-style-type: none"> To give an overview of different body systems of laboratory animals
	Comparative osteology and arthrology	VAN 601	1+2	<ul style="list-style-type: none"> To make a student well versed with the bones and joints of different domestic animals Demonstration of all bones and dissection of joints of buffalo/Cattle
11.	Comparative splanchnology	VAN 602	2+2	<ul style="list-style-type: none"> To give a detailed overview of different systems constituting splanchnology Demonstration of structure and placement of organs in body cavities of all the animals
12.	Myology, angiology and neurology and aesthesiology of ox	VAN 603	1+3	<ul style="list-style-type: none"> To give a thorough knowledge about the muscles, course of blood vessels and nerves of the body in addition to various organs of circulatory, nervous and sensory systems of ox as a type animal Dissection of heart, different vessels, brain, cranial nerves, brachial plexuses and lumbo-sacral plexus. Dissection of eye, ear, hoof and horn of buffalo/cattle
13.	Gross anatomical techniques	VAN 604	0+2	<ul style="list-style-type: none"> Hands-on training for preparation of gross anatomical specimens

				<ul style="list-style-type: none"> • Handling of gross anatomical specimens
14.	Theory and practice of histological and histochemical techniques	VAN 605	1+2	<ul style="list-style-type: none"> • To give exposure to methods of processing the tissues for research • Hands on training about special staining methods
15.	General histology and ultrastructure	VAN 606	3+1	<ul style="list-style-type: none"> • To understand basic principles of light microscopy and light and ultrastructure of tissues
16.	Systemic histology and ultrastructure	VAN 607	3+1	<ul style="list-style-type: none"> • To understand and identify arrangement of four basic tissues in organs of different body systems • Study of histological structure of organs of digestive, respiratory, urinary, genital and cardiovascular systems of buffalo, horse and dog/cat
17.	Developmental anatomy	VAN 608	3+1	<ul style="list-style-type: none"> • To understand the developmental processes of different body systems at various stages of pregnancy. • Study of serial sections of the chick and pig embryos at different stages of development
18.	Avian anatomy	VAN-609	1+2	<ul style="list-style-type: none"> • To give detailed basic idea about anatomy and histology of domestic fowl • Differences and functional adaptation of birds with respects to mammals

(Prabhakar Kumar)

Associate Professor & OIC
Department of Veterinary Anatomy
College of Veterinary & Animal Science
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Department of Veterinary Physiology & Biochemistry

Degree Programme:

MVSc (Veterinary Physiology) & Ph.D (Veterinary Physiology)

Programme Outcomes (POs):

1. To impart knowledge regarding physiology of different organ system of animals.
2. Training in various techniques for application in research in Animal Physiology.
3. To develop the presentation capacity and research capacities among the students.

Programme Specific Outcomes (PSOs):

1. To teach physiological basis of clinical abnormalities in body functions.
2. To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.
3. To teach the Growth process, and reproductive physiology of animals

Masters Courses: (MVSc in Veterinary Physiology)



S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1.	Physiology of Digestion	VPY 601	2+1	• To teach comparative physiology of digestive system of monogastric animals, ruminants and birds, and basic techniques.
2.	Cardiovascular and Respiratory Physiology	VPY 602	2+1	• To teach function and regulation of heart, recording of ECG and respiration in different animals and basic techniques.
3.	Renal Physiology and Body Fluid dynamics	VPY 603	2+1	• To impart knowledge regarding excretory system of mammals and birds, maintenance of body fluid homeostasis
4.	Haematology	VPY 604	2+1	• To acquaint the students about haematology of different animals including handson training.
5.	Growth and Environmental Physiology	VPY 605	2+0	• To teach the Growth process and its regulation, effect of mineral and vitamins on body functions and influence of environmental conditions on homeothermy.
6.	Physiology of Animal Reproduction	VPY 606	2+1	• To impart knowledge of male and female reproductive system of different species of animals including birds.
7.	Clinical Physiology	VPY 607	1+1	• To teach physiological basis of clinical abnormalities in body functions.
8.	Neuromuscular Physiology	VPY 608	2+0	• To impart knowledge of coordination of body functions


REGISTRAR
S.V.B.P.U.A.&T., MEERUT


				and regulation of brain functions and sense organs.
9.	Endocrinology of Domestic Animals	VPY 609	2+0	• To impart knowledge of chemical integration of body functions.
10.	Instrumentation and Research Techniques in Veterinary Physiology	VPY 610	0+2	• Training in various techniques for application in research in Animal Physiology
11.	Physiology of Wild Life	VPY 611	1+0	• To impart the knowledge on physiology of wild animals. The course content refers to wild animals related to Indian forests restricted to small and large animals. This course does not cover insects and other species for which veterinarian are not usually called for.
12.	Masters Seminar	VPY 612	1+0	• To develop the presentation capacity in the students.
13.	Masters Research	VPY 613	0+30	• Research work will be completed.

Doctoral Courses: (Ph.D in Veterinary Physiology)

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1.	Research and Publication Ethics	RPE 700	1+1	<ul style="list-style-type: none"> • Focusing on basics of philosophy of science and ethics, Research integrity, Publication ethics. • Hands-on-sessions are designed to identify research misconduct and predatory publications. • Indexing and citation databases, open access publications, Research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.
2.	Applied physiology of body fluids and electrolytes	VPY 701	2+1	• To impart knowledge regarding physiology of body fluids and electrolytes in relation to homeostasis.
3.	Physiology of animal behaviour	VPY 702	2+0	• To acquaint the students about physiology of animal behaviour in different species of domestic animals.
4.	Recent trends in ruminant digestion	VPY 703	2+1	• To impart knowledge about advances in digestion of ruminant animals.



 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

5.	Recent trends in neuroendocrinology	VPY 704	2+1	• To acquaint the students about advances in neuroendocrinology of domestic animals.
6.	Myophysiology and kinesiology	VPY 705	2+0	• To impart knowledge to the students about myophysiology and kinesiology.
7.	Avian physiology	VPY 706	2+1	• To teach physiology of birds.
8.	Physiology of lactation	VPY 707	2+1	• To impart knowledge on physiology of lactation in dairy animals.
9.	Recent trends in environmental physiology and growth	VPY 708	2+1	• To teach physiology of growth process in animals and effect of environmental factors on homeostasis of animals.
10.	Cellular and molecular physiology	VPY 709	2+0	• To impart knowledge about cellular and molecular physiology.
11.	Recent trends in immunophysiology	VPY 710	2+1	• To impart knowledge regarding physiology of immune system.
12.	Physiology of stress	VPY 711	2+0	• To understand impact of various stress factors on the physiology of animals.
13.	Recent trends in reproductive physiology	VPY 712	2+1	• To understand recent developments in physiology of reproduction in domestic animals.
14.	Doctorate Seminar-I	VPY 713	1+0	• To develop the presentation capacity in the students.
15.	Doctorate Seminar-II	VPY 714	1+0	• To develop the presentation capacity in the students.
16.	Doctorate Research	VPY 715	0+75	• Research work will be completed.


26.11.2022
(R.K. Singh)

OIC
Officer Incharge
Vet. Physio. & Biochem.
Veterinary & Animal Science
S.V.P.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

ANIMAL GENETICS AND BREEDING

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
AGB 601*	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1	I
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1	II
AGB 603*	POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING	2+1	I
AGB 604*	SELECTION METHODS AND BREEDING SYSTEMS	3+1	II
AGB 605*	BIOMETRICAL TECHNIQUES IN ANIMAL BREEDING	3+1	I
AGB 606	CONSERVATION OF ANIMAL GENETIC RESOURCES	2+0	I
AGB 607	CATTLE AND BUFFALO BREEDING	2+1	II
AGB 608	SMALL FARM ANIMAL BREEDING	2+0	II
AGB 609	POULTRY BREEDING	2+1	I
AGB 610	LABORATORY ANIMAL BREEDING	1+0	II
AGB 691	MASTER'S SEMINAR	1	I, II
AGB 699	MASTER'S RESEARCH	20	I, II
AGB 701	RECENT ADVANCES IN ANIMAL GENETICS	2+0	I
AGB 702	RECENT TRENDS IN ANIMAL BREEDING	2+0	II
AGB 703	ADVANCES IN BIOMETRICAL GENETICS	2+1	II
AGB704**	ADVANCES IN SELECTION METHODOLOGY	2+1	I
AGB 705	BIOINFORMATICS IN ANIMAL GENETICS AND BREEDING	2+0	I
AGB 706	ADVANCES IN MOLECULAR CYTOGENETICS	2+0	II
AGB707**	UTILIZATION OF NON-ADDITIVE GENETIC VARIANCE IN FARM ANIMALS	2+1	I
AGB 791	DOCTORAL SEMINAR I	1	I, II
AGB 792	DOCTORAL SEMINAR II	1	I, II
AGB 799	DOCTORAL RESEARCH	45	I, II

*Compulsory for Master's programme; **Compulsory for Doctoral programme


REGISTRAR
R.V.B.P.U.A.&T., MEERUT

ANIMAL GENETICS AND BREEDING

Course Contents

AGB 601	ANIMAL CYTOGENETICS AND IMMUNOGENETICS	2+1	SEM - I
Objective	To educate about basic principles of cytogenetics and immunogenetics and their applications in improving farm animals.		
Theory	<p><u>UNIT-I:</u> Development in animal cytogenetics and immunogenetics of farm animals. Immunoglobulins and their types: antigen-antibody interactions, Immune response, ELISA.</p> <p><u>UNIT-II:</u> Major histocompatibility complex; genetics of biochemical variants and their applications; Ir-genes and concepts of disease resistance including major genes; hybridoma and its significance; concept of immuno-fertility, BoLA, BuLA, TLRs, Interleukins.</p> <p><u>UNIT-III:</u> Chromatin structure of eukaryotes; chromosome number and morphology in farm animals banding and karyotyping; chromosomal and genetic syndromes, DNA packing in chromosomes, Z+B DNA, FISH chromosome painting and PRINS. RH Panel Mapping.</p> <p><u>UNIT-IV:</u> Mutation and assays of mutagenesis; sister chromatid exchanges; recombinant DNA technique and its application in animal improvement programme.</p>		
Practical	Polymorphism of haemoglobulins, transferrins, enzymes/proteins; preparation of monovalent blood reagent-isoimmunization, titre testing and absorption of polyvalent serum; identification of bar bodies; in vitro and in vivo preparation of somatic metaphase chromosomes; screening of chromosomal abnormalities; microphotography and karyotyping; banding procedures for comparing the chromosomal complement, FISH and PRINS.		
Suggested Readings	<p>Hare WCD & Elizabeth L Singh 1999. <i>Cytogenetics in Animal Reproduction</i>. CABI.</p> <p>Roitt I. 1997. <i>Essential Immunology</i>. Blackwell.</p> <p>Stine GJ. 1989. <i>The New Human Genetics</i>. Wm C Brown Publ.</p> <p>Summer AT & Chandley AC. 1993. <i>Chromosome Today</i>. Chapman & Hall.</p>		
AGB 602	MOLECULAR GENETICS IN ANIMAL BREEDING	2+1	SEM - II
Objective	To educate about molecular techniques to identify molecular markers as an aid to selection.		
Theory	<p><u>UNIT-I:</u> Basic concept: Genesis and importance of molecular techniques; Genome organization – physical and genetic map, current status of genome maps of livestock.</p> <p><u>UNIT-II:</u> Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting.</p> <p><u>UNIT-III:</u> DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer.</p> <p><u>UNIT-IV:</u> Statistical techniques for analyzing molecular genetic data, Quantitative Trait Loci (QTL) mapping and its application in animal breeding, Genome scan, Candidate gene approach, Genomic selection, Marker Assisted Selection- basic concept.</p>		
Practical	Extraction and purification of genomic DNA, Gel electrophoresis, Restriction enzyme digestion of DNA and analysis, PCR, PCR-RFLP, PCR-SSCP, Bioinformatics tool for		


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Suggested Readings

Akano IE 1992. *DNA Technology*. IAP Academic Press.
Micklos DA, Fryer GA & Crotty DA. 2003. *DNA Science*. Cold Spring Harbour.
Setlow JK. 2006. *Genetic Engineering – Principles and Methods*. Springer.

AGB 603

POPULATION AND QUANTITATIVE GENETICS IN ANIMAL BREEDING

2+1

SEM - I

Objective

To study genetic structure of animal population and importance of genetic variation and covariation among traits.

Theory

UNIT-I: Individual verses population. Genetic Structure of population. Factors affecting changes in gene and genotypic frequencies and their effect on genetic structure of animal populations. Approach to equilibrium under different situations: Viz: Single autosomal locus with two alleles, single sex-linked locus, two pairs of autosomal linked and unlinked loci.

UNIT-II: Small population: random genetic drift, effective population size, pedigreed populations, regular and irregular inbreeding systems.

UNIT-III: Quantitative genetics-gene effects, population mean and variance and its partitioning, biometric relations between relatives.

UNIT-IV: Genetic and phenotypic parameters-their methods of estimation, uses, possible biases and precision. Scale effects and threshold traits.

Practical

Problems relating to gene and genotypic frequencies under different conditions. Estimation of inbreeding in regular and irregular systems. Estimation of effective population size. Computation of quantitative genetic effects. Estimation of variance components. Computation of heritability, repeatability, genetic, environmental and phenotypic correlations and their standard errors.

Suggested Readings

Bulmer MG. 1980. *The Mathematical Theory of Quantitative Genetics*. Clarendon Press.
Crow JF & Kimura M. 1970. *An Introduction to Population Genetics. Theory*. Harper & Row.
Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
Pirchner F. 1981. *Population Genetics in Animal Breeding*. S. Chand.

AGB 604

SELECTION METHODS AND BREEDING SYSTEMS

3+1

SEM - II

Objective

To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.

Theory

UNIT-I: Type of selection and their genetic consequences. Response to selection and its prediction and improvement of response to selection.


UNIT-II: Theoretical aspects of accuracy and efficiency of different base of selection. Prediction of breeding value using different criteria. Combined Selection. Correlated response to selection and efficiency of indirect selection.

UNIT-III: Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateau and limit.

UNIT-IV: Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphism and its application in genetic improvement.

Practical

Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection. Computation of breeding values using different sources of information for female and male selection. Computation of


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

realized heritability and genetic correlation. Selection index: Computation, Accuracy and response in component traits. Estimation of heterosis for different types of crosses. Estimation of GCA and SCA.

Suggested Readings

Falconer DS & Mackay TFC. 1996. *An Introduction to Quantitative Genetics*. Longman.
Jain JP. 1982. *Statistical Techniques in Quantitative Genetics*. Tata McGraw-Hill.
Tomar SS 1996. *Text Book of Population Genetics*. Vol. I. *Qualitative Inheritance*; Vol. II. *Quantitative Inheritance*. Universal Publ.

AGB 605 BIOMETRICAL TECHNIQUES IN ANIMAL 3+1 SEM - I
BREEDING

Objective

To educate about the various biometrical techniques for data analysis and their applications in animal breeding research.

Theory

UNIT-I: Review of basic concepts in statistical inference and balanced experimental designs. Nature of **structure of animal breeding data and sources of variation**.

UNIT-II: Introduction to matrix algebra, types of matrices and matrix operations. Determinants and their properties, methods of finding inverse of a matrix and their application.

UNIT-III: ANOVA, Regression and Correlations, **Henderson's methods for estimation of variance components**, Basic concepts of linear models, Least-squares analysis, maximum likelihood; Method of estimation; Generalized LS and weighted LS. Fisher's discriminant function and its application, **D² - Statistics in divergent analysis**.

UNIT-IV: Linear models in animal breeding, Methods of analysis of unbalanced animal breeding data. Adjustment of data. Data base management **and use of software packages** in animal breeding.

Practical

Matrix applications, determinant and inverse of matrices; Building of models for various types of data; Estimation of variance components; **Least squares method for analysis of research data**; Collection, compilation, coding, transformation and analysis of animal breeding data by using above biometrical techniques with computer application.

Suggested Readings

Henderson CR. 1984. *Application of Linear Models in Animal Breeding*. Univ. of Guelph.
Kaps M & Lamberson WR. 2004. *Biostatistics for Animal Science*. CABI.
Mather K & Jinks JL. 1977. *Introduction to Biometrical Genetics*. Chapman & Hall.
Searle Sr. 1971. *Linear Models*. John Wiley & Sons.
Singh RK & Choudhary BD. 1977. *Biometrical Methods in Quantitative Genetic Analysis*. Kalyani.

AGB 606 CONSERVATION OF ANIMAL GENETIC 2+0 SEM - I
RESOURCES

Objective

To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.

Theory

UNIT-I: **Domestic Animal Diversity in India**, its origin, history and utilization. Present status and flow of Animal Genetic Resources and its contribution to livelihood security. Methodology for **genotypic characterization of livestock and poultry breeds** through systematic surveys. Fodder availability; management of breed; physical, biochemical and performance traits and uniqueness of animals of a breed; social, cultural and economic aspects of their owners/communities rearing the breed.

UNIT-II: Methodology for molecular genetic characterization, diversity analysis and relationship among the breeds. Concept of conservation, *In-situ* and *ex-situ* (*in-vivo* and *in-vitro*); models of conservation; prioritization of breeds for conservation. **National and international strategies for conservation of Animal Genetic Resources**.

UNIT-III: Status, opportunities and challenges in conservation of AnGR. IPR issues pertaining to animal genetic resources/animal products or by-products. Registration of livestock breeds and protection of livestock owner's rights in India.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.
Nicholas FW. 1987. *Veterinary Genetics*. Clarendon Press.
Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 607 CATTLE AND BUFFALO BREEDING 2+1 SEM - II**Objective**

To educate about the concept of cattle and buffalo breeding.

Theory

UNIT-I: History of dairy cattle and buffalo breeding. Breeds of cattle and buffalo and their Characterisation. Inheritance of important economic traits. Recording and handling of breeding data. Standardization of records. Computation of correction factors for the adjustment of the data. Estimation of breeding values of the cows and bulls.

UNIT-II: Sire evaluation methods using single trait and multiple traits; construction of Sire indices, Sire evaluation under animal model, sire mode; and maternal grand sire model. Open nucleus breeding systems with MOET.

UNIT-III: Methods of cross breeding. Breeding of type, milk quality and production efficiency. Plans for developing new breeds of dairy cattle. History of development of important breeds of dairy cattle.

UNIT-IV: Considerations in the import of exotic germplasm for breeding cattle in the tropics. Appraisal of buffalo and cattle breeding programme. Role of breed associations in dairy improvement.

Practical

Performance recording – milk recording - Estimation of economic traits – Standardization of records – Index cards – Sire evaluation – Comparison of latest methods - Computation of genetic parameters – Genetic gain – Estimation of heterosis – Culling and replacement.

Suggested Readings

Lasley JF. 1987. *Genetics of Livestock Improvement*. 3rd Ed. IBH.
Nicholas FW. 1987. *Veterinary Genetics*. Clarendon Press.
Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Schmidt GM & Van Vleck LD. 1974. *Principles of Dairy Science*. WH Freeman.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 608 SMALL FARM ANIMAL BREEDING 2+0 SEM - II
(Sheep, Goat, Swine and Rabbit)**Objective**

To educate about the small farm animal breeding concepts.

Theory

UNIT-I: Breeds–Economic traits–Prolificacy–Breeding records and standardization.

UNIT-II: Genetic parameters – Selection of males and females – Breeding systems. Development of new breeds.

UNIT-III: Breeding policy – Breeding research – Conservation of breeds.


UNIT-IV: Culling and replacement – EADR.

Suggested Readings

Ross CV. 1989. *Sheep Production and Management*. Prentice Hall.
Turner HN & Young SSY. 1969. *Quantitative Genetics in Sheep Breeding*. MacMillan.
Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 609 POULTRY BREEDING 2+1 SEM - I**Objective**

To educate about the advances in poultry breeding practices.

Theory

REGISTRAR
S.V.B.P.U.A.&T., MEERUT

UNIT-I: Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry including lethals – Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

UNIT-II: Selection criteria and selection indices – Response to selection – Genetic controls – Genotype and environment interaction – Inbreeding, and its effects on production traits in egg and meat-type chickens – Inbred lines – Strain development – Crossing : strain and line crosses – Introduction to diallel cross – Utilisation of heterosis and reciprocal effect – Reciprocal recurrent selection and recurrent selection.

UNIT-III: Industrial breeding – Artificial insemination in chicken – Autosexing – Random Sample Test.

UNIT-IV: Biochemical variants and immunogenetics of poultry – Use of molecular genetics in poultry breeding – Quantitative trait loci and marker-assisted selection – Conservation of poultry genetic resources.

Practical

Inheritance of qualitative traits – Economic traits of egg-type and meat-type chicken – Procedures of standardization – Estimations of heritability, correlation between various production traits, inbreeding co-efficient and heterosis – Selection of sires and dams – Osborne index – Restricted selection index – Collection and evaluation of semen and insemination – Diallel cross.

Suggested Readings

Crawford RD.1990. *Poultry Breeding and Genetics*. Elsevier.

Hutt FB. 2003. *Genetics of Fowl*. Norton Greek Press.

Singh RP & KumarJ. 1994. *Biometrical Methods in Poultry Breeding*. Kalyani.

AGB 610 LABORATORY ANIMAL BREEDING 1+0 SEM - II

Objective

To educate about the laboratory animal breeding principles.

Theory

UNIT-I: Introduction to laboratory animal genetics – Breeding colonies of mice, rats, hamsters, guinea pigs and rabbits.

UNIT-II: Selection and mating methods/systems – mongamous, polygamous and others.

UNIT-III: Development of genetically controlled laboratory animals – Rules for nomenclature, inbred strains, outbred stocks, mutant stocks, recombinant inbred strains, transgenic strains, gene targeting and production of 'gene knock-out' animals.

UNIT-IV: Genetic control and monitoring – Record keeping – Ethics of laboratory animal use.

Suggested Readings

Van Vleck LD, Pollak EJ & Bltenacu EAB. 1987. *Genetics for Animal Sciences*. WH Freeman.

AGB 701 RECENT ADVANCES IN ANIMAL GENETICS 2+0 SEM - I

Objective

To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.

Theory

UNIT-I: Eukaryotic genome: Gene families, Pseudogenes SnRNPs, Gene conversion, tandemly repeated genes, Nuclear Organiser region, mRNA splicing, Minisatellites, Microsatellites and its usage.

UNIT-II: Transposons, RNA processing Transcuplion regulation of gene expression, selective gene amplification, post transeptional regulation. The proteasome and longevity of proteins.

UNIT-III: Transgenic animals their benefits in livestock production, somatic cell nuclear transfer, transgenic animals in biomedical research, ethical consideration of transgenic animals; gene therapy and transgenic animal production. Pharming of Pharmaceutical.

UNIT-IV: Radiation hybrid panels and their usage in livestock, microdissection of chromosomes, *In-situ* hybridization, chromosome painting, meiotic crossing over, genome selection; Structure and functions of major histocompatibility complex, T Cell receptor, CD4, Toll Like Receptors and their functions.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Suggested Readings

Selected articles from journals.

AGB 702 RECENT TRENDS IN ANIMAL BREEDING 2+0 SEM - II**Objective**

To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Theory

UNIT-I: Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding.

UNIT-II: Formulation of detailed breeding plans ongoing breed improvement programmes and their impact analysis in various species of livestock under different situations.

UNIT-III: Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

Suggested Readings

Selected articles from journals.

AGB 703 ADVANCES IN BIOMETRICAL GENETICS 2+1 SEM - II**Objective**

To impart knowledge about recent advances in population genetic theory and application in animal breeding.

Theory

UNIT-I: Mating designs; genetic basis of tripple test cross analysis (TTC); triallem analysis, partial diallel crosses and mating design for studying reciprocal and maternal differences.

UNIT-II: Models for studying the inheritance of endosperm characters; classificatory problems; discriminant function, D^2 analysis; principal component analysis.

UNIT-III: Use of genetic parameters for prediction of recombinant inbred lines; advances in studies of genotype environment interaction and selection indices.

UNIT-IV: Generation matrix and its use in population genetics; gene mapping of QTL (quantitative trait loci).

Practical

Estimation of genetic parameters – Diallel analysis – Triallem analysis – D^2 analysis – Problems in Matrix.

Suggested Readings

Selected articles from journals.

AGB 704 ADVANCES IN SELECTION 2+1 SEM - I
METHODOLOGY**Objective**

To educate about the latest advances in selection theory and their application in animal breeding.

Theory

UNIT-I: Fundamental theorem of natural selection; Selection in finite populations effect on genetic structure and variance. Optimum designs for the estimation of genetic parameters. Design of selection experiments for testing selection theory.

UNIT-II: Methods of measurement of genetic and environmental trends. Advances in selection indices Multistage, Restricted and retrospective selection indices.

UNIT-III: Multi-information, Empirical evaluation of selection theory: genetic slippage, limits to selection, asymmetry of response, selection experiments, effect of selection on variance.

UNIT-IV: Selection for threshold traits; single and multiple trait best linear unbiased estimation (BLUE) and prediction (BLUP); selection under single and multiple trait animal models; direct and correlated response through various selection indices, relationship between BLUP and selection index; fundamentals of marker assisted selections.

Practical


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Suggested Readings

Selected articles from journals.

AGB 705 BIOINFORMATICS IN ANIMAL GENETICS 2+0 SEM - I AND BREEDING

Objective

To educate about basic concepts of bioinformatics and their applications in Animal Genetics and Breeding.

Theory

UNIT-I: Overview of bioinformatics, Database concepts, Algorithms, Information resources for protein and genome databases: Gene Bank, EMBL, SWISSPROT, PROSITE.

UNIT-II: Nucleotide and protein sequence analysis, Pair-wise and multiple sequence alignments, Phylogeny, Micro-array processing, Clustering, Analysis software, Secondary database search.

UNIT-III: Genetic characterisation, Use of bioinformatics tools for identifying QTL and selection of elite germplasm.

Suggested Readings

Selected articles from journals.

AGB 706 ADVANCES IN MOLECULAR CYTOGENETICS 2+0 SEM - II

Objective

To educate about the advances in cytogenetics and their application in animal genetic and breeding

Theory

UNIT-I: Structure of eukaryotic chromosomes – Evolution of karyotype – Various in vitro cell culture techniques – Cell lines and utility – Genotoxicity.

UNIT-II: Somatic cell genetics – Stem cell genetics – Molecular cytogenetics and gene mapping – ISH, FISH, Radiation hybrid mapping, Fibre-FISH, PRINS.

UNIT-III: Positional cloning – Spectral karyotyping.

UNIT-IV: Image analysis – Chromosome walking – Chromosome painting.

Suggested Readings

Selected articles from journals.

AGB 707 UTILISATION OF NON-ADDITIVE 2+1 SEM - I GENETIC VARIANCE IN FARM ANIMALS

Objective

To educate about the recent advances in estimation of non-additive genetic variation and possible use in developing synthetic population of livestock and poultry.

Theory

UNIT-I: Heterosis – forms and genetic basis; detection and estimation of non-additive genetic variance – average dominance, overdominance.

UNIT-II: Partitioning of between cross variance – general combining ability, specific combining ability and reciprocal effects; methods of analyzing diallel crosses; utilization of non-additive genetic variance.

UNIT-III: Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

UNIT-IV: Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.

Practical

Computation of degree of dominance using NC Plans; analysis of partial and complete diallel cross data; estimation of crossbreeding effects; estimation of genetic correlation among paternal purebred and crossbred half sibs; computation of response through RS and RRS.

Suggested Readings

Selected articles from journals.


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VETERINARY PARASITOLOGY

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VPA 601	VETERINARY HELMINTHOLOGY - I	2+1	I
VPA 602	VETERINARY HELMINTHOLOGY - II	2+1	II
VPA 603	VETERINARY ENTOMOLOGY AND ACAROLOGY	2+1	I
VPA 604	VETERINARY PROTOZOOLOGY	2+1	II
VPA 605	PARASITOLOGICAL TECHNIQUES	0+2	I
VPA 606	CLINICAL PARASITOLOGY	1+1	I
VPA 607	TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES	1+1	II
VPA 608	IMMUNOPARASITOLOGY	2+1	I
VPA 609	PARASITIC ZONOSSES	2+0	II
VPA 610	PARASITES OF ZOO AND WILD ANIMALS	2+1	II
VPA 611	MALACOLOGY	1+1	I
VPA 691	MASTER'S SEMINAR	1	I, II
VPA 699	MASTER'S RESEARCH	20	I, II
VPA 701	APPLICATIONS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN PARASITOLOGY	1+2	I
VPA 702	MOLECULAR DIAGNOSTICS AND VACCINE DEVELOPMENT IN PARASITOLOGY	2+1	II
VPA 703	HOST PARASITE INTERACTIONS	2+0	I
VPA 704	ADVANCES IN PROTOZOOLOGY	2+1	II
VPA 705	ADVANCES IN HELMINTHOLOGY - I	2+1	I
VPA 706	ADVANCES IN HELMINTHOLOGY - II	2+1	II
VPA 707	ADVANCES IN ENTOMOLOGY AND ACAROLOGY	2+1	I
VPA 708	<i>IN VITRO</i> CULTIVATION OF PARASITES	1+2	II
VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0	II
VPA 710	BIONOMICS OF PARASITES	3+0	I
VPA 711	ENVIRONMENTAL PARASITOLOGY	1+1	I
VPA 790	SPECIAL PROBLEM	0+2	I, II
VPA 791	DOCTORAL SEMINAR I	1	I, II
VPA 792	DOCTORAL SEMINAR II	1	I, II
VPA 799	DOCTORAL RESEARCH	45	I, II


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VETERINARY PARASITOLOGY

Course Contents

VPA 601 VETERINARY HELMINTHOLOGY – I 2+1 SEM - I

Objective

To learn about various aspects of trematode and cestode parasites of veterinary importance.

Theory

UNIT-I: Introduction, history, classification, general account and economic importance of platyhelminths.

UNIT-II: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Dicrocoeliidae, Opisthorchiidae, Strigeidae and Fasciolidae.

UNIT-III: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Echinostomatidae, Heterophyidae, Plagiorchiidae, Troglotrematidae, Prosthogonimidae, Nanophyetidae and Paragonimidae.

UNIT-IV: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of trematodes belonging to families: Notocotylidae, Brachylemidae, Cyclocoelidae, Paramphistomatidae and Schistosomatidae.

UNIT-V: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Mesocostoididae, Anoplocephalidae, Thysanosomidae, Dipylidiidae and Dilepididae.

UNIT-VI: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of cestodes belonging to families: Davaineidae, Hymenolepididae, Taeniidae and Diphylobothriidae.

Practical

Identification of trematode and cestode parasites; their eggs and intermediate hosts. Observation on parasitic stages in host tissues and associated pathological lesions.

Suggested Readings

- Chowdhury N. and Toda I. 1994. *Helminthology*. Springer Verlag, Narosa Publishing House.
- Dalton JP. 1999. *Fasciolosis*. CABI.
- Gibson DI. 2002. *Keys to the Trematoda*, Vol.I. CABI.
- Khalil LF, Jones A & Bray RA. 1994. *Keys to the Cestode Parasites of Vertebrates*. CABI.
- Kumar V. 1998. *Trematode Infections and Diseases of Man and Animals*. Kluwer Academic Publishers.
- Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.
- Mehlhorn H. 1988. *Parasitology in Focus: Facts and Trends*. Springer Verlag.
- Singh G & Prabhakar S. 2002. *Taenia solium Cysticercosis*. CABI
- Sood ML. 2003. *Helminthology in India*. International Book Distributors.
- Soulsby E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 602 VETERINARY HELMINTHOLOGY – II 2+1 SEM - II

Objective


To learn about various aspects of nematodes, thorny-headed worms and leeches of veterinary importance.

Theory

UNIT-I: Introduction, history, classification, general account and economic importance of nematodes and thorny-headed worms.

UNIT-II: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Ascarididae, Anisakidae, Oxyuridae, Heterakidae and Subuluridae.

UNIT-III: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Rhabditidae, Strongyloididae and Strongylidae.


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UNIT-IV: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichonematidae, Amidostomidae, Stephanuridae, Syngamidae and Ancylostomatidae.

UNIT-V: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Metastrongylidae, Protostrongylidae, Filaroididae, Trichostrongylidae, Ollulanidae, Crenosomatidae and Dictyocaulidae.

UNIT-VI: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Spiruridae, Thelaziidae, Acuariae, Tetrameridae, Physalopteridae, Gnathostomatidae, Filariidae, Setariidae, Onchocercidae and Dracunculidae.

UNIT-VII: Morphology, epidemiology, life cycle, pathogenesis, clinical signs, diagnosis and control measures of nematodes belonging to families: Trichinellidae, Trichuridae, Capillariidae, Dioctophymatidae, Polymorphidae, Oligacanthorhynchidae and Gnathobdellidae.

Practical

Identification of nematode parasites; their eggs and intermediate hosts, differentiation, study of their stages in the tissues and associated pathological lesions.

Suggested Readings

Andersen RC. 2000. *Nematode Parasites of Vertebrates, their Development and Transmission*. CABI.

Kennedy MW & Harnett W. 2001. *Parasitic Nematodes: Molecular Biology, Biochemistry and Immunology*. CABI.

Lapage G. 2000. *Monning's Veterinary Helminthology and Entomology*. Greenworld Publ.

Lee DL. 2002. *The Biology of Nematodes*. Taylor & Francis.

Soulsby E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindal.

VPA 603

VETERINARY ENTOMOLOGY AND ACAROLOGY

2+1

SEM - I

Objective

To learn various aspects of arthropods of veterinary importance.

Theory

UNIT-I: Introduction, history, classification and economic importance.

UNIT-II: Distribution, life cycle, seasonal pattern, pathogenesis, economic significance and control of arthropods belonging to the families: Culicidae, Ceratopogonidae, Simuliidae and Psychodidae.

UNIT-III: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Tabanidae, Gasterophilidae, Muscidae, and Glossinidae.

UNIT-IV: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Oestridae, Sarcophagidae, Calliphoridae and Hippoboscidae.

UNIT-V: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Pediculidae, Haematopinidae, Linognathidae, Menoponidae, Philopteridae and Trichodectidae.

UNIT-VI: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Siphonapteridae, Cimicidae and Reduviidae.

UNIT-VII: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Dermatyssidae, Argasidae and Ixodidae.

UNIT-VIII: Distribution, life cycle, seasonal pattern, pathogenesis, diagnosis, economic significance and control of arthropods belonging to the families: Sarcoptidae, Psoroptidae, Demodicidae, Trombiculidae, Cytoditidae and Linguatulidae.

UNIT-IX: Strategic control measures of arthropods with special emphasis on improved versions of chemical, biological and immunological control and integrated pest management.


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Practical

Collection, preservation, identification and differentiation of various arthropods and their developmental stages; associated pathological changes and lesions; skin scraping examination.

Suggested Readings

- Gupta SK & Kumar R. 2003. *Manual of Veterinary Entomology and Acarology*. International Book Distr. Co.
 Harwood RF & James MT. 1979. *Entomology in Human and Animal Health*. MacMillan.
 Kettle DS. 1995. *Medical and Veterinary Entomology*. CABI.
 Lehane M. 2005. *The Biology of Blood Sucking Insects*. 2nd Ed. Cambridge University Press.
 Marquardt WC. 2000. *Parasitology and Vector Biology*. Academic Press.
 Mullen G & Durben L. 2002 *Medical and Veterinary Entomology*. Academic Press.
 Wall R & Shearer D. 1997. *Veterinary Entomology*. Chapman & Hall.

VPA 604**VETERINARY PROTOZOOLOGY****2+1****SEM - II****Objective**

To project the importance and to impart detailed knowledge on various aspects of protozoan parasites.

Theory

UNIT-I: Introduction, history, classification, general account, economic importance of protozoan parasites.

UNIT-II: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Trypanosomatidae, Monocercomonadidae, Trichomonadidae, Hexamitidae and Endamoebidae.

UNIT-III: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Eimeriidae, Cryptosporidiidae and Sarcocystidae.

UNIT-IV: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of protozoan parasites belonging to the families: Plasmodiidae, Babesiidae, Theileriidae, Haemogregarinidae and Balantidiidae.

UNIT-V: Morphology, epidemiology, pathogenesis, clinical signs, diagnosis and control measures of Rickettsiales like *Anaplasma*, *Ehrlichia* and *Haemobartonella*.

Practical

Identification of protozoan parasites and observation on parasite stages in host tissues and the attendant pathological lesions. Diagnosis of protozoan parasites of veterinary importance.

Suggested Readings

- Bhatia BB & Shah HL. 2000. *Protozoa and Protozoan Diseases of Domestic Livestock*. ICAR.
 Bhatia BB. 2000. *Textbook of Veterinary Protozoology*. ICAR.
 Dobbelaere DAE & McKeever D. 2002. *Theileria*. Springer Verlag.
 Dubey JP & Beattie CP. 1988. *Toxoplasmosis of Animals and Man*. CRC Press.
 Dubey JP, Speer CA & Fayer R. 1989. *Sarcocystosis of Animals and Man*. CRC Press.
 Dubey JP, Speer CA & Fayer R. 1990. *Cryptosporidiosis in Man and Animals*. CRC Press.
 Kreier JP. 1991-95. *Parasitic Protozoa*. Ed. JR Baker. Academic Press.
 Levine ND. 1985. *Veterinary Protozoology*. Iowa State Univ. Press.
 Lindsay DS & Weiss LM. 2004. *Opportunistic Infections :Toxoplasma, Sarcocystis and Microsporidia*. Kluwer Academic Press.
 Maudlin I. 2004. *The Trypanosomiasis*. Oxford Univ. Press.
 Sterling CR. and Adam RD. 2004. *The Pathogenic Enteric Protozoa*. Kluwer Academic Press.
 Thompson A. 2003. *Cryptosporidium*. Elsevier.

VPA 605**PARASITOLOGICAL TECHNIQUES****0+2****SEM - I****Objective**

To impart practical knowledge on various techniques used in veterinary parasitology.

Practical

Microscopy, micrometry, camera lucida drawings, micro- and digital photography.



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Collection, processing and examination of faecal and blood samples; lymph node biopsies, skin scrapings and nasal washings from animals for parasitological findings. Quantitative faecal examination. Evaluation of the efficacy and resistance of drugs against parasites. Maintenance of tick and fly colonies in laboratory for experimental purposes and testing of drugs; tick dissection for vector potential. Collection of aquatic snails from field and their examination for the presence of different parasitic stages. Collection, fixation, staining, whole mounts and identification of parasites. Cryopreservation of parasites, culturing techniques for important parasites and pasture larval count, worm count and assessment of worm burden. Remote sensing (RS) and geographic information system (GIS) as tools for mapping parasitic diseases.

Suggested Readings

- Chaudhri SS & Gupta SK. 2003. *Manual of General Veterinary Parasitology*. International Book Distr. Co.
 Durr P & Gatrell A. 2004. *GIS and Spatial Analysis in Veterinary Science*. CABI.
 Ministry of Agriculture, Fisheries and Food (MAFF). 1986. *Manual of Veterinary Parasitological Laboratory Techniques*. 3rd Ed. Tech. Bull. 18, HMSO.
 Rathore VS & Sengar YS. 2005. *Diagnostic Parasitology*. Pointer Publ.

VPA 606 CLINICAL PARASITOLOGY 1+1 SEM - I

Objective

Collection and examination of clinical material for parasitological investigations and study of clinical cases.

Theory

UNIT-I: History, clinical signs, gross and microscopic examination of secretions and excretions of clinical cases.

UNIT-II: Collection and dispatch of material to laboratory for diagnosis.

UNIT-III: Animal sub-inoculation tests; blood and biopsy smear examination; histopathology of affected organs.

Practical

Identification, observation of parasitic stages in host tissues, excretions, secretions and associated pathological lesions.

Suggested Readings

- Faust EC, Russell PF & Jung RC. 1971. *Craig and Faust's Clinical Parasitology*. Lea & Febiger.
 Sloss MW, Kemp RL & Zajac AM. 1994. *Veterinary Clinical Parasitology*. Indian Ed. International Book Distr. Co.
 Soulsby EJJ. 1965. *Textbook of Veterinary Clinical Parasitology*. Blackwell.

VPA 607 TRENDS IN CONTROL OF LIVESTOCK AND POULTRY PARASITES 1+1 SEM - II

Objective

To learn about integrated approach for the control of helminths, arthropods and protozoan parasites of veterinary importance.

Theory

UNIT-I: Conventional and novel methods of control of helminth – anthelmintics, their mode of action, characteristic of an ideal anthelmintic, anthelmintic resistance, spectrum of activity, delivery devices, integrated control method and immunological control. Formulation of deworming schedule. Snail and other intermediate host control.

UNIT-II: Conventional and novel methods of control of protozoan parasites – antiprotozoan drugs, their mode of action, integrated control method and immunological control.


UNIT-III: Conventional and novel methods of control of insects – Insecticides / acaricides - methods of application, their mode of action, insecticide resistance, integrated control method and immunological control.

Practical

In vivo and *in vitro* detection of efficacy of and resistance to parasitocidal agents.

Suggested Readings

- Kaufmann J. 1996. *Parasitic Infections of Domestic Animals*. Birkhauser Verlag.
 Mehlhorn H (Ed). 2001. *Encyclopedic Reference of Parasitology: Diseases, Treatment, Therapy*. Springer Verlag.


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Objective

To impart knowledge about the immunology, immunodiagnosis and immunoprophylaxis of ecto- and endoparasites of veterinary importance.

Theory

UNIT-I: Introduction, types of parasitic antigens and their characterization.

UNIT-II: Types of immunity in parasitic infections. Cellular and humoral immunity to parasites, hypersensitivity, regulation of the immune response.

UNIT-III: Evasion of immunity, immunomodulations and their uses.

UNIT-IV: Immune responses in helminths, arthropods and protozoa of veterinary importance.

UNIT-V: Immunodiagnostic tests and their techniques; application of biotechnological tools in the diagnosis and control of parasitic diseases.

UNIT-VI: Vaccines and vaccination against parasitic infections.

UNIT-VII: Genetic control of parasites.

Practical

Preparation of various antigens (somatic, secretory and excretory) and their fractionation and characterization; raising of antisera and demonstration of various immunodiagnostic methods for the diagnosis of parasitic infections.

Suggested Readings

Behnkey JM. 1990. *Parasites, Immunity and Pathology*. Taylor & Francis.

Boothroyd JC & Komuniecki R. 1995. *Molecular Approaches to Parasitology*. Wiley-Liss Publication, New York.

Cohen S & Sadun EH. 1976. *Immunology of Parasitic Infections*. Blackwell.

Cox FEG. 1993. *Modern Parasitology*. Blackwell.

Marr JJ, Nilsen TW & Komuniecki RW. 2003. *Molecular Medical Parasitology*. Elsevier.

Waklin D. 1996. *Immunity to Parasites*. Cambridge University Press.

Objective

To provide the students with an in-depth knowledge of occurrence and importance of parasitic zoonoses and how these parasites are diagnosed and controlled.

Theory

UNIT-I: Introduction to the concept of zoonotic infections, definitions, various classifications of zoonoses, host-parasite relationships, modes of infections, factors influencing prevalence of zoonoses.

UNIT-II: A detailed study of transmission, epidemiology, diagnosis and control of major protozoa of zoonotic importance.

UNIT-III: A detailed study of transmission, epidemiology, diagnosis and control of major helminths of zoonotic importance.

UNIT-IV: A detailed study of transmission, epidemiology, diagnosis and control of major arthropods of zoonotic importance.

Suggested Readings

Miyazaki 1991. *Helminthic Zoonoses*. International Medical Foundation of Japan.

Palmer SR, Soulsby EJJ & Simpson DIH. 1998. *Zoonoses*. Oxford.

Parija SC. 1990. *Review of Parasitic Zoonoses*. AITBS Publ.

Rathore VS. 2005. *Parasitic Zoonoses*. Pointer Publishers.

Shakespeare M. 2002. *Zoonoses*. Pharmaceutical Press. University Press.

Objective

To learn about biological and control aspects of parasitic diseases of zoo and wild animals.

Theory

UNIT-I: A detailed study of major protozoa of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT-II: A detailed study of major arthropod parasites of zoo and wild animals with particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

UNIT-III: A detailed study of major helminth parasites of zoo and wild animals with



particular emphasis on morphological features, geographical distribution, epidemiology, diagnosis and management.

Practical

Methods for investigating parasitic diseases in wild animals. Collection of parasites at post-mortem. Identification and quantification of parasites. Visit to Zoo and Wild Life Parks/ Sanctuaries.

Suggested Readings

- Chowdhury N & Alonso Aquirre A. 2001. *Helminths of Wild Life*. Oxford & IBH Publishing Co. Pvt. Ltd.
- Friend M & Franson JC. 1999. *Field Manual of Wildlife Diseases: General Field Procedures and Diseases of Birds*. Free of charge at: www.nwhc.usgs.gov/publications/field_manual/field_manual_of_wildlife_diseases.pdf
- NBII Wildlife Diseases Information Node can be reached at: <http://wildlifediseases.nbii.gov>
- Samual W, Pybus M & Kocan A. (Eds). 2001. *Parasitic Diseases of Wild Mammals*. Iowa State Univ. Press.

VPA 611 MALACOLOGY 1+1 SEM - I

Objective

To learn about the details of various snails involved in diseases transmission.

Theory

- UNIT-I: Characters and classification of Mollusca.
- UNIT-II: Occurrence, distribution, ecology, life history, morphology and control of vector snails belonging to families, Planorbidae, Lymnaeidae, Thiridae, Amnicolidae, Helicidae, Succineidae and Zonitidae.
- UNIT-III: Examination of vector molluscs for parasitic infections.
- UNIT-IV: Haematology, internal defense mechanisms, parasite-induced pathology and molluscan tissue culture.

Practical

Collection and identification of vector molluscs, study of their shells and internal organs. Breeding, rearing and maintenance of vector molluscs in the laboratory. Examination of molluscs for various developmental stages of parasites.

Suggested Readings

- Malek EA & Cheng TC. 1974. *Medical and Economic Malacology*. Academic Press.
- Sturm CF, Pearce TA & Valdés A. 2006. *The Mollusks: A Guide to Their Study, Collection and Preservation*. American Malacological Society, Pittsburgh and Universal Publishers, Boca Raton.

**VPA 701 APPLICATIONS OF REMOTE SENSING 1+2 SEM - I
AND GEOGRAPHIC INFORMATION SYSTEM
IN PARASITOLOGY**

Objective

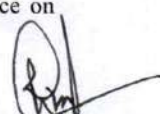
To study the emerging applications of Remote Sensing and Geographic Information System in parasitology.

Theory

- UNIT-I: Basic principles of Remote Sensing, satellite and imagery sensor systems, spectral signatures, interpretation of satellite imagery, digital image processing.
- UNIT-II: Fundamentals of GIS, raster data representation, vector data representation, GIS data management, data input, editing, analysis and modeling, GIS output as maps.
- UNIT-III: Integration of RS and GIS. Applications of RS and GIS in parasitology, case studies related to vector and vector-borne parasitic diseases, soil transmitted helminths.

Practical

Understanding maps and map projections, maps as models. IRS data products, visual interpretation of image, Digital image processing, contrast enhancements, spatial filtering techniques, image transformations, image classification. Applications of Remote Sensing in parasitology. Components of GIS, creation of digital database in a GIS, GIS operations, data analysis and modeling. Case studies of applications of GIS in parasitology. Application of GIS in modeling the spatial and temporal spread of parasites. Global Positioning System (GPS), its applications and hands-on practice. Hands-on practice on


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RS and GIS software's like ERDAS Imagine, ArcGIS, ILWIS etc. Internet as resource for RS data products.

Suggested Readings

Selected articles from journals

VPA 702 MOLECULAR DIAGNOSTICS AND 2+1 SEM - II
VACCINE DEVELOPMENT IN PARASITOLOGY

Objective

To understand the molecular analysis of parasites for diagnosis, disease control, drug development and vaccine production.

Theory

UNIT-I: Introduction and parasite genomics.

UNIT-II: DNA and RNA technology, Gene expression and regulation.

UNIT-III: Recombinant protein production.

UNIT-IV: Hybridoma technology and its application in parasitology.

UNIT-V: Molecular diagnosis and Phylogeny. Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. Restriction Fragment Length Polymorphism (RFLP), Polymerase Chain Reaction, modified PCR and related techniques, Random Amplified Polymorphic DNA (RAPD), Nucleic acid probe and Cleavage Length Fragment Polymorphism (CFLP).

UNIT-VI: Types of immune responses produced by various parasites, novel and other antigens, proteases and cytokines in vaccine production.

UNIT-VII: Nucleic acid vaccines. Vectored parasitic vaccines.

Practical

Identification, characterization, and purification of antigens, analysis of parasite protein antigens, preparation of polyclonal antibodies. RAPD, RFLP, PCR, modified PCR and related techniques. DNA and RNA isolation protocols from blood, tissues and parasites and immuno- assays for studying the vaccine response.

Suggested Readings

Selected articles from journals.

VPA 703 HOST PARASITE INTERACTIONS 2+0 SEM - I

Objective

To understand the importance of host-parasite interactions.

Theory

UNIT-I: Introduction, distribution of parasites on/in the host, morphological specializations for life on the host.

UNIT-II: Behavioural defenses, host immune responses and genetic resistance to parasites.

UNIT-III: Establishment of parasites in immuno-competent, susceptible, intermediate and abnormal hosts, chronicity of parasitic infections, immuno-evasive strategies of the parasites, host-parasite equilibrium.

UNIT-IV: Pathology of host parasite interactions, host parasite interactions in relation to malnutrition and micronutrient metabolism.

Suggested Readings

Selected articles from journals.

VPA 704 ADVANCES IN PROTOZOOLOGY 2+1 SEM - II

Objective

To discuss the latest scientific developments on various aspects of protozoan parasites.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of intestinal protozoa.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of haemoprotozoans.

UNIT-III: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of tissue and other protozoa



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Practical

Morphological, pathological and immunodiagnostic studies on various protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 705 ADVANCES IN HELMINTHOLOGY – I 2+1 SEM - I**Objective**

To discuss the latest scientific developments on various aspects of trematodes and cestodes.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of trematodes and their larval stages.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of cestodes and metacestodes.

Practical

Morphological, pathological and immunodiagnostic studies on various trematodes and cestodes.

Suggested Readings

Selected articles from journals.

VPA 706 ADVANCES IN HELMINTHOLOGY – II 2+1 SEM - II**Objective**

To discuss the latest scientific developments on various aspects of nematodes and thorny-headed worms.

Theory

UNIT-I: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of nematodes and their larval stages.

UNIT-II: Advanced studies on taxonomy, molecular biology, pathogenesis, immunology and serology of thorny-headed worms.

Practical

Morphological, pathological and immunodiagnostic studies on various nematodes and thorny-headed worms.

Suggested Readings

Selected articles from journals.

**VPA 707 ADVANCES IN ENTOMOLOGY AND
ACAROLOGY 2+1 SEM - I****Objective**

To discuss latest scientific developments on various aspects of arthropods.

Theory

UNIT-I: Origin, evolution, regional and seasonal distribution, forecasting insect and acarine population through biological modelling.

UNIT-II: Population dynamics of insects and acarines in relation to biotic and abiotic factors.

UNIT-III: Recent developments pertaining to insects of veterinary importance.

UNIT-IV: Recent developments pertaining to arachnids of veterinary importance.

UNIT-V: Chemical, biological, immunological control measures and in-depth study of integrated pest management. Modulation of vector competence to transmit parasitic infections using molecular genetics by developing transgenic vectors.

Practical

Identification of arthropods of veterinary importance in the region. Dissection of arthropods for recovery of infective stages of parasites. Immunopathological changes in the host tissues due to haemato-phagous arthropods.

Suggested Readings

Selected articles from journals.

VPA 708 IN VITRO CULTIVATION OF PARASITES 1+2 SEM - II**Objective**

Development of skills for cultivation of various parasites in the laboratory for research and practical control.


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Theory

UNIT-I: Introduction, problems and goals.

UNIT-II: *In vitro* cultivation of genital flagellates, intestinal flagellates and intestinal ciliates.

UNIT-III: *In vitro* cultivation of intestinal and tissue protozoa.

UNIT-IV: *In vitro* cultivation of haemoprotozoans.

UNIT-V: *In vitro* techniques, media and tissue culture for cultivation of helminths and their larval stages.

UNIT-VI: *In vitro* mass rearing and colonization of ticks, flies and other insects.

Practical

Preparation of media and cultivation of important parasites, raising and maintenance of cell-lines of important parasites.

Suggested Readings

Selected articles from journals.

VPA 709	EMERGING AND RE-EMERGING PARASITIC DISEASES	2+0	SEM - II
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Objective

To study the emerging and re-emerging parasitic diseases.

Theory

UNIT-I: Emerging and re-emerging helminthic diseases.

UNIT-II: Emerging and re-emerging protozoan diseases.

UNIT-III: Emerging and re-emerging vector-borne diseases.

Suggested Readings

Selected articles from journals.

VPA 710	BIONOMICS OF PARASITES	3+0	SEM - I
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Objective

To study ultrastructure, physiology, biochemistry and bionomics of important parasites.

Theory

UNIT-I: Ultrastructure, physiology, biochemistry and bionomics of trematodes and cestodes of veterinary importance.

UNIT-II: Ultrastructure, physiology, biochemistry and bionomics of nematodes of veterinary importance.

UNIT-III: Ultrastructure, physiology, biochemistry and bionomics of important arthropod parasites.

UNIT-IV: Ultrastructure, physiology, biochemistry and bionomics of important protozoan parasites.

Suggested Readings

Selected articles from journals.

VPA 711	ENVIRONMENTAL PARASITOLOGY	1+1	SEM - I
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Objective

To study the effect of environmental changes and ecological disturbances on the emergence, proliferation and transmission of parasitic diseases.

Theory

UNIT-I: Environmental changes and ecological disturbances due to natural phenomenon and human interventions (demographic, societal and agricultural changes, global warming, floods, hurricanes and pollution etc.).

UNIT-II: Effect of environmental changes and ecological disturbances on the proliferation and transmission of helminthic diseases.

UNIT-III: Effect of environmental changes and ecological disturbances on the proliferation and transmission of protozoan diseases.

UNIT-IV: Effect of environmental changes and ecological disturbances on the proliferation of intermediate hosts and vectors and their role in transmission of diseases.

Practical

Examination of water, soil, meat and vegetables etc. to record the contamination with parasites due to environmental changes. Assessment of effect of temperature and humidity on the development of parasites. Use of Process-based (mathematical) models to express the scientifically documented relationship between climatic variables and biological



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parameters e.g., vector breeding, survival and biting rates; parasite incubation rates.

Suggested Readings

Selected articles from journals.

VPA 790

SPECIAL PROBLEM

0+2

SEM - I, II

Objective

To provide expertise in handling practical research problem(s).

Practical

Short research problem(s) involving contemporary issues and research techniques.



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LIVESTOCK PRODUCTION MANAGEMENT

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
LPM 601*	CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	2+1	I
LPM 602*	SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1	II
LPM 603	SWINE PRODUCTION AND MANAGEMENT	1+1	I
LPM 604	LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+1	II
LPM 605	SHELTER MANAGEMENT	1+1	I
LPM 606	PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT	2+0	II
LPM 607	CLIMATOLOGY AND ANIMAL PRODUCTION	1+0	I
LPM 608*	POULTRY FARM AND HATCHERY MANAGEMENT	2+1	I
LPM 609	FARM ANIMAL BEHAVIOR	1+0	II
LPM 610	INTEGRATED LIVESTOCK FARMING SYSTEM	2+1	II
LPM 611	EQUINE PRODUCTION AND MANAGEMENT	1+1	I
LPM 612	WILDLIFE MANAGEMENT AND CONSERVATION	2+0	II
LPM 613	LIVESTOCK BUSINESS MANAGEMENT	1+1	I
LPM 691	MASTER'S SEMINAR	1	I, II
LPM 699	MASTER'S RESEARCH	20	I, II
LPM 701**	ADVANCES IN CATTLE AND BUFFALO PRODUCTION AND MANAGEMENT	3+0	I
LPM 702**	ADVANCES IN SHEEP AND GOAT PRODUCTION AND MANAGEMENT	2+1	II
LPM 703	ADVANCES IN SWINE PRODUCTION AND MANAGEMENT	2+1	I
LPM 704	ADVANCES IN LABORATORY ANIMAL PRODUCTION AND MANAGEMENT	1+0	II
LPM 705**	ADVANCES IN POULTRY PRODUCTION AND MANAGEMENT	2+1	I
LPM 706	ADVANCES IN ENVIRONMENTAL MANAGEMENT	1+1	II
LPM 707	ADVANCES IN EQUINE MANAGEMENT	2+0	I
LPM 791	DOCTORAL SEMINAR I	1	I, II
LPM 792	DOCTORAL SEMINAR II	1	I, II
LPM 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
ABM 533	POULTRY AND HATCHERY MANAGEMENT	2+0	

* Compulsory for Master's programme; **Compulsory for Doctoral programme



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Course Contents

SEM - I

Thomas CK & Sastry NSR.1991. *Dairy Bovine Production*. Kalyani.

SEM - II

UNIT-III: Feeding Management: Feeding methods - Principles to be followed in feeding and watering- feeder space, waterer space, Designing feeders and waterers. -Range management - Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat.


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UNIT-IV: Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying- shearing -Avoidance of goatry odour in milk, Tupping

UNIT-V: Wool: Importance of wool - Fiber structure- Fleece characters - Goat fibres - Characters of mohair and pashmina, fur and Angora - Marketing of goat fibres/ wool.- Planning of sheep and goat farm of various sizes - Economics of sheep and goat farming.

Practical

Visit to sheep and goat farms and critical analysis of various managerial practices under different conditions. Study of practical housing management -Analysis of practical diseases control management - Shearing management -Record keeping. - Preparation of project for commercial farming -Characterization of sheep and goats; handling of sheep and goat; daily and periodical operations for sheep and goats - Methods of identification of sheep and goat. Cost of rearing sheep and goat for mutton and wool - Housing plans for various age and categories of sheep and goat - Dipping; Vaccination of sheep and goat - Shearing of wool.

Suggested Readings

Devendra C & Mecleroy GB. 1982. *Goat and Sheep Production in Tropics*. Longman.
Gupta JL. 2006. *Sheep Production and Management*. BS Publ.
ICAR. 2002. *Handbook of Animal Husbandry* 3rd Ed. ICAR.
Kaushish 1994. *Sheep Production in the Tropics and Sub Tropics*. Scientific Publ.

LPM 603

SWINE PRODUCTION AND MANAGEMENT 1+1

SEM - I

Objective

To impart knowledge on various aspects of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of growth and economic pig production systems.

Theory

UNIT-I: Introduction - Population and importance - Economic contribution of pigs - Advantages and disadvantages of swine keeping - Systems of management -Problems in pig farming.

UNIT-II: Breeds of pigs - Selection of breeding stock - Breeding seasons - Age and weight at first services - Methods for detection of heat - Natural service and artificial insemination - Care of pregnant sows, piglets and growers - Care of breeding boar.

UNIT-III: Housing, sanitation and hygiene, disease prevention measures - Housing and equipment -Wallowing - Sanitation and hygiene - Role of management in the prevention and the control of diseases.

UNIT-IV: Feeding and management of new born, weaner and finishers, dry, pregnant and farrowing sows - Feeding principles to be followed - Methods of watering -Feeder space - Water space, etc - Marketing: Methods of marketing in swine production - Record keeping.

Practical

Visits to piggeries and critical Analysis of various types of managerial practices - Analysis of the trend and structures of pig population - Analysis of practical breeding management methods, practical disease control management- special management methods - Ageing and identification - Judging -Constraints and remedial measures in pig farming - Economics of production -Project preparation for research and commercial farms.

Suggested Readings

Boden (e) S.1995. *Swine Practice*. WB London.
Narayankhedkar SG. 1997. *Production and Management of Swine, Camel, Equine and Yak*. Tindall Publ.

LPM 604

LABORATORY ANIMAL PRODUCTION AND MANAGEMENT 1+1

SEM - II

Objective

To educate the students become familiarize with various aspects of rabbit farming, problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice and guinea pigs, measures to reduce the mortality in young ones at different seasons.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Theory

UNIT-I: Introduction - Importance of rabbit for meat and fur production, rats, mice and guinea pigs, - Common breeds and strains.

UNIT-II: System of housing - Common diseases and their control measure. Management of specific pathogen free and gnotobiotic animals, concepts related to welfare of laboratory animals.

UNIT-III: Breeding - Age at maturity, litter size - Weaning - Feeding of growers - Selection of replacement stock, transportation of rabbit.

UNIT-IV: Transportation of Laboratory animals - marketing of meat and fur.

Practical

Handling and restraining of laboratory animals - Visits to small animal farms and critical analysis of various types of managerial practices- Analysis of the trend and structures of Laboratory animals population - Analysis of practical breeding management methods - practical disease control management and special management methods - Ageing and identification - Judging -Economics of production.

Suggested Readings

Indian Soil Institute.1993. *Rabbit Management*. IBH & Oxford.

Reddy DV. 2007. *Applied Nutrition: (Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition)*. IBH & Oxford.

Ronald N & Penman S. 1991. *A Manual for Small Scale Rabbit Production*. South Asia Publ.

LPM 605

SHELTER MANAGEMENT

1+1

SEM - I

Objective

To familiarize students with type of houses suited for different livestock under varying climatic conditions.

Theory

UNIT-I: General principles in planning animal houses- farmstead and animal houses - Selection of site and planning; layouts for livestock farm of different sizes in different climatic zones in India - Farm structures - General principles of construction of enclosures, floor and road.

UNIT-II: Housing requirements of different classes of Livestock - Preparation of layouts, plans, arrangement of alleys- Fitting and facilities in the houses for horses, dairy cattle, calves, bulls, work cattle, dogs, pigs, sheep, goats, and poultry.

UNIT-III: Improvement of existing buildings; water supply; feed and fodder delivery systems - Economics of Livestock housing.

UNIT-IV: Housing - Disease control measures and sanitation of all classes of livestock

Practical

Score card for animal houses - Time and motion study in Animal houses -Preparation of plans for Animal houses for horses, cattle, sheep, pigs, goats, and other livestock - Dogs and other pet animals - Economics of livestock housing - Preparation of plan for animal houses of different sizes and climatic zones of India.

Suggested Readings

Sastry NSR & Thomas CK. 2006. *Livestock Production and Management*. Kalyani.

Thomas CK & Sastry NSR 1991. *Dairy Bovine Production*. Kalyani.

Wathes CM & Charles DR. 1994. *Livestock Housing*. CABI.

LPM 606

PRINCIPLES OF ENVIRONMENTAL HYGIENE AND WASTE MANAGEMENT

2+0

SEM - II

Objective

To familiarize students on principles of air and water hygiene with reference to impurities and inclusions of water, collection and disposal of waste from the animal house, modern techniques in manure disposal and biosecurity measures to be adapted for hygienic production of livestock products.

Theory

UNIT-I: Animal air hygiene: Definition - Composition of air - Air pollution - Factors affecting outdoor and indoor pollution - Assessment of these factors on animal health and production - Methods to control these factors.


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UNIT-II: Water Hygiene: Importance of water - Impurities and inclusions - Sterilization- Examination of water and water supplies - Collection of samples-Topographical physical, chemical, bacteriological and microscopic examination of water - Hygienic requirements and standards for drinking water- Quantity of water required by domestic animals - Methods of watering.

UNIT-III: Manure - Quantity of manure voided by domestic animals - Animal excreta factor in spread of disease - Hygienic and economic disposal of farm waste -Modern techniques used in automation / semi-automation in disposal of farm waste.

UNIT-IV: Environmental protection act, Air (Prevention and control of pollution) act and water (Prevention and control of pollution) act – Biosecurity measures to be adapted for efficient and healthy production.

UNIT-V: Effect of environmental pollution on livestock and its products directly and indirectly - Controlling environmental pollution - Different factors affecting the quality of livestock and its products meant for human consumption.

Suggested Readings

Baba MD. 2007. *Environmental Changes and Natural Disasters*. New India Publ.

Overcash MR. 1983. *Livestock Waste Management*. CRC Press.

Thapliyal DC & Misra DS. 1996. *Fundamentals of Animal Hygiene and Epidemiology*. International Book Distr. Co.

LPM 607 CLIMATOLOGY AND ANIMAL PRODUCTION 1+0 SEM - I

Objective

To familiarize students on climate, weather, various climatic factors and their role in production and health of animals in both temperate and tropics, micro and macroclimatic conditions of animal house and assessing the heat tolerance of bovines.

Theory

UNIT-I: Definition of climate -Classification of climatic regions - Climatic factors-Assessment of climate - Study of climatic factors in relation to animal production.

UNIT-II: Light, natural and artificial light-mechanism of light action-photo period and light responses – Applications - Importance of light in production of animals and birds.

UNIT-III: Introduction of breeds into different climatic regions - Agro meteorology and weather forecasting for Animal Husbandry activities - Micro climate modification in animal houses.

UNIT-IV: Estimation of microclimatic conditions in Animal house - Measurement of Temperature, Relative humidity, Air Velocity and Mean temperature of the surrounding, measurement of intensity of light in animal houses – Construction of seismographs and hythergraphs -estimation of cooling power of atmosphere heat tolerance test in bovines.

Suggested Readings

Lal DS. 1998. *Climatology*. Sharda Pustak Bhavan, Allahabad.

McDowell RE. 1972. *Improvement of Livestock Production in Warm Climates*. WH Freeman.

Siddhartha K & Roger B. 1996. *Atmosphere, Weather and Climate*. ELBS.

LPM 608 POULTRY FARM AND HATCHERY 2+1 SEM - I
MANAGEMENT

Objective

To acquaint students on basic aspects of housing, feeding, breeding and healthcare of poultry and comparing the performance under cage and floor system of management of poultry, biosecurity measures to be followed to reduce mortality and efficient hatchery management to produce healthy young ones.

Theory

UNIT-I: Poultry housing systems Cage Vs floor system, litter management and lights for poultry, rearing turkey, duck and quails.

UNIT-II: Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks.

UNIT-III: Procuring, care and pre-incubation storage of hatching eggs - Method of incubation, sanitation disinfection and management of hatchery.

UNIT-IV: Embryonic development and factors effecting fertility and hatchability of eggs.

UNIT-V: Chick sexing, packing and hatchery business - Transporting management off arm and hatchery waste.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Practical

Poultry Farm management - Brooding of chicks; selection of laying flocks -Disease preventive measures - Selection and care of hatching eggs; incubator operation, fumigation and candling setting and hatching, packaging of chicks -Waste management - Marketing of products.

Suggested Readings

Ensminger ME. 1992. *Poultry Science*. International Book Distr. Co.
 Hued LM. 2003. *Modern Poultry Farming*. Greenworld.
 Powell-Owen W. 2008. *Poultry Farming and Keeping*. Daya Books.
 Prashad J. 2005. *Poultry Production and Management*. Kalyani.
 Singh RA. 1996. *Poultry Production*. 3rd Ed. Kalyani.

LPM 609**FARM ANIMAL BEHAVIOR****1+0****SEM - II****Objective**

To make acquainted students on principles of farm animal behaviour with regard to environmental influence, group formation, social behaviour and behavioural adaptations under domestication.

Theory

UNIT-I: Introduction to Animal behaviour - Importance of animal behaviour studies - Patterns of behaviour - Daily and seasonal cycles of behaviour – Physiological basis of behaviour.

UNIT-II: Environmental modification of behaviour - Developmental changes in behaviour - Genetic differences in behaviour - Behavioural disorders.

UNIT-III: Group formation - Social relationship, process of socialisation locality and behaviour - Practical application - Behavioural character for managemental practices - Favourable and unfavourable behaviour for domestication -Behavioural adaptations under domestication.

UNIT-IV: Physical environment and behaviour - Common vices and their remedial measures - Analysis of behaviour in relation to location - Analysis of behaviour in relation to climatic environment - Analysis of social behaviour.

Suggested Readings

Arora MP. 1995. *Animal Behaviour*. WB London.
 Bouenger EG. 1994. *Animal Behaviour*. WB London.
 Fraser AF & Broom DM. 1997. *Farm Animal Behaviour and Welfare*. CABI.
 Fraser AF & Broom DM. 1999. *Farm Animal Behaviour and Welfare*.
 Kumar V. 1996. *Animal Behaviour*. WB London.

LPM 610**INTEGRATED LIVESTOCK
FARMING SYSTEM****2+1****SEM - II****Objective**

To familiarize on various aspects viz., scope and limitations of integrated livestock farming system, recent approach and economic feasibility of different integration models for sustainable production.

Theory

UNIT-I: Scope and limitation of integrated farming systems - Sustainability of integrated Livestock Farming Systems and their economic importance.

UNIT-II: Integration of fish, arable farming and different livestock enterprises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization, cattle, buffalo sheep, goat, pig, poultry, rabbit, silk worm, bee keeping etc.

UNIT-III: New approach for changing farming systems in present energy crises.


UNIT-IV: Project formulation and evaluation of various livestock enterprises.

Practical

Various livestock farming units and their economic analysis - Evaluation of different farming systems and their economic importance - Preparing feasibility report for various farming projects.

Suggested Readings

Mukherjee TK. 1992. *Integrated Livestock Fish Production Systems*.


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

- Raman KV & Balaguru T. (Eds.). 1992. *Farming Systems Research in India: Strategies for Implementation*. NAARM.
- Renard C. (Ed.). 1997. *Crop Residues in Sustainable Mixed Crop/Livestock Farming Systems*. CABI.
- Speirs M. & Opsen O. 1992. *Indigenous Integrated Farming System in the Sahel*. World Bank.

LPM 611 EQUINE PRODUCTION AND MANAGEMENT 1+1 SEM - I

Objective

To educate the students become familiarize with principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: Equine population in India - Breeds of native and exotic horses - Types and classes of light and work horses.

UNIT-II: Housing and routine management practices -Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices.

UNIT-III: Feeding and breeding of horses donkey and Mules, foaling, care of foal.

UNIT-IV: Foot care and shoeing care, Stud farms - Race clubs - Race horses and their care - Horse behaviour and training - Exercising - Basic Horsemanship.

UNIT-V: Health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention.

UNIT-VI: Mode of transport - Facilities requirement - Cleaning, disinfection and preparation of vehicles Transport stress - Management during transport -Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport - Laws governing the import and export of livestock and its products- - Horse passport and trading.

Practical

Control of horse for examination, passing of stomach tube, dentition and ageing, saddling, exercising of horse, hoof care.

Suggested Readings

Blanchard TL et al. 2002. *Manual of Equine Reproduction*. Mosby Publ.

Frape D. 1986. *Equine Nutrition and Feeding*. Blackwell Publ.

Kacker RN & Panwar BS. 1996. *Text Book of Equine Husbandry*. Vikas Publ.

Mills DS & Nankervis KJ. 1998. *Equine Behaviour: Principles and Practice*. Blackwell Publ.

Pilliner S. 1994. *Care of the competition Horse*. BT Batsford.

Rose RJ & Hodgson DR. 2000. *Manual of Equine Practice*. WB Saunders.

LPM 612 WILD LIFE MANAGEMENT AND CONSERVATION 2+0 SEM - II

Objective

To acquaint students with the principles and concepts of wild life sanctuaries and national parks, classification of wild animals, role of authorities in conservation and management of wild animals in captivity.

Theory

UNIT-I: Zoo and captive wild animals - Principles and concepts - Ecology of wild life sanctuaries and National parks- wild life legislation in India - Status of forest in India - Biological and ecological basis of management of wild life.

UNIT-II: Voluntary organization on wild life - Rules and regulations of zoo authority of India -Wild life protection act - Zoological classification of wild animals -Funding agencies for wild life research and preparation of project. -Conservation of wild animals.

UNIT-III: Wild life health control - Reproduction in zoos - Population analysis - Population manipulation - Habit analysis and design - The resources and its management - Distribution of important Indian animals - Zoo animals and birds - Breeding characteristics - Movements - Cover requirements - Food -Population density - Mortality - Nesting losses caused by predators, predator and prey relationship - Human interference - Refuge rehabilitation.



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UNIT-IV: Restraints - Maps - Survey and plans of management systems - Principles, protective measures - Development and conservation of water supply- puberty- Breeding seasons - pregnancy - Parturition - Lactation postnatal survival of the young - Social factors among various species - Miscellaneous management procedures.

Suggested Readings

- Berwick SH & Saharia VB. (Eds.). 1995. *The Development of International Principles and Practices of Wild Life Research and Management*. Deford Univ. Press.
 Bobbins CT. 1983. *Wild Life Feeding and Nutrition*. Daya Publ. House.
 Giles RH. 1978. *Wild Life Management*. Wild Life Society.
 Giles RH. 1984. *Wild Life Management Techniques*. 3rd Ed. Wild Life Society.
 Jadhav NV, Baig MI & Devangare AA. 2004. *Handbook of Wild Animals and Livestock Management*.
 WWF. 1994. *Wild Life (Protection) Act 1972* (as Amended up to 1991). Natraj Publ.

LPM 613 LIVESTOCK BUSINESS MANAGEMENT 1+1 SEM - I

Objective

To acquaint students with knowledge in principles, planning, technical approach and preparing financial statement in Livestock Business Management and preparing projects for financing.

Theory

UNIT-I: Management principles - Planning - Techniques, strategic planning, organization structure, co-ordination and controlling techniques - Approaches to management.
UNIT-II: SWOT analysis, financial accounting - Accounting records - Balance sheet, fund flow statement - Cost and analysis for managerial decisions – Budgeting and control.
UNIT-III: Tools of financial analysis, working capital financing - Long term financial management - Investment analysis - Capital markets - Corporate risk management - Venture capital.
UNIT-IV: Marketing - Objectives, strategies - Selecting and managing marketing channels - Pricing strategies - Sales promotion - Legislation relating licensing -Company law.

Practical

Preparation of financial statements, depreciation accounting methods, trend and variance analysis, cost-volume profit analysis - Financial planning and forecasting - Estimation of working capital requirement - Break even analysis -Visit to livestock business firms and banks - Preparing projects for financing.

Suggested Readings

- Koontz H & O'Donnel C. 1999. *Essentials of Management*. Tata McGraw Hill.
 Kotler P. 2000. *Marketing Management – Analysis, Planning and Control*. Prentice Hall of India.
 Maheswari SN. 1998. *Management Accounting*. Tata McGraw Hill.
 Massie JL. 1995. *Essential of Management*. Prentice Hall of India.
 Srinivasan NP. 1998. *Management Accounting*. Sterling Publications.

LPM 701 ADVANCES IN CATTLE AND BUFFALO 3+0 SEM - I
PRODUCTION AND MANAGEMENT

Objective

To acquaint students on latest developments on dairying in India compared with developed countries, problems and prospectus of dairying, detailed aspects of care and management of different classes of dairy cattle and buffaloes.

Theory

UNIT-I: Dairy farming in India – Global scenario - Present status and reasons for the same – Avenues for progress – The needs of the nation and how to achieve it.
UNIT-II: Advances in housing management of dairy cattle and buffaloes in various agro climatic zone of India - Management systems for cattle and buffaloes.
UNIT-III: Establishing Dairy Cattle Enterprise – Characteristics of a successful dairy farm – Choice of the foundation stock – Breeding Management Problems associated with reproduction.
UNIT-IV: Advances in Feeding Management of cattle and buffalo, Feed for milking herd, dry cows, bulls and calves, Management of high yielding animals.
UNIT-V: Milking Management – Biosynthesis of milk - Factors affecting the composition and yield of milk - milk ejection reflex - Milking systems –Sanitary standards for the f


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

quality milk – Cessation of milking, advances in herd management- raising calves – growing heifers, replacements and culling –marketing, Computerization of dairy enterprises.

UNIT-VI: Advance in health management of dairy animals, metabolic diseases of high yielder- advances in preventive measures for production related diseases.

Suggested Readings

Clarence HE . 2007. *Dairy Cattle & Milk Production*. Daya Publ. House.

Thomas CK & Sastry NSR. 1991. *Dairy Bovine Production*. Kalyani.

Selected articles from journals.

LPM 702

**ADVANCES IN SHEEP AND GOAT
PRODUCTION AND MANAGEMENT**

2+1

SEM - II

Objective

To educate the students on advances in sheep and goat farming for improving their productivity through different management practices.

Theory

UNIT-I: Utility origin – Domestication - Numbers and distribution of meat and dual-purpose breeds - Methods of rearing – Range sheep production.

UNIT-II: The farm flock – Pure bred flock - Management during breeding season - The sexual seasons and its control - Puberty – Time of the year to breed – Flushing– Ram-Ewe ratio.

UNIT-III: Advances in feeding management, Nutrient deficiencies in range forage, Feed to supplement range forage, General feeding practices, Feeding materials, Lamb feeding, Use of antibiotics and hormones, Hand feeding, Self feeding, Pellet feeding , Feeding lambs and ewes during lactation.

UNIT-IV: Recent development in sheep and goat management and their relevance under Indian economic conditions, needs and possibilities for future research.

UNIT-V: Role of sheep husbandry in dry farming in India, Present development programmes in sheep and goat production, Advances in reproduction, housing, feeding and watering, diseases, Shearing methods and culling of sheep and goat.

UNIT-VI: Role of goat in animal agriculture, Goat farming in India, selection of Breeding stock, Breeding problems, Housing, Principles of feeding, Practices, Crops and crop residues for goats, Milking practices.

Practical

Study of population trend and structure - Visit to sheep and goat farms and critical analysis of various farm practices, Analysis of breeding, feeding, housing - Disease control management, management of young ones and maturing systems Estimation of fibre diameter medullation percentage crimps, tensile strength, Grease, pH and moisture content of wool - Score card and grading of wool.

Suggested Readings

Gupta JL. 2006. *Sheep Production and Management*. CBS.

Selected articles from journals.

LPM 703

**ADVANCES IN SWINE PRODUCTION
AND MANAGEMENT**

2+1

SEM - I

Objective

To educate about the latest advances of swine farming in India, principles of housing, breeding, feeding and health care of pigs, management practices at different stages of swine.

Theory

UNIT-I: The past, present and future of Swine production systems in India and production policies adopted in advanced countries.

UNIT-II: Advances in breeding and selection – Prenatal and postnatal development - Growth reproduction and lactation - Economic traits of swine production.

UNIT-III: Advances in feeding and nutrition in pigs; automatic feeding and watering techniques, Feed stuffs, Energy, protein, minerals and vitamin sources, metabolic and nutritional disorders – Toxic substances.

UNIT-IV: Advances in housing of pigs, environmental physiology - Infectious diseases and parasitism. reduction in new born piglet mortality.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Practical

Marketing - Study of population trend and structure. Analysis of breeding, feeding, housing, health care, farrowing management, summer management and special management principles practiced.

Suggested Readings

Selected articles from journals.

LPM 704 ADVANCES IN LABORATORY ANIMAL 1+0 SEM - II
PRODUCTION AND MANAGEMENT

Objective

To educate the students on the latest advances in problems and prospectus, principles of housing, breeding, feeding and health care of rabbits, rats, mice & guinea pigs, measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: Importance and limitations of rabbits for meat and fur production, rats, mice and guinea pigs - **Common breeds and strains.**

UNIT-II: Advances in system of housing, **common diseases and their control** measure.

UNIT-III: Breeding strategies - Age at maturity, litter size, Weaning, Feeding of growers, Selection of **replacement stock**, **transportation of rabbit.**

UNIT-IV: Transportation of Laboratory animals – marketing of meat and fur.

UNIT-V: Management of specific pathogen free and gnotobiotic animals, concepts to related to welfare of laboratory animals.

Practical

Visit to Rabbit farms - Study of the various chores in government farms and private farms - Critical analysis of breeding, feeding, disease control management and housing - Rabbit slaughter technique.

Suggested Readings

Selected articles from journals.

LPM 705 ADVANCES IN POULTRY PRODUCTION 2+1 SEM - I
AND MANAGEMENT

Objective

To educate the students on advances in housing, feeding, breeding and health care in poultry farming.

Theory

UNIT-I: Planning, organization, **executive and management** of poultry farms and hatcheries of various sizes - alternative in poultry production.

UNIT-II: **Demand, supply, present status of poultry production.**

UNIT-III: Problems and new management techniques in poultry for egg and meat in India vis-à-vis in other countries of the world, **automation in poultry houses**, management of specific pathogen free flocks.

UNIT-IV: Poultry **development policies and planning** for higher production constraints in development and solutions, Ethology and entology in relation to poultry production.

Practical

Planning and preparation of research and commercial projects on broiler and layer production management.

Suggested Readings

Selected articles from journals.

LPM 706 ADVANCES IN ENVIRONMENTAL 1+1 SEM - II
MANAGEMENT

Objective

To educate the students on advances in climate, weather, various climatic factors monitoring and their role **in production** and health of animals in both temperate and tropics, micro **and** macroclimatic conditions of animal house and environmental influences on the performance of farm animal production.

Theory


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UNIT-I: The animal Industry and the quality of the environment – Management of the living environment - Microenvironment and macro environment.

UNIT-II: Air Pollution: Indoor and out door - Chemical, physical and bacteriological changes - Causes - Standards and the extent tolerated by animals - Effects on animal production.

UNIT-III: Fixing standards in relation to CO₂ - Air supply in relation to cubic space, temperature, air, velocity, relative humidity, dust particles, bacterial count, effective temperature and cooling power - Methods to get over pollution -Cleaning and washing - Air conditioning.

UNIT-IV: Utilization and disposal of animal waste, Health hazards, Waste utilization, technologies for processing and treatment of animal wastes, Health and economic impacts, Legal constraints, Microbiology of wastes, Waste properties, Gases and odour.

UNIT-V: Water Pollution: Significance, treatment and control - Funding agencies for animal welfare.

Practical

Assessment of various factors in Indoor and outdoor environment- Assessment of CO₂, air supply, dust particles and bacterial count in air - Visit to sewage treatment plant - Planning farm waste disposals - Physical chemical and bacteriological examination of water watering of farm animals.

Suggested Readings

Baba MD. 2004. *Environmental Changes and Natural Disasters*. New India Publ. Agency.
Selected articles from journals.

LPM 707

ADVANCES IN EQUINE MANAGEMENT

2+0

SEM - I

Objective

To familiarize the students on latest aspects of principles of housing, breeding, feeding and health care of different classes of horse, stable routines and measures to reduce the mortality in young ones at different seasons.

Theory

UNIT-I: New indigenous and exotic horses breeds- Types and classes of light and workhorses.

UNIT-II: Advances in housing and routine management practices -Hygiene and maintenance of stable. Color and markings, Dentition and ageing selecting and judging horses- unsoundness and stable vices.

UNIT-III: New Feeding techniques and breeding of horses donkey and Mules, foaling, care of foal.

UNIT-IV: Foot care and shoeing care, Stud farms, Race clubs, Race horses and their care, Horse behaviour and training, Exercising ,Basic Horsemanship.

UNIT-V: Advances in health management & diseases control. Control of internal and external parasites of horse- Colic and its prevention.

UNIT-VI: Mode of transport, Facilities requirement, Cleaning, disinfection and preparation of vehicles Transport stress, Management during transport ,Regulatory acts of states and centre in animal disease control and welfare. Precautions and requirements before, during and after transport, Laws governing the import and export of livestock and its products, Horse passport and trading.

Suggested Readings

Selected articles from journals.


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	Local
	Regional
	Global
	National

Degree / Discipline: Veterinary Microbiology

Brief History

The department of Veterinary Microbiology is the constituent department of the College of Veterinary & Animal Sciences came into existence in 2012 after recruitment of the teaching staff on the regular posts. The key objectives of the department are to (i) impart education to the undergraduate and postgraduate students, admitted in the field of Veterinary Microbiology that comprises general and systematic studies of microbes, their immunological and biotechnological studies, experimental animal studies and prevention and control of infectious agents. The faculty is trained in modern methods of teaching and research, and keeps updated in knowledge and advances in these disciplines.

Programme Outcomes (POs)

1. Acquired the knowledge with the facts and figures related to Veterinary Microbiology.
2. Understood the basic concepts, fundamental principles and scientific theories related to various diseases.
3. The students acquire knowledge to take required measurements for prevention and control of bacterial, viral and fungal diseases.
4. Laboratory sessions emphasize the proper selection, collection and transportation of bacteriologic and fungal specimens.

Programme Specific Outcomes (PSOs)

1. The course is emphasized on morphology, physiology and function of microorganism.
2. The students will gain insight of microbiology starting from history, basic laboratory techniques and fundamental knowledge about the microorganisms.
3. The students will acquire the skill in the use and care of the basic microbiological equipment, performance of basic laboratory procedures of basic microbiology.
4. The students will acquire the knowledge of proper collection and forwarding of microbiological specimens to the laboratory.

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Course Outcomes (COs)

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1	Bacteriology-I	VMC-601	3+1	CO1: To impart knowledge on general microbiology and important aerobic bacteria for the students. CO2: Students acquire knowledge about pathogenesis and epidemiology microbes.
2	Bacteriology-II	VMC-602	3+1	CO1: Students learn about spore forming bacteria and some important aerobes and anaerobes. CO2: Students are able to acquire knowledge about pathogenesis and epidemiology anaerobic microbes.
3	Veterinary Mycology	VMC-603	1+1	CO1: Students learn general and pathogenic mycology. CO2: Students at the end impart knowledge on Systematic study of animal mycoses. CO3: Students learned the basic techniques of collection and processing of clinical material for isolation of fungi.
4	General Virology	VMC-604	2+1	CO1: Students learn the general aspects of viral structure, classification, replication, interactions and immunity to viruses. CO2: To impart History of virology; origin and nature of viruses. CO3: Students learned the basic techniques of collection, preservation, transportation of samples and their processing, isolation and cultivation of viruses.
5	Systematic Veterinary Virology	VMC-605	3+1	CO1: Students able to learn viral properties, epidemiology, pathogenesis, diagnosis and control of diseases caused by animal viruses. CO2: At the end of this course students impart knowledge on different viral disease related to animal species.
6	Principles of Immunology	VMC-606	2+1	CO1: To impart knowledge about fundamental principles of immunology and its applications in the field of infectious diseases. CO2: Students gain knowledge on the immunological surveillance. CO3: To impart the knowledge on Immunity against veterinary infectious agents. CO4: To define about the different immunological cells.



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7	Vaccinology	VMC-607	2+0	<p>CO1: Students are able to understand science and practice of vaccines for prevention of bacterial and viral diseases.</p> <p>CO2: Students able to understand modern methods of vaccine construction.</p> <p>CO3: Students learn the immunization schedules of veterinary vaccines, logistic problems and vaccination failure.</p> <p>CO4: To describe various strategies of disease control and eradication by vaccination.</p>
8	Diagnostics of Infectious Diseases	VMC-608	1+2	<p>CO1: To provide training in essential immunological and molecular diagnostic techniques.</p> <p>CO2: To learn various development and validation of diagnostic tests.</p> <p>CO3: To impart knowledge on Principles of serodiagnostic tests.</p> <p>CO4: To provide training in Molecular diagnostic techniques of infectious diseases.</p>
9	Techniques in Microbiology and Immunology	VMC-609	0+3	<p>CO1: To learn various important techniques of bacteriology, virology and immunology.</p> <p>CO2: To learn antibiotic sensitivity of micro-organisms from clinical specimens.</p> <p>CO3: To learn pathogenicity test in cell culture or laboratory animals.</p> <p>CO4: Various aspects of Hypersensitivity tests.</p>
10	Master's Seminar	VMC-691	1+0	CO1: Skill for the slide presentation of the update's disease model related to animals.
11	Master's Research	VMC-699	20	CO1: Student will complete their research problem as per the area specific disease or by the advisor.

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Doctoral Programme

Degree/Discipline: Veterinary Microbiology

Course Outcomes (COs)

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1	Advances in Bacteriology	VMC 701	2+1	CO1: To learn about the latest development in the field of bacteriology. Co2: To learn about Biochemical, physiological and pathogenesis studies of various bacterial diseases.
2	Advances in Mycology	VMC 702	2+1	CO1: To learn about the latest development in the field of mycology CO2: To impart knowledge on Advanced studies on molecular approaches for identification of fungi.
3	Bacterial Genetics	VMC 703	2+1	CO1: To learn the basic aspects of bacterial genetics. CO2: To learn the replication of eucaryotic and procaryotic DNA
4	Microbial Toxins	VMC 704	2+1	CO1: To learn about the bacterial and fungal toxins. CO2: To impart the knowledge on biochemical and biological characteristics of toxins produced by various bacteria. CO3: Isolation of toxigenic strains of bacteria from suspected material. CO4: To learn the immunobiological studies of toxins.
5	Molecular Determinants of Bacterial Pathogenesis	VMC 705	2+1	CO1: To learn the molecular mechanisms of bacterial pathogenesis. CO2: To demonstrate the production and effects of exotoxins and endotoxins, LPS. CO3: To describe the role of plasmids in causation of disease.
6	Advances in Virology	VMC 706	2+1	CO1: Advanced study of virus structure, their nucleic acids and proteins; latest trends in animal virus research. CO2: Separation and characterization of viral proteins, and nucleic acid by polyacrylamide gel electrophoresis

Ragh
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7	Special Problem	VMC 790	0+2	CO1: Any updates information will be served as special problem for them
8	Doctoral seminar I	VMC 791	1+0	CO2: Skill for the slide presentation of the update's disease model related to animals.
9	Doctoral seminar II	VMC 792	1+0	CO1: Skill for the slide presentation of the update's disease model related to animals.
10	Molecular and Genetic Aspects of Viral Pathogenesis	VMC 707	2+1	CO1: To study molecular and genetic determinants of viral virulence and pathogenesis; animal models for studying viral pathogenesis. CO2: To learn the animal models for studying viral pathogenesis. CO3: Isolation and molecular characterization of viruses with varying virulence
11	Structure function relationship of DNA and RNA Viruses	VMC 708	3+0	CO1: To understand the relationship between structure and function of DNA and RNA viruses of animals for the development of next generation viral vaccine and antivirals. CO2: To understand the development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.
12	Oncogenic Viruses	VMC 709	2+0	CO1: To study mechanisms of viral oncogenesis. CO2: General features of cell transformation and characterization of transformed cells. CO3: To understand the diagnosis of viral oncogenesis
13	Slow Viral Infections and Prions	VMC 710	2+0	CO1: To study slow viral infections; properties and replication of prions, and diseases caused by them. CO2: To understand the Properties, replication and epidemiology of prions. CO3: To describe immunity, diagnosis and control of various diseases caused by prions.

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25/11/2022

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14	Molecular Immunology	VMC 711	2+1	CO1: To familiarize with advances in research on immune system molecules such as antigens, antibodies, complement, cytokines, surface molecules, etc. CO2: To understand the Novel functions of immunoglobulins and their fragments produced by rDNA technology.
15	Advances in Cellular Immunology	VMC 712	2+1	CO1: To learn advances in research on immune cell biology and cellular interactions in immune responses. CO2: To understand the gene-knockout and transgenic animals in immunobiology research
16	Cytokines and Immunomodulators	VMC 713	2+0	CO1: To learn about structure and function of various cytokines and other immunomodulators. CO2: To understand the Roles in activation, division and differentiation of immune cells, and immunoregulation.
17	Advances in Vaccinology	VMC 714	2+0	CO1: To learn about advances in vaccine research and modern approaches to vaccine development. CO2: To understand modern methods of vaccine construction. CO3: To define immunization schedules of veterinary vaccines, logistic problems and vaccination failure. CO4: To describe various strategies of disease control and eradication by vaccination.
18	Advances in Immunodiagnosics	VMC 715	1+1	CO1: To learn and employ modern approaches to immunodiagnosis. CO2: To understand and develop newer methods of immunodiagnosis tests.

By
25-11-2022

Head
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19	Modern Immunotechnology	VMC 716	1+2	CO1: To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods. CO2: To learn the Hybridoma technology: advances in monoclonal antibody production.
20	Current Topics in Infection and Immunity	VMC 717	3+0	CO1: To learn on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals. CO2: To understand types of vaccines in infectious diseases and current trends in vaccine development.
21	Veterinary Microbial Biotechnology	VMC 718	2+1	CO1: To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes. CO2: To learn Construction of defined mutants and marker vaccines using genetic manipulation techniques. CO3: To know and learn manipulation of microbial processes for production of industrially useful substances. CO4: To learn the use of PCR for infectious disease diagnosis.


 25.11.2022
 Head
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Department of Veterinary Pathology

Degree Programme:

MVSc (Veterinary Pathology) & Ph.D (Veterinary Pathology)

Programme Outcomes (POs)

1. Acquired the knowledge with the facts and figures related to Veterinary Pathology.
2. Understood the basic concepts, fundamental principles and scientific theories related to various diseases.
3. The students acquire knowledge to take required measurements for prevention and control of bacterial, viral, fungal, nutritional, metabolic and neoplastic diseases.
4. Laboratory sessions emphasize the collection, transportation processing of various disease conditions.

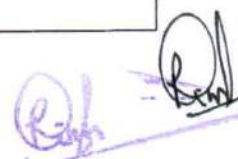
Programme Specific Outcomes (PSOs)

1. The course is emphasized on disease transmission, pathogenesis and diagnosis.
2. The students will gain insight of basic laboratory techniques and fundamental knowledge about the diseases.
3. The students will acquire the skill in the use and care of the basic as well as advanced diagnostic tools.
4. The students will acquire the knowledge of proper collection and processing of microbiological specimens to the laboratory.

Course Outcomes (COs)

Sr. No	Course Title	Code	Credit Hrs	Course Outcomes
1.	Pathology of nutritional and metabolic Disturbances	VPA 701	2+1	To teach students about nutritional and metabolic disorders of livestock.
2.	Advances in toxicopathology	VPA702	2+1	To teach students about toxicity in livestock due to plants and extraneous poisons.
3.	Advances in diagnostic pathology	VPA 703	1+2	To teach current diagnostic techniques for diagnosis of different diseases.
4.	Ultrastructural pathology	VPA 704	1+1	To study the significance of ultra-structural changes in organelles.
5.	Immunopathology	VPA 705	2+1	To teach students immunologically mediated and autoimmune diseases of livestock.
6.	Pathology of important and emerging Diseases of pets and	VPA706	1+1	To teach students important and emerging diseases of pets and livestock.




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	livestock			
7.	Advances in avian pathology	VPA707	2+1	To teach different diagnostic techniques for diagnosis of different avian diseases.
8.	Pathology of fungal diseases	VPA 708	2+1	To teach the diseases caused by different fungi and mycotoxins in animals.
9.	Molecular pathology of cell injury	VPA709	2+1	To acquaint the students about the molecular basis of cell injury and inflammation.
10.	Experimental pathology	VPA710	1+1	To provide expertise in designing the experiments and handling of animals.
11.	Special problem	VPA 790	0+2	To provide expertise in handling practical research problem(s).

Sr. No	Course Title	Code	Credit Hrs	Course Outcomes
12.	General pathology	VPP 601	2+1	To acquaint students with different types of degenerations, cell injuries caused by different types of irritants and inflammation.
13.	Techniques in pathology	VPP 602	1+1	To acquaint students with different techniques used frequently in Veterinary Pathology.
14.	Animal oncology	VPP 603	1+1	To acquaint students with different types of neoplasms of domestic animals, their nature, cause, pathology and diagnosis.
15.	Clinical pathology	VPP 604	1+2	To acquaint students with clinical alterations in blood, urine, CSF and other body fluids due to different diseases.
16.	Necropsy procedures and interpretations –i	VPP 605	0+1	To acquaint students with different Post-mortem procedures in large animals and study of PM lesions in different diseases
17.	Necropsy procedures and interpretations –ii	VPP 606	0+1	To acquaint students with different Post-mortem procedures in small animals and poultry and study of PM lesions in different diseases.
18.	Systemic pathology	VPP 607	2+1	To teach the students about the different disease conditions of haemopoietic, circulatory, respiratory, digestive, urinary and genital systems, nervous, musculoskeletal, endocrine, glands and special senses.


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19.	Pathology of infectious diseases of domestic animals	VPP 608	2+1	To teach the students about the important infectious disease conditions of domestic animals
20.	Toxicopathology	VPP 609	2+1	To teach students about toxicity in livestock due to plants and extraneous poisons.
21.	Avian pathology	VPP 610	2+1	To teach the students about the different disease conditions of poultry including pathology and diagnosis.
22.	Pathology of laboratory animals, fish and wild animals	VPP 611	2+1	To teach the pathology and diagnosis of different disease conditions of laboratory animals, fish and wild animals.
23.	Veterolegal pathology	VPP 612	1+0	To educate the students about common veterolegal problems and legal writing of PM report.

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Department of Veterinary Pharmacology & Toxicology

Degree Programme – MVSc (Veterinary Pharmacology & Toxicology) &
PhD (Veterinary Pharmacology & Toxicology)

Programme outcomes (POs)

1. To understand the mechanism of **drug receptors interactions** its effects at molecular level.
2. Provide information on **medicinal plants**, their pharmacological active constituents and understand the use of **medicinal herbs as an alternative of chemical drugs** etc.
3. To impart knowledge to the students on drug discovery, drug development and clinical trials, pharmacovigilance, pharmacoepidemiology and pharmacoeconomics aspect of drug.
4. To impart information on individualization of **drug therapy, genetic variation involve in drug response** and clinical management of poisoning cases.

Programme specific outcomes (PSo)

1. The course emphasis on learning of molecular basis of drug action.
2. Students learn on **drugs discovery and drug development** and safety evaluation of drug for animal and human health.
3. Students understand the how active constituents of **herbal plant** involve in **management of various clinical conditions as an alternate of chemical drugs**.
4. Student will acquire the information on individualization of drug and **gene therapy** and involvement of immune system in mitigation of infection.

Course Outcomes:

MVSc Veterinary Pharmacology & Toxicology

S. No.	Course Title	Code	Credit Hr	Course Outcomes
1.	Concepts of Pharmacology, Drug Design and Development*	VPT-501	2 (2+0)	CO1: To provide information on basic concepts of drug actions, and drug design and development . CO2: To impart information on drug receptor interaction at molecular level at how drug affect functioning of enzyme/effector.
2.	Autonomic and Autacoid Pharmacology*	VPT-502	3 (2+1)	CO1: To impart information on pharmacological basis of therapeutic uses of autonomic and autacoid drugs. CO2: To impart importance of


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				autonomic nervous system in functioning of various system
3.	CNS Pharmacology	VPT-503	3 (2+1)	CO1: To understand the drugs acting on CNS and their clinical significance in veterinary medicine
4.	Digestive and Respiratory Pharmacology	VPT-504	3 (2+1)	CO1: To impart information on drugs acting on digestive and respiratory systems.
5.	Cardiovascular and Urinary System Pharmacology	VPT-505	2 (2+0)	CO1: To understand the knowledge of physiology of cardiovascular and renal system CO2: To impart information on drugs acting on CVS and kidneys
6.	Endocrine and Reproductive Pharmacology	VPT-506	3 (2+1)	CO1: To understand the knowledge of endocrine pharmacology and drugs acting on different glands. CO2: To impart information on drug acting of animal reproducing system.
7.	Chemotherapy*	VPT-507	3 (2+1)	CO1: To impart information on various chemotherapeutic agents with relevance to their molecular mechanisms and therapeutic aspects. CO2: To impart information on drug resistance mechanism.
8.	Toxicology of Xenobiotics*	VPT-508	3 (2+1)	CO1: To provide information on source/ exposure of toxicants in animals CO2: To impart therapeutic management of poisoning and antidotal therapy in animals.
9.	Toxinology	VPT-509	3 (2+1)	CO1: To impart knowledge of molecular basis of toxicity induced by toxins of plants, microbes and animals origin. CO2: To impart therapeutic management of toxin and antidotal therapy in animals.
10.	Pharmacological Techniques* 0+2	VPT-510	2 (0+2)	CO1: To impart the knowledge of various pharmacological techniques and screening methods of drugs.
11.	Techniques in Toxicology*	VPT-511	2 (0+2)	CO1: To understand the methods of animal toxicity tests and To impart information on assessment of various toxicants using specific tests.
12.	Ethnopharmacology	VPT -512	2 (1+1)	CO1: To impart the knowledge and importance of traditional Indian medicine. CO2: To imparts information on collection, extraction, isolation of active constituents from medicinal


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				plants. CO3: To understand the use of medicinal herbs as an alternative of chemical drugs etc
13.	Fundamentals of Pharmacokinetics	VPT-513	2 (1+1)	CO1: To study the disposition of drugs and dosage regimen. CO2: To impart information on pharmacokinetic parameters involve in drug action
14.	Master's Seminar*	VPT-591	2 (0+2)	
15.	Master's Research	VPT-599	30	


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PhD (Veterinary Pharmacology & Toxicology)

S. No.	Course Title	Code	Credit Hr	Course outcomes
1.	Molecular Pharmacology*	VPT-601	2 (3+0)	<ul style="list-style-type: none"> To understand the identification and characterization of receptors and drug receptors interactions To provide underlying mechanisms of drug receptor interactions and its effects at molecular level.
2.	Advances in Autacoid Pharmacology	VPT-602	1 (1+0)	<ul style="list-style-type: none"> To impart knowledge of autacoids and their clinical importance in various clinical conditions of animals. To understand the involvement of autacoids in fever, inflammation and pain etc.
3.	Pharmacology of Herbal Drugs	VPT-603	3 (2+1)	<ul style="list-style-type: none"> To imparts information on collection, extraction, isolation of active constituents from medicinal plants. To understand the use of medicinal herbs as an alternative of chemical drugs etc
4.	Biotransformation of Xenobiotics	VPT-604	2 (2+0)	<ul style="list-style-type: none"> To provide information on molecular mechanisms involve in metabolisms/ biotransformation of xenobiotics.
5.	Clinical Pharmacology and Pharmacokinetics *	VPT-605	3 (2+1)	<ul style="list-style-type: none"> To impart knowledge on Drug discovery, drug development and clinical trials. To impart Pharmacovigilance, pharmacoepidemiology and pharmacoeconomics aspect of drug.
6.	Pharmacogenomics	VPT-606	2 (2+0)	<ul style="list-style-type: none"> To impart information on individualization of drug therapy. To understand the genetic variation involve in drug response
7.	Immunopharmacology and Immunotoxicology	VPT-607	2 (2+0)	<ul style="list-style-type: none"> To impart information on immune system and its interaction with various system. To understand the information on autoimmunity various immunotherapy.
8.	Molecular Toxicology	VPT-608	3 (3+0)	<ul style="list-style-type: none"> To understand the mechanisms toxicity at organs and system level. To understand the method of targets organ toxicity at cellular/ molecular level.
9.	Clinical Toxicology*	VPT-609	3 (2+1)	<ul style="list-style-type: none"> To provide information of clinical management of toxicity in animals. To provide concepts of clinical toxicology and forensic toxicology
10.	Ecotoxicology	VPT-610	3 (3+0)	<ul style="list-style-type: none"> To impart knowledge regarding ecotoxicology for conservation of healthy eco-system (air, water, soil and feed etc.)


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				<ul style="list-style-type: none"> To impart information on biomarkers of environmental toxicology.
11.	Regulatory Toxicology	VPT-611	3 (2+1)	<ul style="list-style-type: none"> To impart information on acts and regulations and risk assessment regarding use of drugs, chemicals and cosmetics. To impart information on law and regulation involve in safety evaluation study of chemical and drugs.
12.	Special Problem	VPT -690	1 (0+1)	<ul style="list-style-type: none"> To provide knowledge on handling practical research problem(s). To understand importance of short research problem(s) involving contemporary issues and research techniques.
13.	Doctoral Seminar I*	VPT-691	1 (1+0)	
14.	Doctoral Seminar II*	VPT-591	1 (1+0)	
15.	Doctoral Research	VPT-699	70	


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Department of Veterinary Public Health & Epidemiology

Degree Programme: MVSc (Veterinary Public Health & Epidemiology) & PhD (Veterinary Public Health & Epidemiology)

Programme Outcomes (POs)

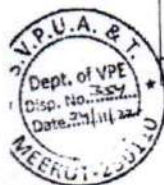
1. Acquire knowledge about the genesis and importance of Veterinary Public Health.
2. Understand the basics of zoonoses and measures that can help in their prevention and control.
3. Learn about Food Hygiene and Safety in food production
4. Be aware of recent issues related to environment and its protection.

Programme Specific Outcomes (PSOs)

1. Learn about public health and management of human and animal diseases using the one-health approach.
2. Learn about the basics of epidemiology and how it can be used for better management of animal and human diseases.
3. Learn of possible measures related to food safety and its implementation for improving human health.
4. Learn basic laboratory techniques that may help in the diagnosis of various zoonotic pathogens

Course Outcome

MVSc				
S. N.	Course Title	Course No.	Cr. Hr.	Course Outcome (Bullet Points)
1.	Elements of Veterinary Public Health	VPE 601	1+1	- The students will learn the basics of Veterinary Public Health - Knowledge of current issues in Veterinary Public Health will be acquired
2.	Bacterial and Rickettsial Agents of Public Health Significance	VPE 602	2+1	- The students will learn about important bacterial and rickettsial agents of public health significance and measures to control them. - The course will help in better understanding and management of such agents
3.	Viral, Fungal and Parasitic Agents of Public Health Significance	VPE 603	2+1	- The students will acquire knowledge about important viral, parasitic and fungal agents of public health significance. - The course will help in better understanding and management of such agents
4.	Zoonoses and Public	VPE 604	2+1	- Know about epidemiology, prevention, and control of zoonoses



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	Health			- To know about recent trends in emerging diseases of public health significance
5.	Principles of Food Hygiene and Safety	VPE 605	3+1	- Know about the principles of food hygiene - Know about major food borne infections and their control
6.	Meat and Milk Hygiene	VPE 606	2+1	- Know about hygiene and its importance in meat and milk production - Role of VPH in prevention and control of food borne infections
7.	Environmental Pollution and Safety	VPE 607	2+1	- To know about pollutants and in the environment and their control - To learn about the residues and their public health significance
8.	Fish, Fish Products and Seafood Hygiene	VPE 608	1+1	- To learn about fish hygiene - To learn about fish borne disease
9.	Bioterrorism and Disaster Management	VPE 609	1+1	- To acquire knowledge about disaster and its management. - To learn about bioterrorism - To learn about the management of biomedical waste and its importance
10.	Principles of Epidemiology	VPE 610	2+0	- To learn about basics of epidemiology - Use of epidemiology in better understanding diseases
11.	Applied Epidemiology	VPE 611	1+1	- To learn about the application of epidemiology in disease diagnosis, prevention, and control - Practical application of epidemiological tools in disease investigation
12.	Livestock and Poultry Disease Investigation	VPE 612	0+2	- To get exposure to actual field-based investigation of livestock and poultry disease - To know about basics of disease diagnosis
PhD				
1.	Current Topics in Veterinary Public Health	VPE 701	2+1	- To acquaint with contemporary issues concerning VPH - Learn about one-health, AMR etc
2.	Emerging and Reemerging Zoonoses	VPE 702	2+1	- To acquaint with emerging and re-emerging zoonotic diseases - Learn about factors that lead to emergence of zoonoses
3.	Quality Control of Animal Food Products	VPE 703	2+1	- To provide expertise to student in food quality control. - Learn about quality control and quality assessment.
4.	Occupational Health Hazards	VPE 704	2+1	- To acquaint with occupational health hazards - To better understand the methods that can aid in prevention of such infections
5.	Disposal and Recycling of	VPE 705	2+1	- To educate about safe and economic disposal of waste

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	Waste			-Learn about better use, recycling of waste
6.	Biohazards, Biosecurity and Disaster Management	VPE 706	2+0	- To update knowledge on biological hazards and their prevention -Learn about disaster management and its relevance in veterinary sector
7.	Food Plant Sanitation	VPE 707	2+1	- To impart basic knowledge of sanitation in food plants - Know about proper disposal of waste generated in food plants
8.	Advances in Environmental Pollution Control	VPE 708	2+1	- To update knowledge on modern environmental pollution problem and control -To learn about the residues and their public health significance
9.	Recent Concepts in Epidemiology and Disease Forecasting	VPE 709	2+1	- To learn about different epidemiological aspects of major diseases and to develop suitable disease forecasting system -Practical methods for disease forecasting
10.	Herd Health Management	VPE 710	2+1	-Adoption of holistic approach to address issues of herd health without affecting production -Practical application of knowledge for better herd management
11.	Survey, Surveillance & Data Management	VPE 711	2+1	-To demonstrate different methodologies and procedures involved in conducting survey and surveillance. -To apprise the students of importance of data collection, analysis and interpretation for effective disease control
12.	Ecology of Diseases	VPE 712	2+0	- To make the students aware about ecology, ecological systems and impact of global warming -To understand disease for better management
13.	Molecular Approaches in Epidemiology	VPE 713	0+2	-Learning of recent advanced molecular techniques for establishing disease diagnosis. - Acquire practical skill related to molecular techniques
14.	Special Problem	VPE 790	0+2	-To provide expertise in handling practical research problem -Learn new techniques in laboratory


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LIVESTOCK PRODUCTS TECHNOLOGY
Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
LPT 601	FRESH MEAT TECHNOLOGY	1+1
LPT 602	MEAT PROCESSING, PACKAGING, QUALITY CONTROL AND MARKETING	2+1
LPT 603	POULTRY AND FISH PRODUCTS TECHNOLOGY	2+1
LPT 604	EGG AND EGG PRODUCTS TECHNOLOGY	1+1
LPT 605	ABATTOIR AND POULTRY PROCESSING PLANT PRACTICES	1+1
LPT 606	SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY	2+1
LPT 607	PROCESSING AND MARKETING OF WOOL	2+1
LPT 608*	MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES	2+1
LPT 609	QUALITY CONTROL OF MILK AND MILK PRODUCTS	1+1
LPT 610	TECHNOLOGY OF MILK PRODUCTS	2+1
LPT 611	BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN	1+1
LPT 612*	IN-PLANT TRAINING (NON CREDIT)	0+2
LPT 691	MASTER'S SEMINAR	1+0
LPT 699	MASTER'S RESEARCH	20
LPT 701	ADVANCES IN ABATTOIR PRACTICES AND ANIMAL BYPRODUCTS UTILIZATION	2+1
LPT 702	ADVANCES IN FRESH AND PROCESSED MEAT PRODUCTS TECHNOLOGY	3+1
LPT 703	ADVANCES IN POULTRY PRODUCTS TECHNOLOGY	2+1
LPT 704	ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY	3+1
LPT 705	ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS	2+0
LPT 706	BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS	1+1
LPT 791	DOCTORAL SEMINAR I	1+0
LPT 792	DOCTORAL SEMINAR II	1+0
LPT 799	DOCTORAL RESEARCH	45

* Non-Credit (Satisfactory/Unsatisfactory)


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LIVESTOCK PRODUCTS TECHNOLOGY

Course Contents

LPT 601 FRESH MEAT TECHNOLOGY 1+1

Objective

To impart knowledge about history, current status of meat industry, muscle composition, functions and sensory quality of meat. To educate on factors influencing quality of meat and nutritive value.

Theory

UNIT I

History and development of meat science and meat industry, current trends and prospects of meat industry-Structure and chemistry of animal tissues, muscle functions and postmortem changes- Rigor mortis – Effect of transport on meat quality – its veterinary and clinical importance – PSE and DFD in meat quality – Conversion of muscle to meat.

UNIT II

Composition, nutritional content and general quality characterization and evaluation of meat and its products- meat microbiology –Factors affecting quality of meat – Essential nutrients in meat and poultry meat – Tenderization. Chemical residues in meat meat and their effects on the health of the consumer.

Practical

Microbiological sampling and evaluation of meat. Evaluation of physico-chemical and sensory properties of meat and meat products. Estimation of pH – Colour - Water holding capacity – ERV – Tyrosine value – Thiobarbituric acid number – Estimation of texture profile of meat – Estimation of glycogen, R-value, myoglobin, proximate analysis of meat and meat products including poultry products – Estimation of drip loss - Determination of Sarcomere length, fibre diameter and myofibrillar fragmentation index. Retail and wholesale cuts.

Suggested Readings

- Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.
Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
Pearson AM & Dutson TR. 1999. *Advances in Meat Research*. Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.
Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 602 MEAT PROCESSING, PACKAGING, QUALITY 2+1
CONTROL AND MARKETING

Objective

To impart knowledge on preservations, methods, product development, quality control and packaging practices in meat.

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Theory

UNIT I

Factors affecting fresh meat quality, ageing, basic principles of preservation, chilling, freezing, thermal processing, dehydration, irradiation and use of chemicals and antibiotics; meat curing and smoking.

UNIT II

Comminuted meat; preparation of various kinds of fresh and cooked meat products-Canning – Heat processing – Sausages – Ham, Bacon, Tandoori-Barbecueing of Poultry.Senses of taste and olfaction-factors influencing sensory measurements, physical and chemical properties related to sensory evaluation, types of sensory panels, discriminate and descriptive testing.

UNIT III

Meat adulteration and substitution – Different techniques for meat speciation – Agar gel immuno diffusion techniques – Démonstration of CIE, IEF, ELISA, PCR

UNIT IV

Principles of packaging- Product characteristics affecting packaging requirements; packaging material and their characteristics - different methods of packaging meat – Vacuum packaging – MAP – Retort pouch processing.

UNIT V

Marketing of meat, setting up of a meat retailing unit and other meat merchandising practices. MFPO, BIS Standards for meat products.National and international specifications and standards.

Practical

Proximate composition of meat, tyrosine value, nitrite content, TBARS value, peroxide value, Formulation of different meat products, emulsion stability, shear force value, cooking determinants, subjective and objective method of sensory evaluations.

Suggested Readings

- Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publishing Ltd., UK.
- Pearson AM & Dutson TR. 1999. *Advances in Meat Research*. Vol. IX. *Quality Attributes and their Measurement in Meat, Poultry and Fish Products*. Aspen Publishers, Inc, Maryland, USA.
- Swatland H & Compbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 603

POULTRY AND FISH PRODUCTS TECHNOLOGY

2+1

Objective

To impart knowledge on structure, functional quality, microbiology, processing and preservation of poultry meat, eggs and fish.

Theory

UNIT I

History and development of poultry meat and egg processing industry. Different species of poultry and their production potentials- commonly occurring anti nutrients, and antibiotics in poultry feed ingredients and its

effect on egg and meat nutrition - Quality identification, quality maintenance, chemical, nutritional and microbiological quality of poultry meat. Preservation and packing techniques of shelled and liquid eggs. Quality identification of shell eggs and factors influencing the quality

UNIT II

Pre-slaughter care, transportation, resting, fasting, ante-mortem examination, methods of slaughter and slaughtering procedure-postmortem inspection-reasons for condemnation of carcass-yield and grading of dressed chicken, cut-up parts and de boned meat.

UNIT III

Structure, nutritive value, compositional chemistry, microbiology and functional properties of eggs. Low cholesterol eggs, GMP, HACCP procedures for food safety – Codex regulation for food products safety – WTO/GOI regulations for import and export of poultry products. National and international regulations, standards, quality control and marketing of fish and fish products, utilization of fish processing waste.

UNIT IV

Fishery resources, marine and fresh water fishes, transportation, processing, preservation, grading, standards. Quality control, labeling and marketing of fish and fish products, utilization of fish processing waste.

UNIT V

Post processing value added meat for export- Integration, poultry and fish processing and marketing-Storage, packaging and chilling, freezing, dehydration, canning, irradiation, curing, smoking, barbecuing, cooking and preparation of further processed poultry and fish products.

Practical

Organization, sanitation and maintenance of poultry processing plants. Slaughtering, ante-mortem and postmortem inspection, meat cutting, grading, production of ready to eat, smoked and cured poultry meat. Comminuted and other poultry based convenient items. Visit to poultry processing plant/egg processing plant. Postmortem inspection, carcass yield and grading. Meat bone ratio, quality maintenance, tenderization water holding capacity. TBA values and preparation of further processed and freeze dried poultry products. Whole egg powder, shell meal processing plant waste meal-HACCP-egg powder processing plant. Grading of shelled eggs, liquid eggs, egg powder foaming property, pasteurization of liquid egg, testing microbial load in different foams of egg, visit of egg powder plant/egg processing plant poultry and fish products and its Proximate analysis, microbiological and sensory evaluation and poultry meat and fish.

Suggested Readings

- Mead GC. 1989. *Processing of Poultry*. Elsevier.
Mountney GJ. *Poultry Products Technology*. 2nd Ed. AVI Publ.
Pearson AM & Gillett TA. 1996. *Processed Meats*. 3rd Ed. Chapman & Hall.
Stadelman W & Cotterill OJ. 2002. *Eggs Science and Technology*. 4th Ed. CBS.
Suzuki T. 1981. *Fish and Krill: Protein Processing Technology*. Applied Science Publ.

Objective

To impart knowledge about composition and marketing of eggs and nutritive value of eggs, preservation methods – quality maintenance, functional and value added egg product development, packaging and standards

TheoryUNIT I

Preservation and maintenance of quality of eggs- spoilage of egg and its prevention.-Preparation of fast foods.

UNIT II

Egg breaking plant lay out and organization- freezing- pasteurization- desugarisation-dehydration – quality estimation.

UNIT III

Principles involved in preparation of egg powder and other egg products- Development of convenient egg based products- packaging of egg and egg products.

UNIT IV

Specifications, standards and marketing of egg and egg products-Quality control of egg products.

Practical

Evaluation of physical, chemical, functional and microbial quality of egg and egg products. Preservation of eggs- Preparation of dehydrated and convenient egg products- Visit to egg processing plant.

Suggested Readings

Romanoff AL & Romanoff AJ. 1949. *Avian Egg*. John Wiley & Sons.

Stadelman WL & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed. CBS.

Objective

Teaching about abattoir design, sanitation and basic slaughterhouse practices, effluent treatment and proper disposal of wastes.

TheoryUNIT I

Layout, designing – operation and maintenance of slaughter houses and processing plants-disposal of slaughter house effluents and different designs of effluent treatment plants - equipments, organization and Slaughter house, maintenance, record keeping and operation-sanitation of slaughterhouse- Sanitary practices in meat plant and its benefits; quality control.

UNIT II

Pre-slaughter judging, inspection, grading, pre-slaughter care, slaughter of meat animals; Humane slaughter – Principles and methods of stunning – Ritual slaughter of food animals and poultry – Machineries for slaughter and dressing- processing of different kinds of meat animals- Ante-mortem inspection and Post-mortem examination of animals. Disposal and

condemnation of unfit materials.

UNIT III

Carcass quality appraisal, judgement and their grading, meat cutting, measuring yields. Application of HACCP, GMP, ISO 9000, ISO 14000, ISO 22000, BIS Standards and any recent standards for meat and processing industries

Practical

Visit to slaughterhouse– Plan and outlay of modern abattoir- Procedure for slaughter of food animals and poultry - Ante-mortem and postmortem inspection, slaughtering, grading and meat cutting, carcass yield, meat bone ratio measurement of effluent characteristics: pH, BOD, COD, suspended solids etc.

Suggested Readings

Gerrard F. 1977. *Meat Technology*. Northwood.

Gracey JF. 1999. *Thornton's Meat hygiene*. 10th Ed. WB Saunders.

LPT 606

SLAUGHTER HOUSE BYPRODUCTS TECHNOLOGY

2+1

Objective

To Impart knowledge on animal by-products, processing and industrial utilization.

Theory

UNIT I

Slaughterhouse byproducts industry in India and abroad – Importance of utilizing slaughterhouse offals – Rendering- Planning a by-product plant - Utilization of blood, bones, hooves, glands, intestines, feathers, glandular by-products and other minor by-products for industrial exploitation.

UNIT II

Meat fat characteristics - Preservation and Processing of ruminal contents – Ensiling of ruminal contents – Value products preparation from slaughterhouse by-products, processing of animal byproducts for pet foods.

UNIT III

Flaying - Classification and factors affecting quality of hides and skin- Physical and chemical characteristics of hide and skin- Processing of hide and skin for manufacture of leather- Preparation and quality control of gelatin and glue. Microscopic, physical and chemical characteristics of leather; testing and marketing of leather- Preservation and packaging practices of various kinds of hides and skin.

UNIT IV

Designing of animal byproduct plant. Collection and scope for further utilization of slaughter house byproducts. Waste treatment and pollution control- Environmental Audits-Regulations on pollution control.

Practical

Identification of quality defects in leather- preparation of sausage casing- blood meal, feather meal and meat meal. Demonstration of carcass meal – Meat meal – Bone meal - Preparation of animal casings – Grading of casings and wool – Preparation of slime meal – Collection and preservation of

glandular products – Preparation of pet foods - Visit to local by-products, processing units. Quality evaluation of rendered animal fat.

Suggested Readings

- Dillon M & Griffith C. 2001. *Auditing in the Food Industry - From Safety and Quality to Environmental and other Audits*. Woodhead Publ. Ltd., UK.
- Gregory NG. 1988. *Animal Welfare and Meat Science*. CABI.
- Ockerman HW & Hansen CL. 2000. *Animal by-product processing and utilization*. Technomic Publ. Co. Ltd., Pennsylvania, USA.
- Ockerman HW & Hansen CL. 2002. *Animal Byproducts Processing and Utilization*. CRC.

LPT 607

PROCESSING AND MARKETING OF WOOL

2+1

Objective

To impart knowledge on grading, manufacturing process, marketing and specifications of wool and specialty fibers- growth and structure of wool and fiber, their use.

Theory

UNIT I

Status and prospects of wool -Grading of wool. Faults and impurities in wool and their removal.

UNIT II

Wool types and their uses. Growth and molecular structure of wool fibre; physical and chemical properties of wool. Characteristics of hair fibres and their use, factors influencing quality of wool and hair fibres - Principles and steps involved in manufacturing processes of wool- specialty hair fibres.

UNIT III

Physical and chemical testing of wool. Proclaimed wool and secondary raw material - Marketing of wool, specification and regulation for quality control.

Practical

Visit to wool industry and acquaintance with various steps of manufacturing wool and its quality control, physical and chemical testing of wool. Characterization of wool, grading of wool.

Suggested Readings

- Bergen WV. 1963. *Wool Hand Book*. Vols. I, II. InterScience.

LPT 608

MARKET MILK PROCESSING AND DAIRY PLANT PRACTICES

2+1

Objective

To impart knowledge about milk composition, legislation, milk processing techniques, cleaning and sanitation of dairy equipments.

Theory

UNIT I

Milk standards and legislation and related agencies.

UNIT II

Composition of milk, major and minor constituents of milk, physico-chemical, microbial and nutritional properties of milk and preservation of raw milk.

UNIT III

Layout Designing and organization of dairy plant, Milk procurement, handling and transportation. Chilling, centrifugation, separation, clarification, bactofugation and homogenization. Thermal processing- pasteurization, UHT processing, sterilization, bacto therm and packaging, Storage and distribution of processed milk. Fortified, reconstituted and mild floured milks.

UNIT IV

Membrane processing and related techniques; application of ultrafiltration, reverse osmosis; nanofiltration and microfiltration in the dairy industry.

UNIT V

Current trends in cleaning and sanitization of dairy equipment, biological detergents, ultrasonic techniques in cleaning; biodegredients. Disposal of dairy effluents.

Practical

Platform tests. Determination of fat, SNF, TS, protein, lactose and ash contents of milk. Standardization, pasteurization and sterilization. HCT profile of milk systems. Judging of different types of milks. Layout plan of market milk plant.

Suggested Readings

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

Web BH, Johnson AH & Alford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. Westport AVI Publ.

LPT 609

QUALITY CONTROL OF MILK AND MILK PRODUCTS 1+1

Objective

To impart knowledge about quality control, TQM, HACCP, SPS, CAC and legal standards.

Theory

UNIT I

Importance of quality control in dairy industry. PFA Act, BIS standards, AgMark standards and ISO standards of milk products.

UNIT II

Total quality management in processing of milk products – HACCP and SPS.

UNIT III

Types of microorganisms associated with milk and milk products-Milk borne diseases.

UNIT IV

Physico-chemical and microbial changes during procurement, processing and storage of milk and milk products.


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UNIT V

Fundamental rules for sensory evaluation, Hedonic scale, score cards and their use for grading of milk and milk products.

Practical

Determination of pH and acidity, electrical conductivity, viscosity, phosphatase test, MBRT, Resazurin test, DMC, SPC. Analysis of milk and milk products in reference to BIS/PFA standards. Grading of milk and milk products.

Suggested Readings

Jennes R & Patton S. 1969. *Principles of Dairy Chemistry*. Wiley Eastern.
Yadav JS, Grover S & Batish VK. 1993. *Comprehensive Dairy Microbiology*. Metropolitan Publ.

LPT 610

TECHNOLOGY OF MILK PRODUCTS

2+1

Objective

To impart knowledge about techniques for preparation of different milk products.

Theory

UNIT I

Drying of milk and milk products; freeze dehydration, water activity; sorption behaviour of foods- dried ice cream mix – cream and butter powder.

UNIT II

Hurdle technology and its application in development of dairy products.

UNIT III

Manufacture of milk products; butter, evaporated milk, condensed milk, milk powders, ice cream and other frozen desserts. Manufacture of yoghurt- acidophilus milk- bulgaricus milk- kumiss-kefir. Manufacture of cheddar- mozzarella- cottage and processed cheese. Manufacturing of indigenous milk products- paneer- channa- khoa- ghee- dahi and shrikhand.

UNIT IV

Manufacturing of casein- caseinate- co-precipitates- Whey protein concentrate (WPC) - lactose- dairy whiteners; functional properties of whey proteins- casein- co-precipitates- Ultra Filtration retentate and their modifications.

UNIT V

Evaluation of functional properties. Packing, storage and marketing of milk products. Defects in milk products, their preventions and remedies.

Practical

Preparation of butter- paneer- channa- ghee- ice cream- cheese-cheddar- Mozzarella and cottage cheese- khoa- dahi- yoghurt- casein- caseinate- coprecipitate- determination of degree of browning chemical/physical methods; measurement of different functional properties of different milk products.

Suggested Readings

Aneja RP, Mathur BN, Banerjee AK & Chandan RC. 2002. *Technology of Indian Milk Products*. Dairy India.
Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*.
2nd Ed. Taylor & Francis.

LPT 611 BIOTECHNOLOGY OF FOODS OF ANIMAL ORIGIN 1+1

Objective

To impart knowledge about new techniques of biotechnology for improving food value.

Theory

Role of Biotechnology in productivity of livestock, Meat Speciation and quality control. Use of Biotechnology in production of food additive. Use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, consumer concerns about risks and values, biotechnology and food safety. Future of food biotechnology in India.

Practical

Introduction of basic biotechnological techniques such as western blotting, enzyme isolation and identification, DNA extraction, amplification, different types of PCR, Acquaintance with RT-PCR, Multiplex PCR, gene identification and characterization.

Suggested Readings

Selected articles from journals.

LPT 612 IN-PLANT TRAINING 0+2
(Non Credit: Satisfactory/Unsatisfactory)

Objective

To impart industrial exposure to post graduate students in meat, milk, poultry and fish industry.

Practical

APT students will undergo in-plant training in any one of the specialized area of Animal Products Technology for a period of three weeks in an institute in private/public sector industry. After completion of the training, the student will submit a training report. Evaluation will be based on viva-voce examination and a report submitted by student-Preparation of Project report.

Suggested Readings

Selected articles from journals.

LPT 701 ADVANCES IN ABATTOIR PRACTICES AND ANIMAL 2+1
BYPRODUCTS UTILIZATION

Objective

To impart knowledge on advances in animal byproducts utilization such as leather, fat, casings, gelatin and abattoir effluent treatment. To expose the importance of environmental pollution and their pollutants.

Theory

UNIT I

Existing situation of slaughterhouses and processing plants in India -
Collection of inedible and edible by-products for industrial uses – Disposal of

slaughterhouse effluents – Effluent treatment plant – Different designs of effluent treatment plants- Sanitary and phytosanitary measures– SSOP – Advances in chemistry and technology of leather. Latest techniques in handling, preservation, tannery procedure, manufacture and testing of leather.

UNIT II

Progress in gelatin, glue and natural casings production. Latest technology for utilization of animal byproducts, industry-waste as food, pharmaceuticals and other miscellaneous byproducts. Characterization, processing and quality control of meat fat.

UNIT III

Current trends in utilization of byproducts of egg, meat and poultry processing industry for feed, fertilizer and other useful products of economic importance- Organization, layout and operation of dry and wet rendering plants-Latest trends in disposal of slaughterhouse effluents and control of environmental pollution.

Practical

Visit to various slaughterhouses and meat processing plants – Plan and outlay of various components of modern abattoir – Designs of ETP - - Estimation of BOD and COD from abattoir effluents - Ante-mortem inspection of food animals – Methods of stunning – Stunning instruments – Electrical stunning – Slaughter and dressing of food animals – Post mortem inspection of carcasses of food animals – Fabrication of carcasses of food animals.

Suggested Readings

Gracey JF. 1999. *Thornton's Meat Hygiene*. 10th Ed. WB Saunders.

Selected articles from journals.

Wilson W. 2005. *Wilson's Practical Meat Inspection*. 7th Ed. Blackwell Publ.

LPT 702

ADVANCES IN FRESH MEAT AND PROCESSED MEAT 3+1 PRODUCTS TECHNOLOGY

Objective

To empower students on recent advances in processing, preservation, quality control, packaging, regulations and standards of meat. To bring out knowledge on harmful residues in meat and to impart information on meat species identification.

Theory

UNIT I

Development of muscular tissue – Abnormal growth and developments in muscle – Genetic nutritional and physiological aspects – Muscle proteins – Myofibrillar, sarcoplasmic and connective tissue proteins – Cytoskeletal proteins - Skeletal muscle fibre types – Lipid profile – Factors affecting muscle function and composition - Stress on the animal – Stress and the meat quality- Latest findings in the area of pre-slaughter care of meat animals- Keeping and Eating quality of meat – Properties of fresh meat – Odour, Colour, Water holding capacity - texture profile – Artificial tenderization – Meat in human nutrition – Essential nutrients in meat and poultry meat –

Prefabricated meat – Chemical residues in meat and their effects on the health of the consumer.

UNIT II

Principles of preservation – Methods - temperature control – Refrigeration – Chilling – Freezing – Mechanisation of chiller and freezer - Thermal processing – Canning – retort processing - Intermediate moisture meat – Moisture control – Dehydration – Freeze drying – Curing – Smoking – Direct microbial inhibition – Irradiation – Use of antibiotics and chemical preservatives – Organic acids – Recent advances in preservation of meat.

Meat adulteration and substitution – Different techniques for meat speciation - Packaging of meat and meat products-Critical assessment of ageing, chilling, freezing, smoking, curing, tenderization and irradiation techniques.

UNIT III

Basic meat processing procedure-Functional properties of tissue component in meat processing-forming processed meat products. Approaches for new product development-different equipments used for processing of meat products-Indigenous and heritage meat products-purpose of smoking-composition of smoke-method of smoking-liquid smoke preparation-Ham, bacon,sausages, patties, burger, meat loaves-various novel meat products.

UNIT IV

Fermented meat products-heat processing-restructured meat products-Reformed meat products-Effect of massaging,tumbling and flaking techniques and quality-intermediate, moisture meat-Enrobed meat products-Meat analogues and substitutes-Thermal processing of meat-Browning reaction-Enzymatic and non enzymatic-Protein changes in processed meat products-lipid changes-protein and lipid interaction-protein and carbohydrate interaction.

UNIT V

Meat additives and regulations pertaining to processed and convenient meat based products-Meat packaging and retailing practices-National and international standards, grading, specifications and quality control of meat and meat products.

Practical

Estimation of Colour - Estimation of texture profile of meat – Estimation of glycogen, Lactic acid, R-value, myoglobin, proximate analysis of meat and meat products – Estimation of hydroxy proline - Histological structure of muscle - Estimation of emulsion stability, thawing in meat and meat products– Identification of different packaging material – Agar gel immuno diffusion techniques – Demonstration of CIE, IEF, ELISA, PCR – Different methods of packaging of meat and meat products including poultry products - Visit to different cold stores.Evaluation of carcass quality,Estimation of muscle fiber diameter, Estimation of lipid profile of meat.

Organoleptic evaluation of meat-Estimation of Nitrate-Preparation of some novel meat products and studies on their shelf life-Total viable count and differential counts of meat and meat products-Visist of meat /poultry processing units.

Suggested Readings

- Kerry J, Kerry J & Ledward D. 2005. *Meat Processing-Improving Quality*. Woodhead Publ. Ltd., UK.
Selected articles from journals.
Swatland H & Campbell T. 2004. *Meat Cuts and Muscle Foods*. Nottingham Univ. Press.

LPT 703 ADVANCES IN POULTRY PRODUCTS TECHNOLOGY 2+1

Objective

Discussion on latest development in processing, preservation, quality control, packaging, regulations and standards of poultry meat.

Theory

UNIT I

Indian scenario of poultry processing industry Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. Automation in broiler farming, catching, transporting, control of shrinkage and methods of slaughter.

UNIT II

Preservation techniques, Room temperature preservation of poultry fast foods by multi hurdle technology critical evaluation of application of refrigeration, tenderization, canning, dehydration, irradiation, curing, smoking and cooking techniques in poultry processing and development of additional processed products.– Regulation of CAC and European standards of poultry meat and meat products.

UNIT III

Recent trends in packing and marketing of poultry and poultry products. Modified atmosphere packaging- Different packing materials for meat and cooked products.

UNIT IV

Policies and marketing trends in poultry meat -Regulations, specifications, standards and use of additives in poultry products.

UNIT V

Poultry product development formulation and profitability.

Practical

Cooked and uncooked meat quality standards- sensory evaluation of poultry meat- packaging material- Modified Atmosphere Packaging-Factors influencing meat quality at different freezing temperatures and thawing.

Suggested Readings

Selected articles from journals.

LPT 704 ADVANCES IN MILK AND MILK PRODUCTS TECHNOLOGY 3+1

Objective

To disseminate knowledge about production of high quality milk, preservation method, advances in processing of milk and milk products and packaging.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Theory

UNIT I

Principles and practices of production of high quality milk Advances in methods of chilling and preservation of milk. Thermal processing of milk, principles and methods, types of UHT-processing plants. Advances in packaging of milk.

UNIT II

Bacteriological, physical, chemical and nutritional effects of processing on milk - New concepts in milk processing – radiation and microwave processing- Membrane processing in dairy industry such as Reverse Osmosis(R.O), Ultra Filtration (UF), Nano Filtration (NF) and Micro Filtration (MF)- Fouling and cleaning of membranes.

UNIT III

New concepts in technology of dairy products. Cream powder, sterilized cream, frozen products, ice-cream mix, low, medium, high heat milk powder, milk based infant foods. Advances in starter cultures and their application, butter, butter spread, butter powder, cheese and cheese spread, probiotic products.

UNIT IV

Indigenous dairy products, khoa powder, paneer/channa powder, gulab jamun powder, kulfi powder- Recent advances in utilization of dairy byproducts in product development, preservation of milk products. Application of immobilized enzyme in dairy products.

Practical

Use of Starter cultures, lyophilization process, Maintenance of cultures. Demonstration of Membrane processing Technology, Advances in Packaging-Retort, Vacuum and Control Atmosphere Packaging Technology.

Suggested Readings

Selected articles from journals.

Walstra P, Wouters JTM & Geurts TJ. 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

LPT 705

ADVANCES IN QUALITY CONTROL OF LIVESTOCK PRODUCTS 2+0

Objective

To impart knowledge about the advances in quality control in dairy and meat industry.

Theory

UNIT I

Recent advances in quality control in dairy and meat industry in special reference to Total Quality management, HACCP – good manufacturing practices for manufacturing of quality and safe livestock products.

UNIT II

PFA and BIS standards, international standards organization (ISO 9000), product quality certification, international standards for milk powders, American Dairy Products Institute (ADPI) standards.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

UNIT III

Rheology of milk products-Preservatives, antioxidants, antibiotics and pesticides residue in milk- Advances in bacteriological and physico-chemical analysis of milk and milk products

UNIT IV

Importance of quality assurance of livestock products for domestic and export trade – quality standards for meat - Effect of processing on nutritional and chemical qualities of meat products – Sensory evaluation of meat products – Physicochemical and microbiological quality assessment and standards - Economics of processing and product development. good manufacturing practices, meat hygiene regulations in relation to slaughter houses and processing plants-international regulations-State Municipal and other regulations pertaining to meat trade-Meat Food Products Order-ISO certification-Codex alimentarius-Bureau of Indian standards.

Suggested Readings

Selected articles from journals.

LPT 706

BIOTECHNOLOGICAL TECHNIQUES AND PROCESSES IN ANIMAL PRODUCTS

1+1

Objective

To impart knowledge about biotechnological techniques, methods, starter cultures and industrial application of biotechnology in meat industry.

Theory

UNIT I

Introduction, development and prospects of biotechnology in animal products, ancient and traditional food processing biotechniques.

UNIT II

Modern biotechnological methods and processes in animal products development, chemical and physical factors required for growing microbial cultures in nutritive substrate- Meat species identification- Quality control – Screening products for contaminants – Polymerase Chain Reaction (PCR) based products.

UNIT III

Basic principles of the industrial use of bio-reactions for production of biomass-upstream and downstream processing-application of micro-organisms as starter cultures in meat industry, microbial production of food ingredients.

Practical

Production, selection and purification of microbial cultures, making products using different microbial cultures, production of acidulation, buttery flavour, pigments, anti-microbial agents to improve the product quality and safety- Polymerase Chain Reaction (PCR).

Suggested Readings

Selected articles from journals.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

ANIMAL NUTRITION

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
ANN 601*	ANIMAL NUTRITION – ENERGY AND PROTEIN	3+0	I
ANN 602*	ANIMAL NUTRITION – MINERALS, VITAMINS AND FEED ADDITIVES	3+1	II
ANN 603	FEED TECHNOLOGY	1+1	II
ANN 604*	FEED CONSERVATION STORAGE AND QUALITY CONTROL	2+2	I
ANN 605	RUMINANT NUTRITION	2+1	I
ANN 606	NON-RUMINANT NUTRITION	1+1	I
ANN 607	NUTRITION OF COMPANION / LABORATORY, WILD AND ZOO ANIMALS	2+1	II
ANN 608*	RESEARCH TECHNIQUES IN ANIMAL NUTRITION	1+3	II
ANN 609	NON CONVENTIONAL FEED STUFF AND TOXIC CONSTITUENTS / ANTIMETABOLITES IN ANIMAL FEEDSTUFF	2+1	II
ANN 691	MASTER'S SEMINAR	1	I, II
ANN 699	MASTER'S RESEARCH	20	I, II
ANN 701**	MODERN CONCEPTS OF FEEDING RUMINANTS AND FORAGE UTILIZATION	3+0	I
ANN 702	MODERN CONCEPTS OF FEEDING MONOGASTRIC ANIMALS	2+0	I
ANN 703	NUTRITION AND RUMEN FERMENTATION	1+1	II
ANN 704	ADVANCES IN MICRONUTRIENTS	1+0	II
ANN 705**	ADVANCED TECHNIQUES IN NUTRITION AND RESEARCH	1+2	I
ANN 706	ADVANCES IN FEED TECHNOLOGY	1+1	II
ANN 707	CLINICAL NUTRITION	1+1	I
ANN 708	NUTRIENT AND DRUG INTERACTION	2+0	II
ANN 709**	NEW FEED RESOURCES AND TOXICANTS IN ANIMAL FEEDING	2+0	II
ANN 791	DOCTORAL SEMINAR I	1	I, II
ANN 792	DOCTORAL SEMINAR II	1	I, II
ANN 799	DOCTORAL RESEARCH	45	I, II
SERVICE COURSE			
ABM 531	FEED BUSINESS MANAGEMENT	2+0	

*Compulsory for Master's programme; **Compulsory for Doctoral programme


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

ANIMAL NUTRITION

Course Contents

ANN 601 ANIMAL NUTRITION – ENERGY AND 3+0 SEM - I
 PROTEIN

Objective

Familiarization with fundamental concepts of energy and proteins, metabolism of carbohydrate, fat and protein and their efficiency of utilization. Requirement of carbohydrates, fat and proteins for various physiological functions.

Theory

UNIT-I: Basic terminology and classification of carbohydrates, fats and proteins. Fundamental concepts of Digestion and metabolism of Carbohydrate Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity.

UNIT-II: Measures of feed energy. Partitioning of feed energy. Efficiency of energy and Protein utilization. Feeding standards- comparative appraisal and limitations.

UNIT-III: Rumen degradable Protein (RDP), and rumen undegradable protein (UDP) and Kinetics. Energetics of protein synthesis and turn over. Quantification of microbial protein synthesis. Protein quality determination in monogastrics and utility.

UNIT-IV: Energy balance, Fasting catabolism. Direct and indirect calorimetry. Determination of energy and protein requirements. Energy and protein requirement for maintenance, growth, pregnancy and lactation in ruminants, companion animals and poultry.

Suggested Readings

- Blaxter K. 1989. *Energy Metabolism in Animal and Man*. Cambridge Univ. Press.
Bondi A. 1987. *Animal Nutrition*. Wiley InterScience.
Crampton EW & Harris LE. 1969. *Applied Animal Nutrition*. WH Freeman.
Maynard LA, Loosli JK, Hintz HF & Warner RG. 1987. *Animal Nutrition*. McGraw-Hill.
McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
Singh UB. 1987. *Advanced Animal Nutrition for Developing Countries*. Indo-Vision.

ANN 602 ANIMAL NUTRITION – MINERALS, 3+1 SEM - II
 VITAMINS AND FEED ADDITIVES

Objective

Role, requirement, functions, deficiency and toxic effects of vitamins, essential, probably essential and toxic minerals. Understanding soil-plant-animal-human relationship for utilization of minerals. Recent trends in the use of feed additives, probiotics, prebiotic and enzymes in animal feeding.

Theory

UNIT-I: Essential minerals, general role of minerals, soil-plant-animal-human relationship, requirement of minerals, factors affecting requirements. Macro elements and micro elements, their distribution, metabolism, physiological functions, deficiencies and excesses, requirements and sources. Probable essential minerals. Toxic minerals. Definition, history, classification, chemistry, functions, deficiencies and excesses, requirements and sources of water soluble and fat-soluble vitamins.

UNIT-II: Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbage. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals.

UNIT-III: Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants. Feed additives including probiotics Prebiotics, Symbiotics and feed enzymes. Research techniques in nutrition.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Practical

General principles of mineral estimation, Sampling and processing techniques, Estimation of macro- and micro-minerals. Determination of bioavailability of minerals. Formulation of mineral mixture for various species. Identification of adulterants and quality control. Atomic absorption spectrometry in mineral estimation. Preparation of diets for mineral studies. Principles of vitamin estimation. Estimation of some important vitamins (vitamin A, E, C). Formulation of vitamin mixture for various species.

Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.
 Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques*. Kalyani.
 McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
 McDowell LR. 2003. *Minerals in Animal and Human Nutrition*. Reed Elsevier India.
 Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.
 Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
 Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.
 Underwood EJ & Shuttle 1999. *The Mineral Nutrition of Livestock*. 3rd Ed. CABI.

ANN 603**FEED TECHNOLOGY****1+1****SEM - II****Objective**

Introduction to the subject, formula feed manufacturing and different operations involved. Layout, designing, operation and management of feed mill.

Theory

UNIT-I: Importance of feed technology in relation to animal productivity. The integrated biological, chemical and physical basis for evaluating the inherent nutritional quality of feed ingredients and feeds. Familiarization of various feed mill equipments, layout and operations. Problems of feed manufacturing units and control measures. Quarantine measures.

UNIT-II: Introduction to the formula feed manufacturing including principles of material handling, grinding, mixing, pelleting and other major processing operations. Crumbling, Flaking, Popping, Extrusion. Principles of instrumentation and analysis, with emphasis on application to quality control and research in the feed industry.

UNIT-III: The formulation of concentrate mixtures, premixes and rations using computer. Automated feed mill. Personal management in feed plants, laws and regulation of feed manufacturing industry. Codex alimentarius, HACCP. Organizational charts for small, medium and large feed plants, labour standard, planning and production programme, handling of plant equipment. Merits and demerits of automated feed plant

Practical

Identification of feed ingredients and their specifications, as well as compound feed for different categories of livestock and poultry. Feed microscopy. Formulating premixes. Introduction to Pulverisers, pelletisers, complete feed blocks equipments Plant layout and design of different capacity of feed mills, problems related to feasibility, records keeping in different sections of feed mill. Experiential learning at the feed plant for preparing feed, urea molasses mineral blocks, mineral mixture.

Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.
 Givens DL. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ.
 Gohl BO. 1985. *Tropical Feeds*. FAO.
 Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
 McElliherny, Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.
 Perry TW. 2004. *Feeds and Feeding*. Prentice Hall.
 Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.
 Zaworski F. 1997. *Feed Industry Red Book*. ZMAG Publ.


 REGISTRAR
 S.V.S.P.U.A.&T., MEERUT

Objective

To acquaint with inherent nutritional quality of feed ingredients and feeds. Evaluation of feeds and fodders and feed preservation techniques. Procurement and storage of feed ingredients. Losses during storage and its control.

Theory

UNIT-I: Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

UNIT-II: Evaluation of processed and preserved feeds and forages. Role of moisture, temperature and relative humidity during storage of feedstuffs and their effect on biotic factors. Handling and storage of liquid feed Ingredients. Physical and chemical changes in feeds during storage; storage losses; insect pests and rodents in feed stores and their control; Role of fungi, tolerance limits and measures to check them in stored products.

UNIT-III: Factors affecting the quality of feed and feedstuffs on preservation. Microbiological evaluation of processed and preserved feeds, Effect of preservation on nutritional value of feed. Properties and mode of action of pesticides and fumigants; principles of good sanitation and hygiene of godowns.

UNIT-IV: Proximate composition, Limitations of various systems of analysis, Partitioning of forage fibre by Van Soest method, Quality control of feed ingredients, Specifications of feed ingredients and finished feeds, BIS standard., Pesticide and insecticide residues in feeds

Practical

Laboratory evaluation of preserved and processed feed and forages. Physical properties of feeds and feedstuffs; identification of insect-pests and fungi in stored products; techniques for detection of hidden infestation in grains; quality control and inspection of stored feed materials; moisture equilibrium determination and estimation of chemical changes including alcoholic acidity, rancidity and uric acid in feeds during storage. Weende proximate analysis, Van Soest fibre fractionation, Enzymatic evaluation, Pro rata deduction (Feed laws), urea, FFA, peroxide value, adulterants, and heavy metal.

Suggested Readings

- Givens DI. 2000. *Forage Evaluation in Ruminant Nutrition*. Great Britain Publ.
 Khare BP. 1994. *Stored Grain Pests and their Management*. Kalyani.
 Krishna G & Ranjhan SK. 1991. *Special Analytical Techniques in Nutritional Biochemistry*. Kalyani.
 Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
 McEllihner Robert R. 1994. *Feed Manufacturing Technology*. The American Feed Industry Assoc.
 Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. John Wiley & Sons.

Objective

Requirement of nutrients for different physiological functions in various ruminant species. Latest concepts of feeding the nutrients for maximising production.

Theory

UNIT-I: Nutrients and their metabolism with special reference to milk, meat and wool production.

UNIT-II: Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat.

UNIT-III: Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters.

UNIT-IV: Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status. Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production. Feeding during natural calamities, feeding in various agro-climatic zones of India.

Practical

Design and planning of feeding experiments. Identification of feed and fodder on the basis of its composition. Artificial rumen technique, Methods for evaluation of feedstuffs-in vitro gas, *in sacco* digestion kinetics. Determination of nutritive value of feeds and fodders by metabolism trial in dairy cattle, determination of nutritive value of pastures by the use of range techniques, study of rumen metabolic profile. Preparation of bypass Nutrients Identification of rumen microbes and rumen studies.

Suggested Readings

Dhority BA. 2003. *Rumen Microbiology*. Nottingham Univ. Press.
Kellems RO & Church DC. 2002. *Livestock Feeds and Feeding*. Prentice Hall.
Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.

ANN 606

NON-RUMINANT NUTRITION

1+1

SEM - I

Objective

Requirement of nutrients and feeding of various non-ruminants species for efficient quality production.

Theory

UNIT-I: Nutrients, their metabolism and requirements for poultry and swine during different stages of growth and production. Limiting iminoacids-lysine and methionine.
UNIT-II: Feeding systems and feed additives, feed formulations for different purposes including least cost rations.
UNIT-III: Quality control of poultry and swine rations for efficient egg and meat production. Nutrition in relation to disease and stress.
UNIT-IV: Nutritional factors affecting quality of the products. Hind gut fermentation and its importance, Nutrient requirements of rabbits and equines, Nutritional manipulation for producing value added egg, meat / pork.

Practical

Design and planning for poultry and swine feeding experiments, formulation and compounding of general and least cost rations, determination of nutritive value of poultry and swine feeds by balance experiments, evaluation of protein quality, Visit to poultry and piggery units, feed and fodder stores, Use of software in least cost feed formulations. Basic principles governing the least cost formulation software's.

Suggested Readings

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House.
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
Rose SP. 1996. *Principles of Poultry Science*. CABI.
Stevan I, Scott ML & John DS. 2001. *Nutrition of the Chicken*. Univ. of Guelph.

ANN 607

NUTRITION OF COMPANION,
LABORATORY, WILD AND ZOO ANIMALS

2+1

SEM - II

Objective

Preparation, storage and evaluation of feeds and feeding standards of companion/ laboratory /wild and zoo animals.

Theory

UNIT-I: Feed Habbits, food Patterns, digestive structure and functions companion, laboratory , wild and zoo animals. Natural dietary habits. Nutritional requirements of various species of animals.
UNIT-II: Feeding standards and feeding habits of companion / laboratory animals. Importance of colostrum and feeding of neonates and growing animals. Feeding and care of nursing mothers. Feeding of sick and old animals. Post Surgical nutrition.
UNIT-III: Ration formulation for captive animals. Artificial feeding and feeding during emergency. Nutritive characteristics of forages for wild animals. Adequacy of forage plants for wild and zoo animals. Diets used in captivity. Raising orphans. Nutritional melodies. . Nutrition of semi wild and semi domestic animals like mithun and yak under special topography.

②

REGISTRAR
S.V.S.P.U.A.&T., MEERUT

UNIT-IV: Composition, presentation, sterilization, palatability, assessment and storage of companion/laboratory animal diets. Companion food tables and their nutritional assessment. Mistakes and misleading information on companion food labels and labeling.
UNIT-V: Nutraceuticals in companion / laboratory foods and animal foods. Nutritional deficiency diseases. Geriatric nutrition – corrective measures.

Practical

Formulation and preparation of hygienic, balanced diets and feeding for companion/laboratory animals. Characteristics of ration formulation and feeding schedules wild and zoo animals. Feeding schedules for sick and orphan wild / zoo animals. Artificial and emerging feeding. General feeding habits and different feed constituents of wild and captive animals. Research methodology of companion/laboratory animals. Processing and storage of companion/laboratory diets. Visit to Zoological parks and wildlife sanctuary.

Suggested Readings

Case LP. 1995. *Canine and Feline Nutrition*. St. Louis Publ.
 Church DC. 1980. *Digestive Physiology and Nutrition in Ruminants*. Oxford Press.
 Givens DI, Owel E, Aford REF & Omed HM. 2000. *Forage Evaluation in Ruminant Nutrition*. CABI.
 Petter WL & Pearson AEG. 1971. *The Laboratory Animals- Principles and Practices*. Academic Press.
 Reddy DV. 2003. *Applied Nutrition*. Oxford & IBH.
 Robbins C & Cunha T. 1994. *Wildlife Feeding and Nutrition*. Reed Elsevier.

ANN 608

RESEARCH TECHNIQUES IN ANIMAL NUTRITION

1+3

SEM - II

Objective

Planning and designing of experiments, use of various techniques in estimating chemical and bio-chemical constituents in feeds, fodders, blood, milk, rumen liquor, meat, wool etc.

Theory

UNIT-I: Principles of animal experimentation. Specialized feed compounding. Introduction and principle of GLC, HPLC, AAS, tracer technique, flame photometer, NIR, SF6, amino acid analyzer.

UNIT-II: Importance and principle of various techniques in estimating chemical and biochemical constituents and toxic principles in feeds, fodders. Importance, principles and procedures for estimating chemical and biochemical constituents in blood, milk, rumen liquor, meat, wool etc.

Practical

Cell Wall partitioning, Lignin as internal marker in feedstuffs, Mineral estimation by atomic absorption spectrophotometer, In-vitro/in-sacco determination of digestibility and digestion kinetics. Determination of energy content of feed, faeces and urine using bomb calorimeter. Methodology for quality improvement of animal feeds. Interpretation and presentation of results. Tracer techniques in Animal Nutrition. Quality evaluation of silage and hay, feed energy estimation; nitrate, urea, aflatoxin, salmonella, glycosides and sedimentation tests. Blood profile, meat quality.

Suggested Readings

Bondi AA. 1987. *Animal Nutrition*. Wiley InterScience.
 Gupta PC, Khatta VK & Mandal AB. 1988. *Analytical Techniques in Animal Nutrition*. CCS HAU Press.
 Pandey DN & Bajpai A. 2003. *Recent Trends in Animal Nutrition and Feed Technology for Livestock, Pets and Laboratory Animals*. International Book Distr.
 Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 609

NON-CONVENTIONAL FEEDSTUFFS AND TOXIC CONSTITUENTS/ANTIMETABOLITES IN ANIMAL FEEDSTUFF

2+1

SEM - II

Objective

To understand the importance of alternate feeds and their use in augmenting profit in livestock farm. Different toxins present in feed stuffs, their properties and detoxification techniques.

Theory



REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

UNIT-I: Present and future feed requirements and current availability for livestock and poultry. Use of non-traditional feeds – By-products of agricultural, industrial, food processing units and forest by-products. Evaluation by chemical and biological methods. Formulation of economical rations. Level of inclusion of various non conventional feeds in livestock ration.

UNIT-II: Classification of toxic principles in animal feedstuffs. Chemico-physical properties of various toxins. Effect of toxins on biological system and nutrients utilization in different species of livestock. Detoxification of toxin principles by various physical, chemical and biological techniques. Insecticide and pesticide residue detection.

Practical

Estimation of various protease inhibitors; tannins; and mycotoxins in various feeds and feedstuffs. Nitrates, HCN, oxalates, insecticide and pesticide residues, saponins, Gossypol, mimosine, heavy metals.

Suggested Readings

- Banerjee GC. 1988. *Feeds and Principles of Animal Nutrition*. Oxford & IBH.
 Liner IE. 1980. *Toxic Constituents of Animal Food Stuffs*. Academic Press.
 Lohan OP, Chahal SM & Kishore N. 1998. *Feed Quality Evaluation Techniques*. CCS Haryana Agricultural Univ. Press.
 McDonald P, Edwards RA & Greenhalgh JFD. 1995. *Animal Nutrition*. Longman.
 Ponds WG, Church DC & Pond KR. 1995. *Basic Animal Nutrition and Feeding*. 4th Ed. John Wiley & Sons.
 Ranjhan SK. 2001. *Animal Nutrition in the Tropics*. Sangam Books.
 Reddy DV. 2003. *Principles of Animal Nutrition and Feed Technology*. Oxford & IBH.

ANN 701

**MODERN CONCEPTS OF FEEDING
RUMINANTS AND FORAGE UTILIZATION**

3+0

SEM - I

Objective

To impart knowledge of modern concepts in nutrient requirement and feeding and enhanced utilization in ruminant and recent development in analysis of forages.

Theory

UNIT-I: Developments in ruminant digestive physiology – Energy protein requirement and measurement – Requirements of other nutrients. Importance of energy and protein quantity and quality Feed input and milk output relationship.

UNIT-II: Concept of limiting amino acids for high yielders. Strategic feeding of high yielding dairy cows and meat producing ruminants. Concept of Phase feeding. Bypass Nutrient technology. Feeding during stress. Nutrition-immunity interaction. Designer milk and meat. Rumen manipulation to reduce methanogenesis. Nitrogen oxide emission and heavy metal residues. Metabolic profile tests.

UNIT-III: Use of conserved forages in ruminant feeding. Chemical composition of common and newer forage – Factors affecting nutritive value of commonly available grasses, pastures, silage, hay and crop residues, voluntary intake of fodder at different stages of growth. Newer methods of forage evaluation – calculated in vitro ME and DOMD by using prediction equations. Merits and demerits of using leaf protein. Top feeds and their effective utilization – pasture consumption and evaluation studies.

UNIT-IV: Seminars on current topics of special interest.

Suggested Readings

Selected articles from journals.

ANN 702

**MODERN CONCEPTS OF FEEDING
MONOGASTRIC ANIMALS**

2+0

SEM - I

Objective

To impart knowledge on modern concepts in nutrient requirement and feeding of monogastric livestock.

Theory

UNIT-I: Nutritional factors affecting egg quality and hatchability in poultry. Feeding for designer eggs. Role of essential fatty acids, amino acids imbalance, toxicity and interactions in monogastrics.

UNIT-II: Developments in digestive physiology of swine – equines – Measurement of protein and energy requirements – Influence of processing of feeds and fodders in monogastric animal nutrition.


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

UNIT-III: Modern concepts of amino acid nutrition at various physiological status – Role of vitamins and minerals in health and disease. Advances in new generation feeds and feed additives.

Suggested Readings

Leeson S & Summers JD. 2005. *Commercial Poultry Nutrition*. International Publ. House.
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
Selected articles from journals.

ANN 703 NUTRITION AND RUMEN FERMENTATION 1+1 SEM - II

Objective

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation.

Theory

UNIT-I: Nutrient requirements for fertility and gestation, prenatal growth and foetal nutrition. Post-natal feeding, growth and developments – Body composition at prenatal and postnatal stages, abnormalities due to malnutrition.

UNIT-II: Rumen microflora and microfauna – considerations and limitations in relation to ruminant feeding practices. Manipulation of rumen fermentation – physical, chemical and biological means – Role of sulphur and phosphorus in rumen fermentation –. Modeling ruminant digestion and metabolism – principles.

Practical

Microbial and protozoal count, Determination TVFA by chromatography. Estimation of ammonia in rumen liquor – study on protection of protein in relation to degradability, Rumen fermentation products – Artificial rumen techniques. Rumen enzyme assay

Suggested Readings

Selected articles from journals.

ANN 704 ADVANCES IN MICRONUTRIENTS 1+0 SEM - II

Objective

To impart knowledge on nutrient requirements for neonatal and post natal development of livestock, recent concepts of rumen fermentation and its manipulation.

Theory

UNIT-I: Developments in the study of major, minor and toxic minerals in animals – animal – soil - plant interrelationship – concepts in absorption and transport of micronutrients – Kinetics and metabolism physiological and biochemical interactions among nutrients – interrelationship of minerals and vitamins in relation to metabolism and requirements – mineral toxicities in relation to livestock feeding.

UNIT-II: Developments in vitamin and mineral requirements for growth, reproduction and lactation – Identification and correction of deficiencies and toxicities of minerals in farm animals.

UNIT-III: Bio-availability of macro and micro nutrients – factors affecting the bio-availability of minerals – bio-marker concept for mineral requirement for correction of deficiencies and toxicity of minerals.

Suggested Readings

Peter RC. 2005. *Applied Animal Nutrition Feeds and Feeding*. Pearson Prentice Hall.
Ponds WG, Church DC, Pond KR & Schoknecht PA. 2005. *Basic Animal Nutrition and Feeding*. Wiley Dreamtech India.
Selected articles from journals.

ANN 705 ADVANCED TECHNIQUES IN NUTRITION 1+2 SEM - I
AND RESEARCH

Objective

To impart knowledge on use of advanced analytical techniques in nutrition research.



REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Theory

UNIT-I: Developments in analysis of nutrients in feeds. Estimation of toxins and mycotoxins – Application of atomic absorption spectrophotometer, HPLC – Enzymatic methods of feed analysis – Isotopes in nutrition research – Feed microscopy – Analytical aspect of feeds and fodders using N.I.R.

UNIT-II: Faecal inoculum as alternative to rumen liquor in in vitro studies – Degradability of feeds by various techniques – rates of VFA and microbial production.

Practical

Estimation of major, minor and toxic minerals by atomic absorption spectrophotometer, Estimation of mycotoxin by HPLC, Estimation of oxalate, nitrates, tannin and mimosine, VFA fractionation by GC. SF6 Technique, amino acid analyzer, NIR, HPLC, Purine derivatives, milk fat and FA estimation.

Suggested Readings

Selected articles from journals.

ANN 706**ADVANCES IN FEED TECHNOLOGY****1+1****SEM - II****Objective**

To impart knowledge on modern feed processing methods and automated feed plant layout.

Theory

UNIT-I: Feed and fodder processing – Particle size reduction – bulk density – processing of grains and oil seeds – processing of roughages – feed plant layout and design – feed plant management – storage of feeds.

UNIT-II: Non conventional feed resources – Formulation of concentrates, premixes and rations – improvement of nutritive value of poor quality roughages – liquid feed supplements. Solid state fermentation (SSF) technology.

Practical

Feed microscopy tests for certain adulterants and anti nutritional factors, Feed plant design– processing of roughages – feed plant sanitation, Wild seed identification – qualitative tests for rancidity, minerals and adulterants, Visit to commercial feed plant.

Suggested Readings

Selected articles from journals.

ANN 707**CLINICAL NUTRITION****1+1****SEM - I****Objective**

Impact of nutrition on health, immunity, digestive/metabolic disorders, reproductive performance, bacterial and parasitic infestations, organic toxins and stress nutrition, feeding management of sick animals.

Theory

UNIT-I: Nutritional factors responsible for disorders. Metabolic disorders and production diseases in farm animals. Prevention of metabolic disorders – recommended dietary regimen.

UNIT-II: Effect of coccidiostats and dietary antigens in early weaned livestock. Nutrition in relation to emerging diseases. Effect of nutrition on fertility, reproduction and lactation. Toxic minerals and counter action (Selenium and fluorine).

UNIT-III: Stress nutrition and post surgical nutrition. Nutritional manipulation and feeding of sick animals. Pesticides residues in feeds and fodders and their impact on animal health, reproduction and production.

Practical

Determination of blood glucose, blood urea nitrogen, SGOT SGPT, total protein, cholesterol and ketone bodies, Metabolic profile tests.

Suggested Readings

Selected articles from journals.

ANN 708**NUTRIENT AND DRUG INTERACTION****2+0****SEM - II****Objective**

To impart knowledge on the effects of drugs on nutrient utilization.



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Theory

UNIT-I: Effects of drugs on digestion and absorption of nutrients – Drugs and intestinal microbial interaction – Effect of drugs and antibiotics as feed additives. Physiological effects – Use and abuse.

UNIT-II: Nutrients in drug detoxification – Antagonists – Hormones and their effect on growth and carcass qualities. Drug residues in animal products - milk and meat – effect on food change. Legal aspects of drugs in animal products.

Suggested Readings

Selected articles from journals.

ANN 709**NEW FEED RESOURCES AND TOXICANTS 2+0
IN ANIMAL FEEDING****SEM - II****Objective**

To impart knowledge on newer feed resources and their value in animal feeding and various toxic substances prevalent in feeds and fodders.

Theory

UNIT-I: Demand and availability of feed – formulation of database in computer – strategy in food animal production – agricultural by-products – Agroindustrial by-products, Farm waste, crop residues, organic wastes of animal origin. Slaughter house waste, industrial waste and their feeding value in animals.

UNIT-II: Processing to enhance feed utilization and availability. Possible health hazards due to waste utilization-chemical and nutritional changes in waste product due to processing. Quality standard and their acceptance.

UNIT-III: Naturally occurring toxicants – Toxicants of plants and non-microbial origin. Naturally occurring alkaloids, mycotoxins and their toxicity – Acquired toxicants, pesticides, weedicides and heavy metals.

UNIT-IV: Effect of toxins on rumen fermentation and nutrient utilization. Methods of detoxification. Food and feed contaminants – their impact on animal performance.

Suggested Readings

Selected articles from journals.


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Department of Veterinary and Animal Husbandry Extension Education

Degree Programme:

MVSc (Veterinary Extension Education) & Ph.D (Veterinary Extension Education)

Programme Outcomes (POs)

1. To build required competencies of the students to meet challenges of current Animal Husbandry scenarios.
2. Students acquire the knowledge of different developmental programmes and or initiatives of the Government of India in the field of Veterinary and Animal Husbandry.
3. Understand the role of different organizations involved in livestock development.
4. Students will learn the policies and regulations for the livestock at National and International level.

Programme Specific Outcomes (PSOs) and Animal Husbandry Extension Education

1. The programme promoting entrepreneurship development among the students through knowledge about Startup India, Mudra Bank Scheme, Dairy Entrepreneurship etc.
2. Students learn the different ICT tool which helps them to modernize their future endeavor.
3. International trade rule and regulation will helps the students to acquire to develop new dimension of livestock entrepreneurship.

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1	Development Perspectives of Extension Education	EXT 601	2+1	<ul style="list-style-type: none"> To acquaint the students with different extension approaches and their implications in animal husbandry. To make students realise the importance of linkages among departments and various institutions. To acquaint the students with the recent development in extension
2.	Communication for Livestock Development	EXT 602	1+1	To acquaint students with dynamics of communication and apply in development of livestock sector.
3.	Diffusion and Adoption of Innovations	EXT 603	2+1	To sensitize the students to technology generation, dissemination and its adoption through effective communication
4.	Programme Planning and Evaluation	EXT 604	1+1	To expose the students to programme planning, Monitoring and evaluation of animal husbandry development programmes.
5.	Research Methodology	EXT 605	2+1	To impart knowledge and skills in formulating and conducting an independent research in the field of Animal Husbandry Extension.
6.	Social Psychology and Group Dynamics	EXT 606	1+1	To acquaint the students with the structure and functioning of social groups and socio psychological aspects in interacting with livestock farmers.
7.	Livestock Entrepreneurship	EXT 607	1+2	<ul style="list-style-type: none"> To orient the students on basic concepts of entrepreneurship and the initiatives in promoting livestock as an enterprise. To impart knowledge in the various facets of entrepreneurial management and consumer behaviour for establishment of livestock ventures.

8.	Human Resource Management in Animal Husbandry Sector	EXT 608	1+1	To make students understand human resource management techniques and deal organizational challenges effectively
9.	Gender Empowerment and Livestock Development	EXT 609	1+0	To acquaint students with gender perspectives, empowerment and its importance in livestock development, policies and programmes.
10.	Farm Journalism	EXT 610	1+1	To sensitize students about the role of print, electronic, digital and internet media for promoting animal husbandry sector.
11.	Statistics for Social Sciences	SSS 600	2+1	To equip the students with knowledge and skills in the applications of statistics in the field of veterinary and Animal Husbandry Extension.
12.	Organizational Leadership and Management	EXT 701	2+0	To orient students with leadership and management perspectives for organizational change and development.
13	Recent Trends in Research Techniques in Social Sciences	EXT 702	2+1	To train the students on research and management techniques/ methods applicable to animal husbandry research.
14	Training for Development	EXT 703	1+1	To impart knowledge on planning, implementation and evaluation of various training programmes.
15	Policies and Regulations in Livestock Sector	EXT 704	1+0	To sensitize students on policies and regulations in animal husbandry sector.
16	Educational Technology	EXT 705	2+1	To acquaint students with different concepts of education technology for the enhancement of quality of education.
17	Dynamics of Social Change	EXT 706	2+0	To provide understanding on the dynamics of social change and its implications to livestock development.
18	Monitoring and Evaluation of Livestock Development Programmes	EXT 707	2+1	To appraise the students about the monitoring and evaluation of livestock development programmes.
19	Theory Constructions in Social Sciences	EXT 708	1+0	To provide the foundation for construction of theories in social science.
	Facilitation for Development	EXT 709	2+1	To orient students on the importance facilitation. • To inspires students to understand facilitation tools to influence change at the individual, group and organisational levels. • To develop capacities in multi-stakeholder engagement, facilitation and networking.
20	Managing Extension	EXT 710	2+1	• To orient students on the importance of knowledge and skills on various management

	Organizations			<p>functions, as applicable to extension organizations</p> <ul style="list-style-type: none"> • Discuss ways of running extension services as managers of livestock -ventures • To develop capacities for becoming effective managers of livestock -ventures
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23/11/2022

Assoc. Prof & OIC
Deptt. of Vety & A.H. Ext. Edu.
COVAS, SVPUAT, Meerut (U.P.) 250110

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REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Department of Veterinary Surgery & Radiology
COVAS, SVPUA&T, Meerut

Degree Programme:

- MVSc (Veterinary Surgery & Radiology) & Ph.D (Veterinary Surgery & Radiology)

Programme Outcomes (POs)

- To encourage clinical practice in the veterinary clinics
- To focus on learning of research, methodology, scientific thinking, planning and experimentation.
- To acquire the knowledge with the facts and figures related to Veterinary surgery.
- To study various surgical affections of the larger and small animals.
- The students acquire knowledge to diagnose the surgical affections using diagnostic techniques like radiology, ultrasonography.

Programme Specific Outcomes (PSOs)

- Under existing clinical ecosystem, the postgraduate course curriculum is expected to build clinical knowledge and skill portfolio of the students.
- Programme will enhance their employability and marketability as multi-service providers with hands on skills and comprehensive knowledge of the entire subject.
- The post graduates and doctorates should, in turn, prove as specialists, in the field of their specialization.
- The students will acquire the knowledge and skill of diagnosis as well as treatment of the surgical cases.


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Course Outcomes (COs)

Masters Courses: (MVSc in Veterinary Surgery & Radiology)

S. No.	Course Title	Code	Credit Hr.	Course Outcomes (Bullet Points)
1	Clinical Practice-I*	VSR 501	3 (0+3)	<ul style="list-style-type: none"> To learn techniques and procedures in anaesthesia. To learn techniques and procedures in diagnostic imaging techniques. To learn techniques and procedures in surgery
2	Clinical Practice-II*	VSR 502	3(0+3)	<ul style="list-style-type: none"> To learn techniques and procedures in anaesthesia. To learn techniques and procedures in diagnostic imaging techniques. To learn techniques and procedures in surgery
3	Principles of Surgery*	VSR 503	3(2+1)	<ul style="list-style-type: none"> To learn basic and advance principles and standards of practice in small animal surgery To learn basic and advance principles and standards of practice in small animal surgery
4	Anaesthesia And Analgesia*	VSR 504	3 (2+1)	<ul style="list-style-type: none"> To gain the basic and practical knowledge of principals of companion and farm animals anaesthesia To gain the basic and practical knowledge of pain management in large and small animals.
5	Diagnostic Imaging Techniques *	VSR 505	3 (2+1)	<ul style="list-style-type: none"> To learn the basic principles and gain practical knowledge of X-Ray techniques and interpretation To learn the basic principles and gain practical knowledge of ultrasonography
6	Soft Tissue Surgery	VSR 506	3 (2+1)	<ul style="list-style-type: none"> To learn about soft tissue surgical skills and various surgical affections of different body systems in companion animals. To learn about soft tissue surgical skills and various surgical affections of different body systems in farm animals.
7	Orthopaedic Surgery*	VSR 507	3 (2+1)	<ul style="list-style-type: none"> To learn about various affections of bones, joints, tendons, ligaments and foot and their treatment in companion and farm animals. To learn about various fracture fixation techniques.
8	Anaesthesia of Zoo, Wild, Exotic and Laboratory Animals	VSR 508	2 (1+1)	<ul style="list-style-type: none"> To learn about basic and practical knowledge of chemical immobilization, sedation and anaesthesia of laboratory animals. To learn about basic and practical knowledge of anaesthesia of exotic, captive and free ranging wild animals.
9	Urogenital Surgery	VSR 509	2 (1+1)	<ul style="list-style-type: none"> To learn about various surgical affections of urinary and genital tract and their treatment in companion animals. To learn about various surgical affections of urinary and genital tract and their treatment in farm

				animals.
10	Ophthalmology	VSR 510	2 (1+1)	<ul style="list-style-type: none"> To learn basic principles and gain practical knowledge of diagnosis of eye diseases. Treatment of various ocular affections.
11	Dentistry and Oral Surgery	VSR 511	2 (1+1)	<ul style="list-style-type: none"> To learn the basic and practical knowledge of diagnosis and treatment of diseases of teeth. To learn diagnosis and treatment of various affections of oral cavity in large and small animals.
12	Camel Surgery	VSR 512	2 (1+1)	<ul style="list-style-type: none"> To learn the basic principles and gain practical knowledge of diagnosis and treatment of surgical diseases of camel.
13	Elephant Surgery	VSR 513	2 (1+1)	<ul style="list-style-type: none"> To learn the basic principles and gain practical knowledge of diagnosis and treatment of surgical diseases of elephant.
14	Clinical Case Conference	VSR 587	1 (0+1)	<ul style="list-style-type: none"> To develop clinical and discussion skills related to any interesting case or findings related to any particular case. Present seminar on unusual/ interesting clinical cases done in the clinics.
15	Special Problem in Radiology	VSR 588	2 (0+2)	<ul style="list-style-type: none"> Investigative radiological problems in clinical or experimental models. Learning Self-learning strategies in problems related to radiology.
16	Special Problem in Anaesthesia	VSR 589	2 (0+2)	<ul style="list-style-type: none"> Investigative anaesthetic problems in clinical or experimental models. Learning Self-learning strategies in problems related to anaesthesiology.
17	Special Problem in Surgery	VSR 590	2 (0+2)	<ul style="list-style-type: none"> Investigative surgical problems in clinical or experimental models. Learning Self-learning strategies in problems related to surgical conditions.
18	Masters Seminar	VSR 591	1 (1+0)	<ul style="list-style-type: none"> To gather knowledge and literature on one selected topic related to veterinary surgery & radiology. To present the collected information specific to that topic and its discussion.
19	Masters Research	VSR 599	30 (0+30)	<ul style="list-style-type: none"> To focus on learning of research methodology, scientific thinking, planning and experimentation. Interpretation of the result data, its discussion with the earlier or related work done by the other researchers. Compilation of the research done in the form of a thesis.


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Doctoral Courses: (Ph.D in Veterinary Surgery & Radiology)

S. No.	Course Title	Code	Credit Hr.	Course Outcomes (Bullet Points)
1	Clinical Practice-I*	VSR 601	2 (0+2)	<ul style="list-style-type: none">• To learn techniques and procedures in anaesthesia.• To learn techniques and procedures in diagnostic imaging techniques.• To learn techniques and procedures in surgery
2	Clinical Practice-II*	VSR 602	2 (0+2)	<ul style="list-style-type: none">• To learn techniques and procedures in anaesthesia.• To learn techniques and procedures in diagnostic imaging techniques.• To learn techniques and procedures in surgery
3	Clinical Practice-III*	VSR 603	2 (0+2)	<ul style="list-style-type: none">• To learn techniques and procedures in anaesthesia.• To learn techniques and procedures in diagnostic imaging techniques.• To learn techniques and procedures in surgery
4	Cardiovascular Surgery	VSR 604	3 (2+1)	<ul style="list-style-type: none">• To learn the basic principles and gain practical knowledge of diagnosis of diseases of cardiovascular system.• To gain practical knowledge of treatment of diseases of cardiovascular system.
5	Advances in Anaesthesiology	VSR 605	3 (2+1)	<ul style="list-style-type: none">• To learn advance concepts and techniques of veterinary anaesthesia like intravenous anaesthesia in large animals, TIVA.• Advances in small animals anaesthesia.
6	Advances in Radiology	VSR 606	3 (2+1)	<ul style="list-style-type: none">• To learn advance theoretical and practical knowledge in radiology.• Use of the newer techniques of radiology in the veterinary practice.
7	Advances in Diagnostic Imaging Techniques	VSR 607	3 (2+1)	<ul style="list-style-type: none">• To learn advance theoretical and practical knowledge of ultrasonography.• Advanced knowledge of the diagnostic imaging techniques and their interpretations.
8	Advances in Orthopaedics	VSR 608	3 (2+1)	<ul style="list-style-type: none">• To learn advance concepts and techniques of treatment of various affections of bones, joints, tendons, ligaments and foot in companion and farm animals.• To learn about advanced fracture management techniques.• Advanced orthotic and prosthetic knowledge.
9	Neurosurgery	VSR 609	3 (2+1)	<ul style="list-style-type: none">• To learn the diagnosis of surgical affections of nervous system in animals.• To learn principles and techniques of treatment of surgical affections of nervous system in animals.
10	Reconstructive and Regenerative Surgery	VSR 610	2 (1+1)	<ul style="list-style-type: none">• To learn principles and techniques of reconstructive and regenerative surgery.• Use of biomaterials in veterinary surgery.
11	Advances in	VSR	3	<ul style="list-style-type: none">• To learn advanced concepts and practical techniques


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	Soft Tissue Surgery	611	(2+1)	of treatment of soft tissue surgery. • To learn advanced concepts of laparoscopic and minimally invasive endoscopic surgery.
12	Advances in Ophthalmology	VSR 612	2 (1+1)	• To learn advanced concepts and practical techniques in ophthalmology. • Learn about advanced ophthalmological instruments and their use in various ocular conditions.
13	Surgical Oncology	VSR 613	2 (1+1)	• To learn about tumour genesis and treatment in animals.
14	Clinical Case Conference*	VSR 687	1 (0+1)	• To develop clinical and discussion skills related to any interesting case or findings related to any particular case. • Present seminar on unusual/ interesting clinical cases done in the clinics.
15	Special Problem in Diagnostic Imaging	VSR 688	2 (0+2)	• Investigative radiological problems in clinical or experimental models. • Learning Self-learning strategies in problems related to radiology
16	Special Problem in Anaesthesia	VSR 689	2 (0+2)	• Investigative anaesthetic problems in clinical or experimental models. • Learning Self-learning strategies in problems related to anaesthesiology
17	Special Problem in Surgery	VSR 690	2 (0+2)	• Investigative surgical problems in clinical or experimental models. • Learning Self-learning strategies in problems related to surgical conditions.
18	Doctoral Seminar-I	VSR 691	2 (2+0)	• To gather knowledge and literature on one selected topic related to veterinary surgery & radiology. • To present the collected information specific to that topic and its discussion.
19	Doctoral Seminar-II	VSR 692	2 (2+0)	• To gather knowledge and literature on one selected topic related to veterinary surgery & radiology. • To present the collected information specific to that topic and its discussion.
20	Doctoral Research	VSR 699	75 (0+75)	• To focus on learning of research methodology, scientific thinking, planning and experimentation. • Interpretation of the result data, its discussion with the earlier or related work done by the other researchers. • Compilation of the research done in the form of a thesis.

Signature

Dr. Vivak Malik

OIC (Vet. Surgery and Radiology)

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VETERINARY MEDICINE

Course Structure

COURSE NO.	COURSE TITLE	CREDITS	SEM
VMD 601	RUMINANT MEDICINE - I	3+0	I
VMD 602	RUMINANT MEDICINE - II	3+0	II
VMD 603	EQUINE MEDICINE	2+0	I
VMD 604	CANINE AND FELINE MEDICINE	2+0	II
VMD 605	AVIAN MEDICINE	2+1	II
VMD 606	DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE	1+0	I
VMD 607	SWINE MEDICINE	1+0	I
VMD 608	METABOLIC DISEASES	2+0	I
VMD 609	DISEASES OF ANIMALS CAUSED BY TOXICANTS	1+0	II
VMD 610	VETERINARY FORENSIC MEDICINE	1+1	II
VMD 611	CLINICAL DIAGNOSTIC TECHNIQUES	0+2	I
VMD 612	CLINICAL PRACTICE - I	0+3	I
VMD 613	CLINICAL PRACTICE - II	0+3	II
VMD 691	MASTER'S SEMINAR	1	I, II
VMD 699	MASTER'S RESEARCH	20	I, II
VMD 701	ADVANCES IN GASTROENTROLOGY	2+0	I
VMD 702	ADVANCES IN CARDIOPULMONARY MEDICINE	2+0	II
VMD 703	ADVANCES IN NEUROLOGICAL AND UROLOGICAL DISORDERS	2+0	II
VMD 704	ADVANCES IN ENDOCRINE AND DERMATOLOGICAL DISORDERS	2+0	II
VMD 705	ADVANCES IN METABOLIC DISEASES	1+2	I
VMD 706	ADVANCES IN INFECTIOUS DISEASES OF RUMINANTS	1+2	II
VMD 707	ADVANCES IN INFECTIOUS DISEASES OF EQUINES	1+2	I
VMD 708	ADVANCES IN INFECTIOUS DISEASES OF PET ANIMALS	1+2	II
VMD 709	ADVANCES IN DISEASES OF POULTRY	1+2	I
VMD 710	ADVANCES IN VETERINARY DIAGNOSTICS	1+2	II
VMD 711	ADVANCES IN VETERINARY THERAPEUTICS	1+2	I
VMD 712	ADVANCED CLINICAL PRACTICE I	0+2	I
VMD 713	ADVANCED CLINICAL PRACTICE II	0+2	II
VMD 714	ADVANCED CLINICAL PRACTICE III	0+2	I
VMD 790	SPECIAL PROBLEM	0+2	I, II
VMD 791	DOCTORAL SEMINAR I	1	I, II
VMD 792	DOCTORAL SEMINAR II	1	I, II
VMD 799	DOCTORAL RESEARCH	45	I, II


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VETERINARY MEDICINE

Course Contents

VMD 601 RUMINANT MEDICINE - I 3+0 SEM - I

Objective

Study of diseases of various body systems, bacterial and viral diseases of bovine, sheep and goats.

Theory

UNIT-I: General systemic states. Diseases of alimentary system, liver and urinary system.

UNIT-II: Diseases of respiratory, nervous, cardiovascular, blood and blood forming organs, musculoskeletal system and skin.

UNIT-III: Mastitis, joint ill, ulcerative lymphangitis, anthrax, clostridial infections, black quarter, bacillary haemoglobinuria, botulism, colibacillosis, pasteurellosis, listeriosis, tuberculosis, Johne's disease, braxy, enterotoxaemia, brucellosis, salmonellosis, leptospirosis, actinomycosis, actinobacillosis.

UNIT-IV: Foot and mouth disease, mucosal disease complex, PPR, malignant head catarrh, infectious bovine rhinotracheitis, rabies, scrapie, louping ill, blue tongue, pox diseases, rinderpest and ephemeral fever.

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*. 10th Ed. WB Saunders.

VMD 602 RUMINANT MEDICINE - II 3+0 SEM - II

Objective

Study of parasitic and fungal diseases of bovine, sheep and goats.

Theory

UNIT-I: Ringworm, cutaneous sporotrichosis, aspergillosis, coccidiomycosis, rhinosporidiosis, mucormycosis, histoplasmosis, candidiasis, blastomycosis.

UNIT-II: Bovine tropical theileriosis, babesiosis, anaplasmosis, trypanosomiasis, toxoplasmosis, coccidiosis.

UNIT-III: Sarcocystosis, fascioliosis, amphistomiasis, gastro-intestinal nematodiasis, schistosomiasis, verminous bronchitis, echino-coccosis, coenurosis, tape worm infestations.

Suggested Readings

Chakrabarti A. 1998. *Text Book of Clinical Veterinary Medicine*. Kalyani Publ.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*. 10th Ed. WB Saunders.

VMD 603 EQUINE MEDICINE 2+0 SEM - I

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis, treatment and prevention of diseases of equines.

Theory

UNIT-I: General systemic states and diseases of various body systems (alimentary, urinary, respiratory, nervous, cardiovascular, blood and blood forming organs, musculoskeletal and integumentary).

UNIT-II: Anthrax, tetanus, botulism, strangles, glanders, malignant edema, actinomycosis, clostridial infections, African horse sickness, infectious equine anaemia, equine influenza, equine encephalomyelitis, equine viral rhinopneumonitis, equine viral arteritis, ulcerative lymphangitis, *Rhodococcus equi* pneumonia.

UNIT-III: Trypanosomiasis/ dourine, babesiosis, parasitic pneumonia, cutaneous eczema, cutaneous acne, cutaneous pustular dermatitis, candidiasis, histoplasmosis, coccidiomycosis, dermatophytosis.

Suggested Readings

Wintzer H. 1986. *Equine Diseases*. Verlag Paul Parey.

Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. *Veterinary Medicine*. 10th Ed. WB Saunders.

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VMD 604 CANINE AND FELINE MEDICINE 2+0 SEM - II

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of dogs and cats.

Theory

UNIT-I: General systemic states, hypothyroidism, diabetes mellitus, diabetes insipidus, rickets.

UNIT-II: Bacterial diseases: leptospirosis, , tetanus, botulism. Viral diseases: canine-distemper, infectious canine hepatitis, parvovirus infection, rabies, corona virus infection.

UNIT-III: Parasitic diseases: toxoplasmosis, neosporosis, sarcoptic mange, demodectic mange, hookworm and toxocara canis infections, leishmaniasis, canine babesiosis, ehrlichiosis, hepatozoonosis.

UNIT-IV: Feline diseases: feline pan-leucopaenia, feline infectious peritonitis, feline herpesvirus, feline spongiform encephalopathy, feline calci and feline immuno-deficiency viral diseases.

Suggested Readings

Dunn JK. 1999. *Textbook of Small Animal Medicine*. WB Saunders.

Ettinger SJ & Feldman EC. 2000. *Text Book of Veterinary Internal Medicine*. Vols. I, II. Saunders.

Gorman NT. 1998. *Canine Medicine and Therapeutics*. Blackwell.

Tilley LP & Smith FWK Jr. 2004. *The 5-minute Veterinary Consult (Canine and Feline)*. 3rd Ed. Lippincot, Williams & Wilkins.

VMD 605 AVIAN MEDICINE 2+1 SEM - II

Objective

Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of avian species.

Theory

UNIT-I: Diseases due to deficiency of vitamins (vitamins A, B complex, C, D,E and K); minerals (calcium, phosphorus, manganese, zinc) and sodium chloride; miscellaneous diseases/conditions/ vices.

UNIT-II: Bacterial diseases: *Escherichia coli* and salmonella infections, coryza, fowl cholera, gangrenous dermatitis, mycoplasmosis, CRD.

UNIT-III: Viral diseases: Newcastle disease, infectious bursal disease, Marek's disease, infectious bronchitis, inclusion body hepatitis, hydro-pericardium syndrome, avian pox, infectious laryngo-tracheitis, avian influenza, lymphoid leucosis, avian encephalomyelitis, infectious bronchitis.

UNIT-IV: Fungal and parasitic diseases: aspergillosis, candidiosis, favus, mycotoxicosis, coccidiosis, roundworm and tape worm infestations, vaccination schedule etc.

Practical

Post-mortem examination of poultry birds, collection of clinical material for laboratory diagnosis.

Suggested Readings

Calnek BW, Barnes HA, Beard CW, Reid WM & Yoder HW Jr. 1999. *Diseases of Poultry*. 10th Ed. Iowa State Univ. Press.

Jordan ETW and Pattison, M. 1996. *Poultry Diseases*. WB Saunders.

Leeson S, Diaz G & Summers JD. 2001. *Poultry Metabolic Disorders and Mycotoxins*. IBDC Publ.

VMD 606 DISEASES OF ANIMAL SPECIES OF REGIONAL IMPORTANCE (CAMEL) 1+0 SEM - I

Objective

Study of diseases of important regional animal species (camel).

Theory

The animal species, to be studied/ taught is to be decided by the individual institution. For Veterinary College at CCS HAU Hisar, camel diseases will be covered.

UNIT-I: General systemic states, nutritional deficiency disorders.

UNIT-II: Specific diseases (malli, kapali, jhooling, peritonitis, specific peritonitis, satyriasis, kurari, allotriophagia, tibersa and other common infectious diseases.


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Suggested Readings

- Gahlot TK. 2000. *Selected Topics on Camelids*. The Camelid Publishing House, Bikaner.
Kohler I, Rollfeson E & Evelyn M. 2001. *Field Manual of Camel Diseases: Traditional and Modern Health Care of Dromedary*. Germany.
Wernery U & Kaden M. 2002. *Infectious Diseases of Camelids*. Blackwell.

VMD 607	SWINE MEDICINE	1+0	SEM - I
Objective	Study of etiology, epidemiology, pathogenesis, symptomatology, diagnosis and treatment of diseases of swine.		
Theory	<u>UNIT-I:</u> General systemic states, swine influenza, hog cholera, African swine fever, swine pox, vesicular exanthema, vesicular stomatitis, rabies. <u>UNIT-II:</u> Porcine enteroviruses, pseudorabies, listeriosis, leptospirosis, brucellosis, anthrax, salmonellosis, swine erysipelas, pasteurellosis, tuberculosis mange etc.		
Suggested Readings	Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. <i>Veterinary Medicine: 10th Ed.</i> WB Saunders. Howard W Dunne & Allen D Leman (Eds.). 1978. <i>Diseases of Swine</i> . Iowa State Univ. Press.		
VMD 608	METABOLIC DISEASES	2+0	SEM - I
Objective	Study of metabolic, production and deficiency diseases of domestic animals.		
Theory	<u>UNIT-I:</u> General aspects, production diseases (parturient paresis, downer cow syndrome, ketosis, post-parturient haemoglobinuria, hypomagnesemic tetany, pregnancy toxemia). <u>UNIT-II:</u> Lactation tetany of mares, eclampsia of bitches, osteodystrophia fibrosa, azoturia of equines, rheumatism-like syndrome in buffaloes, hypothyroidism, diabetes mellitus and diabetes insipidus in dogs. <u>UNIT-III:</u> Deficiency diseases (calcium, phosphorus, vitamin-D3, vit-A, vit B-complex, vit-C and vit-K). <u>UNIT-IV:</u> Deficiency diseases (iron, copper, cobalt, zinc, manganese, iodine, vitamin E and selenium).		
Suggested Readings	Dunn JK. 1999. <i>Text Book of Small Animal Medicine</i> . WB Saunders. Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. <i>Veterinary Medicine</i> . 10 th Ed. WB Saunders.		
VMD 609	DISEASES OF ANIMALS CAUSED BY TOXICANTS	1+0	SEM - II
Objective	Study of diseases caused by various toxicants in domestic animals.		
Theory	<u>UNIT-I:</u> Diseases caused by physical agents and poisoning of organic and inorganic compounds, farm chemicals and phytotoxins. <u>UNIT-II:</u> Diseases caused by mycotoxins and zootoxins, poisonous plants, snake and insect bites.		
Suggested Readings	Kahn Cynthia M. (Ed.). 2005. <i>The Merck Veterinary Manual</i> . Merck & Co. Radostits OM, Gay CC, Blood DC & Hinchcliff KW. 2008. <i>Veterinary Medicine</i> . 10 th Ed. WB Saunders.		
VMD 610	VETERINARY FORENSIC MEDICINE	1+1	SEM - II
Objective	To familiarize students with various aspects of Veterinary Forensic Medicine.		
Theory	<u>UNIT-I:</u> Veterolegal aspects of ante mortem and post mortem examination. <u>UNIT-II:</u> Examination of wounds, blood, offenses, frauds in animals and their products, animal cruelty and welfare.		

UNIT-III: Study of common laws related to veterolegal aspects.

Practical

Ante- mortem and post- mortem examination, examination of wounds, blood, offenses, frauds in animals and their products, collection, dispatch and examination of veterolegal samples.

Suggested Readings

Sharma SN, Gahlot AK, Tanwer RK. 2003. *Veterinary Jurisprudence*. NBS Publishers, Bikaner.

VMD 611 CLINICAL DIAGNOSTIC TECHNIQUES 0+2 SEM - I

Objective

Study the diagnostic protocols and procedures for various diseases of farm and companion animals.

Practical

UNIT-I: Clinical tests and their interpretation related to diseases of alimentary tract, liver, cardio vascular system, blood and blood-forming organs of various species of animals.

UNIT-II: Clinical tests and their interpretation related to respiratory, urinary, nervous, endocrine, musculoskeletal and integumentary systems of various species of animals.

Suggested Readings

Kelly WR. 1984. *Veterinary Clinical Diagnosis*. Balliere Tindall, London.

Kaneko JJ, Harvey JW & Bruss ML. 2008. *Clinical Biochemistry of Domestic Animals*. 6th Ed. Academic Press, Amsterdam.

VMD 612 CLINICAL PRACTICE - I 0+3 SEM - I

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 613 CLINICAL PRACTICE – II 0+3 SEM - II

Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 701 ADVANCES IN GASTROENTEROLOGY 2+0 SEM - I

Objective

Study of contemporary advances in gastroenterology.

Theory

UNIT-I: Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of farm animals.

UNIT-II: Advances in diagnosis, therapy and control of diseases of gastrointestinal system and associated organs of companion animals.

Suggested Readings

Selected articles from journals.

VMD 702 ADVANCES IN CARDIO-PULMONARY MEDICINE 2+0 SEM - II

Objective

Study of recent advances in the field of cardiopulmonary medicine.

Theory

UNIT-I: Advances in diagnosis and therapeutic management of diseases of circulatory system.


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UNIT-II: Advances in diagnosis and therapeutic management of diseases of respiratory system.

UNIT-III: Advances in diagnosis and therapeutic management of diseases of blood and blood forming organs in animals.

Suggested Readings

Selected articles from journals.

VMD 703 ADVANCES IN NEUROLOGICAL AND 2+0 SEM - II
UROLOGICAL DISORDERS

Objective

Study of recent advances in the field of neurological and urological disorders.

Theory

UNIT-I: Advances in diagnosis, therapy and prevention of diseases of nervous and locomotor systems.

UNIT-II: Advances in diagnosis, therapy and prevention of diseases of urinary system.

Suggested Readings

Selected articles from journals.

VMD 704 ADVANCES IN ENDOCRINE AND 2+0 SEM - II
DERMATOLOGICAL DISORDERS

Objective

Study of recent advances in endocrine and dermatological disorders.

Theory

UNIT-I: Advances in diagnosis, therapy and prevention of diseases of integumentary system.

UNIT-II: Advances in diagnosis, therapy and prevention of diseases of endocrine system.

Suggested Readings

Selected articles from journals.

VMD 705 ADVANCES IN METABOLIC DISEASES 1+2 SEM - I

Objective

Study of recent advances and research methodology related to metabolic diseases of domestic/companion animals.

Theory

UNIT-I: Metabolic/production diseases of farm and companion animals.

UNIT-II: Nutritional deficiency diseases of farm and companion animals.

Practical

Short term assignment with some research component pertaining to metabolic/production/nutritional deficiency diseases of domestic and companion animals.

Suggested Readings

Selected articles from journals.

VMD 706 ADVANCES IN INFECTIOUS DISEASES 1+2 Sem II
OF RUMINANTS

Objective

Study of recent advances and research methodology related to infectious diseases of ruminants.

Theory

UNIT-I: Bacterial and viral diseases of bovines, sheep and goats.

UNIT-II: Fungal, parasitic and rickettsial diseases of bovines, sheep and goats.

Practical

Short term assignment with some research component pertaining to ruminant infectious diseases.

Suggested Readings

Selected articles from journals.

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VMD 707 ADVANCES IN INFECTIOUS DISEASES 1+2 SEM - I
OF EQUINES

Objective

Study of recent advances and research methodology related to infectious diseases of equines and canines.

Theory

UNIT-I: Bacterial, viral and rickettsial diseases of equines.

UNIT-II: Fungal and parasitic diseases of equines.

Practical

Short term assignment with some research component pertaining to infectious diseases of equines.

Suggested Readings

Selected articles from journals.

VMD 708 ADVANCES IN INFECTIOUS DISEASES 1+2 SEM - II
OF PET ANIMALS

Objective

Study of recent advances and research methodology related to infectious diseases of pet animals.

Theory

UNIT-I: Bacterial, viral and rickettsial diseases of pet animals.

UNIT-II: Fungal and parasitic diseases of pet animals.

Practical

Short term assignment with some research component pertaining to infectious diseases of pet animals.

Suggested Readings

Selected articles from journals.

VMD 709 ADVANCES IN DISEASES OF POULTRY 1+2 SEM - I

Objectives

Study of recent advances and research methodology related to diseases of poultry.

Theory

UNIT-I: Bacterial and viral diseases of poultry.

UNIT-II: Fungal, parasitic and miscellaneous diseases of poultry.

Practical

Short term assignment with some research component pertaining to diseases of poultry.

Suggested Readings

Selected articles from journals.

VMD 710 ADVANCES IN VETERINARY 1+2 SEM - II
DIAGNOSTICS

Objective

Study of recent advances in diagnostics of animal diseases.

Theory

UNIT-I: Blood and serum biochemical and hematological analyses.

UNIT-II: Imaging techniques for the diagnosis of animal diseases (x-ray, contrast radiography, CAT scan, MRI, scintigraphy, echocardiography etc).

UNIT-III: Electrocardiography, ophthalmoscopy, ultrasonography, EEG, CVP, GFR assessment, pulse-oxymetry etc.

Practical

Assignments on advanced diagnostic techniques for various diseases of domestic animals. Use of above mentioned advanced diagnostic techniques where ever possible. Collection of CSF, Gastric / rumen /intestinal fluid, absorption and digestion tests, hematological interpretations, enzyme and other biochemical profiles.

Suggested Readings

Selected articles from journals.


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VMD 711	ADVANCES IN VETERINARY THERAPEUTICS	1+2	SEM - I
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Objective

Study of recent advances in Veterinary therapeutics.

Theory

UNIT-I: Fluid and electrolyte imbalance and therapy.

UNIT-II: Antimicrobial, antineoplastic and hormonal therapy.

UNIT-III: Blood transfusion and emergency critical care, peritoneal dialysis/hemodialysis, gastric lavage, fluid therapy, parenteral total nutrition, nebulization, oxygen therapy, paracentesis, thoracocentesis.

Practical

Assignments on advanced therapeutic approaches in various diseases of domestic animals.

Suggested Readings

Selected articles from journals.

VMD 712	ADVANCED CLINICAL PRACTICE - I	0+2	SEM - I
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Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 713	ADVANCED CLINICAL PRACTICE - II	0+2	SEM - II
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Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This course will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 714	ADVANCED CLINICAL PRACTICE - III	0+2	SEM - I
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Objective

Application of the theoretical concepts in practice.

Practical

Diagnostic and therapeutic protocol application, specimen collection, examination and management of diseased farm and companion animals.

Note: This courses will be conducted in TVCC (College Clinics), where students shall participate in diagnosis and treatment of diseased animals.

VMD 790	SPECIAL PROBLEM	0+2	SEM - I, II
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Objective

A short-term project work on some aspect of etio-pathogenesis, diagnosis and therapy of diseases of domestic animals.


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Department of Veterinary Gynaecology and Obstetrics

Degree Programme: MVSc/PhD

Programme Outcomes (POs)

- PO1: Will equip students with theoretical and practical aspects of veterinary gynaecology, obstetrics and andrology
- PO2: Will help to create skilled scientific manpower in the animal reproduction
- PO3: Will help in implementation of genetic improvement programme through cutting edge reproductive technologies

Programme Specific Outcomes (PSOs)

- PSO1: Will ensure the availability of skilled manpower in the field of animal reproduction for research and clinical work in subject concerned
- PSO2: The course will equip the students with clinical expertise in the field of animal reproduction
- PSO3: This course will help to boost livestock profitability by increasing the reproductive efficiency
- PSO4: Will ensure productivity enhancement of livestock by implementation of advanced reproductive techniques like multiple ovulation and embryo transfer, OPU-IVF, animal cloning and transgenesis.

Masters Courses: (MVSc in Veterinary Gynaecology and Obstetrics)

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes (Bullet Points)
1	General Gynaecology	VOG 601	3+1	CO1: To learn about the various reproductive events CO2: To learn about the physiological and endocrinological mechanisms regulating animal reproduction
2	Female Infertility	VOG 602	3+1	CO1: To acquire knowledge about the clinical conditions affecting female reproductive tract CO2: To impart training on management of reproductive disorders affecting female animals
3	Veterinary Obstetrics	VOG 603	2+2	CO1: To study the conditions affecting peri-parturient period in farm and companion animals CO2: To impart clinical skill to address and handle obstetrical disorders

 
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4	Andrology & Male Infertility	VOG 604	3+1	CO1: To learn about the various reproductive events in male animals CO2: To learn about the physiological and endocrinological mechanisms regulating male reproduction CO3: To impart clinical expertise to handle male infertility
5	Semen Preservation and Artificial Insemination	VOG 605	2+1	CO1: To learn the technique of artificial insemination and its theoretical aspects CO2: To learn about techniques of semen collection, evaluation, processing and cryopreservation
6	Reproductive Biotechnology	VOG 606	2+1	CO1: To acquire knowledge about various reproductive biotechnologies CO2: To impart practical skills of multiple ovulation and embryo transfer, OPU-IVF, Cloning, stem cell culture, transgenesis etc.
7	Clinical Practice I	VOG 607	0+3	CO1: To learn pathology, diagnosis, clinical manifestation and treatment of various reproductive disorders CO2: To acquire hands on training on clinical management of reproductive disorders
8	Clinical Practice II	VOG 608	0+3	CO1: To learn pathology, diagnosis, clinical manifestation and treatment of various reproductive disorders CO2: To acquire hands on training on clinical management of reproductive disorders
9	Master's Seminar	VOG 691	1+0	CO1: To review the literature, documentation and presentation of topic pertaining to recent advances in animal reproduction
10	Master's Research	VOG 699	20	CO1: To learn about research designing, research methods and documentation of research findings in the form of thesis in the field of animal reproduction CO2: To inculcate research aptitude in the students


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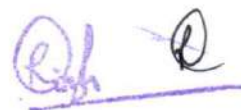
Doctoral Courses: (Ph.D. in Veterinary Gynaecology and Obstetrics)

S.N.	Course Title	Course No.	Cr. Hrs.	Course Outcomes
1	Advances in Gynaecology	VOG 701	2+1	CO1: To learn about the advances in various reproductive events and reproductive disorders CO2: To learn about advances in the physiological and endocrinological mechanisms regulating animal reproduction
2	Advances in Obstetrics	VOG 702	2+1	CO1: To study the conditions affecting peri-parturient period in farm and companion animals CO2: To impart clinical skill and advanced therapeutic protocols to address and handle obstetrical disorders
3	Advances in Andrology	VOG 703	2+1	CO1: To learn about advances in various reproductive events in male animals CO2: To learn about the physiological, cellular and endocrinological mechanisms regulating male reproduction Co3: To impart clinical expertise to handle male infertility
4	Advances in Reproductive Biotechnology	VOG 704	1+1	CO1: To acquire knowledge about various advances in reproductive biotechnologies CO2: To impart practical skills of multiple ovulation and embryo transfer, OPU-IVF, Cloning, stem cell culture, transgenesis etc.
5	Advances in Semen Preservation	VOG 705	1+1	CO1: To learn the physiological and biochemical aspects of semen of various farm and companion animal species CO2: To learn about advances in techniques of semen collection, evaluation, processing and cryopreservation
6	Clinical Practice I	VOG 706	0+3	CO1: To learn pathology, diagnosis, clinical manifestation and treatment of various reproductive disorders CO2: To acquire hands on training on clinical management of reproductive disorders
7	Clinical Practice II	VOG 707	0+3	CO1: To review the literature, documentation and presentation of topic pertaining to recent advances in animal reproduction
8	Special Problem	VOG 790	0+2	CO1: To learn about research designing, research methods and documentation of research findings in the form of thesis in the field of animal reproduction
9	Doctoral Seminar I	VOG 791	1+0	CO1: To review the literature, documentation and presentation of topic pertaining to recent advances in animal reproduction



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10	Doctoral Seminar II	VOG 792	1+0	CO1: To review the literature, documentation and presentation of topic pertaining to recent advances in animal reproduction
11	Doctoral Research	VOG 799	45	CO1: To learn about research designing, research methods and documentation of research findings in the form of thesis in the field of animal reproduction CO1: To inculcate research aptitude in the students



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Department of Agricultural Engineering

Course curriculum

M.Tech. Agricultural Engineering (Process and Food Engineering)

S. No.	Course No.	Course Title	Credit hours	Sub-total
Core Courses-major				
1.	PFE-506	Processing of Cereals, Pulses and oilseeds	3(2-0-1)	20
2.	PFE-508	Fruits and Vegetables Process Engineering	3(2-0-1)	
3.	PFE-503	Advanced Food Process Engineering	3(2-0-1)	
4.	PFE-512	Farm Structures and Environmental Control	2(1-0-1)	
5.	PFE 501	Transport Phenomena in Food Processing	3(2-0-1)	
6.	PFE-504	Unit Operation in Food Process Engineering	3(2-0-1)	
7.	PFE-502	Engineering Properties of Food Materials	3(2-0-1)	
Core courses- minor				
8.	FMPE 512	Agro-Energy Audit and Management	2(2+0)	09
9.	FMPE 513	Design and Analysis of Renewable Energy Conversion Systems	3(3+0)	
10.	FMPE 601	Advances in Farm Machinery and Power Engineering	4(3+1)	
Basic Supporting Courses				
11.	MCA-502	Introduction to Networking and Internet application	2(1-0-1)	06
12.	BPS 661	Experimental Statistics	4(3-0-1)	
Seminar				
13.	PFE-591	Master Seminar	1	01
Non-credit Compulsory courses				
14.	PGS-501	Library and information Services	1	06
15.	PGS-502	Technical writing and communication skills	1	
16.	PGS-503	Intellectual property and its management in agriculture	1	
17.	PGS-504	Basic concepts in laboratory techniques	1	
18.	PGS-505	Agriculture research, research ethics and rural development	1	
19.	PGS-506	Disaster Management	1	
Thesis Research				
20.	PFE-599	Master Research	20	20
Total				62



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Semester wise course curriculum

M.Tech. Agricultural Engineering (Process and Food Engineering)

Semester	Course code	Courses offered	Credit hr(s)
I	PFE-506	Processing of Cereals, Pulses and oilseeds	3(2-0-1)
	PFE-508	Fruits and Vegetables Process Engineering	3(2-0-1)
	FMPE 512	Agro-Energy Audit and Management	2(2-0-0)
	MCA-502	Introduction to Networking and Internet application	2(1-0-1)
	PGS-504	Basic concepts in laboratory techniques	1
	PGS-506	Disaster Management	1
	PGS-505	Agriculture research, research ethics and rural development	1
	PGS-501	Library and information Services	1
	PGS-503	Intellectual property and its management in agriculture	1
II	PFE-512	Farm Structures and Environmental Control	2(1-0-1)
	PFE 501	Transport Phenomena in Food Processing	3(2-0-1)
	PFE-503	Advanced Food Process Engineering	3(2-0-1)
	FMPE 513	Design and Analysis of Renewable Energy Conversion Systems	3(3-0-0)
	PGS-502	Technical writing and communication skills	1
III	PFE-502	Engineering Properties of Food Materials	3(2-0-1)
	FMPE 601	Advances in Farm Machinery and Power Engineering	4(3-0-1)
	BPS -661	Experimental Statistics	4(3-0-1)
	PFE-591	Seminar	1
	PFE-599	Master Research	5
IV	PFE-504	Unit Operations in Food Process Engineering	3(2-0-1)
	PFE-599	Master Research	15
		Total credits	62

Core course syllabus

PFE-501 Transport phenomena in food processing 3(2-0-1)


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UNIT I: Introduction to heat and mass transfer and their analogous behaviour, steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations, use of Gurnie-Lurie and Heisler Charts in solving heat conduction problems. Applications in food processing including freezing and thawing of foods.

UNIT II: Convective heat transfer in food processing systems involving laminar and turbulent flow heat transfer in boiling liquids, heat transfer between fluids and solid foods. Functional design of heat exchangers: Shell and tube, plate and scraped surface heat exchangers, Jacketed vessels.

UNIT III : Radiation heat transfer and its governing laws, its applications in food processing.

UNIT IV: Molecular diffusion in gases, liquids and solids; molecular diffusion in biological solutions and suspensions molecular diffusion in solids, unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing.

Practical: Solving problems on steady and unsteady state conduction with or without generation; numerical analysis; problems in natural and forced convection; radiation; design of heat exchangers; performing experiments on heat conduction, convection and radiation heat transfer.

PFE-502 Engineering properties of food materials

3(2-0-1)

UNIT I: Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; ASTM standard, terms, physical states of materials, classical ideal material, rheological models and equations, visco-elasticity, creep-stress relaxation, Non-Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behaviour.

UNIT II: Contact stresses between bodies, Hertz problems, firmness and hardness, mechanical damage, dead load and impact damage, vibration damage, friction, effect of load, sliding velocity, temperature, water film and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity.

UNIT III: Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, methods of determination, steady state and transient heat flow. Electrical properties; Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination, energy absorption from high- frequency electric field.

UNIT IV: Application of engineering properties in design and operation of agricultural equipment and structures.

Practical: Experiments for the determination of physical properties like, length, breadth, thickness, surface area, bulk density, porosity, true density, coefficient of friction, angle of repose and colour for various food grains, fruits, vegetables, spices and processed foods, aerodynamic properties like terminal velocity, lift and drag force for food grains, thermal properties like thermal conductivity, thermal diffusivity and specific heat, firmness and hardness of grain, fruits and stalk, electrical properties like dielectric constant, dielectric loss factor, loss tangent and A.C. conductivity of various food materials.

PFE-503 Advanced food process engineering

3(2-0-1)

UNIT I: **Thermal processing:** Death rate kinetics, thermal process calculations, methods of sterilization and equipments involved, latest trends in thermal processing. Evaporation: Properties of liquids, heat and mass balance in single effect and multiple effect evaporator, aroma recovery, equipments and applications. Drying: Rates, equipments for solid, liquid and semi-solid material and their applications, theories of drying, novel dehydration techniques.

UNIT II: **Non-thermal processing:** Microwave, irradiation, ohmic heating, pulsed electric field preservation, hydrostatic pressure technique etc.

UNIT III: **Freezing:** Freezing curves, thermodynamics, freezing time calculations, equipments, freeze drying, principle, equipments. Separation: Mechanical filtration, membrane separation, centrifugation, principles, equipments and applications, latest developments in separation and novel separation techniques.

UNIT IV: **Extrusion:** Theory, equipments, applications. Distillation and leaching: Phase equilibria, multistage calculations, equipments, solvent extraction.

Practical: Solving problems on single and multiple effect evaporator, distillation, crystallization, extraction, leaching, membrane separation and mixing, experiments on rotary flash evaporator, humidifiers, reverse osmosis and ultra filtration - design of plate and packed tower, visit to related food industry.

PFE-504 Unit operation in food process engineering

3(2-0-1)

UNIT I: Review of basic engineering mathematics; Units and dimensions; Mass and energy balance.

UNIT II: Principles of fluid flow, methods of heat transfer, heat exchangers and their designs.

UNIT III: Psychrometry, dehydration, EMC, Thermal processing operations; Evaporation, dehydration/drying, types of dryers, blanching, pasteurization, distillation, steam requirements in food processing.

UNIT IV: **Refrigeration principles and Food freezing.** Mechanical separation techniques, size separation equipments; Filtration, sieving, centrifugation, sedimentation. Material handling equipment, conveyors and elevators; Size reduction processes; Grinding and milling.

UNIT V: Homogenization; Mixing- mixers, kneaders and blenders. Extrusion. Membrane technology. Non-thermal processing techniques.

UNIT VI: **Food plant design:** Food plant hygiene- cleaning, sterilizing, waste disposal methods, engineering aspects of radiation processing. Food packaging: Function materials, technique, machinery and equipment.

Practical: Fluid flow properties, study of heat exchangers problems, application of psychrometric chart, determination of EMC, study of driers, elevating and conveying equipments, size reduction equipments, cleaning and sorting equipments, mixing equipments, sieve analysis, kinetics of fruits and vegetables dehydration, calculation of refrigeration load, food plant design, gas and water transmission rate, solving of numerical problems.

PFE-506 Processing of cereals, pulses and oil seeds 3(2-0-1)

UNIT I: **Production and utilization of cereals and pulses,** grain structure of major cereals, pulses and oilseeds and their milling fractions; grain quality standards and physico-chemical methods for evaluation of quality of flours.

 
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UNIT II: Pre-milling treatments and their effects on milling quality; parboiling and drying, conventional, modern and integrated rice milling operations; wheat roller flour milling; processes for milling of corn, oats, barley, gram, pulses, paddy and flour milling equipments.

UNIT III: Dal mills, handling and storage of by-products and their utilization. Storage of milled products, Expeller and solvent extraction processing, assessment of processed product quality.

UNIT IV: Packaging of processed products, design characteristics of milling equipments; selection, installation and their performance, BIS standards for various processed products.

Practical: Physical properties of cereals and pulses, raw and milled products quality evaluations; parboiling and drying; terminal velocities of grains and their fractions; study of paddy, wheat, pulses and oilseeds milling equipments; planning and layout of various milling plants, visit to related agro- processing industry.

PFE-508 Fruits and Vegetables Process Engineering 3(2-0-1)

UNIT I: Importance of post harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.

UNIT II: Harvesting and washing, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables.

UNIT III: Cold storage of fruits and vegetables, controlled atmosphere packaging of fruits and vegetables, gas composition, quality of storage.

UNIT IV: Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.

UNIT V: Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

Practical: Determination of size, shape, density, area-volume-mass relationship of fruits and vegetables, sugar-acid ratio of fruits, evaluation of washer, grader and packaging methods, experiments on drying of fruits and vegetables, controlled atmosphere storage and quality evaluation.

PFE-512 Farm structures and environmental control 2(1-0-1)

UNIT I: Thermodynamic properties of moist air, psychrometric chart and computer programmes for thermodynamic properties.

UNIT II: Farm structures, their design, constructional details and design of low cost structures. Heating, ventilating and exhaust systems, air distribution and air cleaning, combustion of fuels and equipment.

UNIT III: Drying and dehumidification system, air-water contact operations and evaporation, process and product air conditioning, energy efficient environmental control practices.

UNIT IV: Instruments and measurements; codes and standards.

Practical: Calculation of heating and cooling load; design calculation of moisture condensation in agricultural buildings; study of moisture migration behaviour in storage

bins; design aspect of cold storage.

Minor Package Syllabus

FMPE 512 Agro-Energy Audit and Management 2(2+0)

UNIT I: Energy resources on the farm: conventional and non-conventional forms of energy and their use. Heat equivalents and energy coefficients for different agricultural inputs and products. Pattern of energy consumption and their constraints in production of agriculture. Direct and indirect energy.

UNIT II: Energy audit of production agriculture, and rural living and scope of conservation.

UNIT III: Identification of energy efficient machinery systems, energy losses and their management. Energy analysis techniques and methods: energy balance, output and input ratio, resource utilization, conservation of energy sources.

UNIT IV: Energy conservation planning and practices. Energy forecasting, Energy economics, Energy pricing and incentives for energy conservation, factors effecting energy economics. Energy modelling.

Suggested Readings

- Kennedy WJ Jr. & Wayne C Turner. 1984. *Energy Management*. Prentice Hall.
- Pimental D. 1980. *Handbook of Energy Utilization in Agriculture*. CRC
- Fluck RC & Baird CD. 1984. *Agricultural Energetics*. AVI Publ.
- Rai GD. 1998. *Non-conventional Sources of Energy*. Khanna Publ.
- Twindal JW & Anthony D Wier 1986. *Renwable Energy Sources*. E & F.N. Spon Ltd.
- Verma SR, Mittal JP & Surendra Singh 1994. *Energy Management and Conservation in Agricultural Production and Food Processing*. USG Publ. & Distr., Ludhiana.

FMPE 513 Design and Analysis of Renewable Energy Conversion Systems 3(3+0)

UNIT I: Energy cycle of the earth; water flow and storage; ocean currents and tides. Energy heat flow and energy storage; photosynthesis and biomass; renewable energy sources.

UNIT II: Thermodynamics of energy conversion; conversion of solar energy, wind energy, water flows, heat, biomass, etc.; other conversion processes.

UNIT III: Development and use of biogas, alcohols and plant oils, plant oil esters in I.C. engines. Study of various parameters for measuring the performance of the output.

UNIT IV: Design of bio-fuel production units: design of gasifiers, gas flow rates, biogas plants. Establishment of esterification plant, fuel blending.

Suggested Readings

- Boyle Godfrey. 1996. *Renewable Energy: Power for Sustainable Future*. Oxford Univ. Press.
- Culp AW. 1991. *Principles of Energy Conservation*. Tata McGraw Hill.
- Duffle JA & Beckman WA. 1991. *Solar Engineering of Thermal Processes*. John Wiley.


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- Garg HP & Prakash J.1997. *Solar Energy - Fundamental and Application*. Tata McGraw Hill.
- Grewal NS, Ahluwalia S, Singh S & Singh G. 1997. *Hand Book of Biogas Technology. Solar Energy Fundamentals and Applications*. TMH New Delhi.
- Mittal KM. 1985. *Biomass Systems: Principles & Applications*. New Age International.

FMPE 601 Advances in Farm Machinery and Power Engineering

4(3+1)

Theory

UNIT I: Farm machinery system, its characteristics and evaluation. Identification of dynamic characteristics of related components of engine and agricultural machines. Mechanism of dynamic elements and analysis of forces, displacement and their equilibrium in machines.

UNIT II: Statement and formulation of design problems. Computer-aided design of mechanical power transmission systems. Half interval search method. Single and double-tie-rod steering systems, development of mathematical models and its computer-aided solutions.

UNIT III: Analysis of forces in tractor implement combinations under two and three dimensional conditions. Vibrations, transmissibility and effect of damping on various agricultural machine systems like engine, cutter-bar, straw walker, threshing cylinder and reaper-binder.

UNIT IV: Application of various vibration analysis methods. Tractor dynamics; development of the model. Checking, interpretation and statistical analysis of results.

Practical

Development of computer programs for Half interval search method. Single and double-tie-rod steering systems, Development of mathematical models and its computer aided solutions. Design problems using CAD.

Suggested Readings

- Bevan T. 1962. *The Theory of Machines*. Longman.
- Close CM, Fredrick DK & Newwell IC. 2001. *Modelling and Analysis of Dynamic System*. John Wiley & Sons.
- Franklin GF & Powell JD. 1980. *Digital Control of Dynamic System*. Addison Wesley Publ.
- Kepner RA, Bainer R & Berger EL. 1978. *Principles of Farm Machinery*. AVI Publ.
- Mabie HH & Ocrirk FW.1987. *Mechanism and Dynamics of Machinery*. John Wiley & Sons.
- Shigley JE & Uicker JJ .1980. *Theory of Machinery and Mechanism*. McGraw Hill.


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Non-Credits Course content

PGS 501 LIBRARY AND INFORMATION SERVICES

0+1

Objective: To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS

0+1

Objective: To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- *Collins' Cobuild English Dictionary*. 1995. Harper Collins.
- Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
- Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
- Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- Richard WS. 1969. *Technical Writing*. Barnes & Noble.
- Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
- Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
- Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.


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**PGS 503 INTELLECTUAL PROPERTY AND ITS
(e-Course) MANAGEMENT IN AGRICULTURE**

1+0

Objective: The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory: Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbis FH & Maredia K.1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES

0+1

Objective: To acquaint the students about the basics of commonly used techniques in laboratory.

Practical: Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vascupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings


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- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 505 **AGRICULTURAL RESEARCH, RESEARCH ETHICS** **1+0**
(e-Course) AND RURAL DEVELOPMENT PROGRAMMES

Objective: To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I: History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II: Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III: Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia MS. *Manual on International Research and Research Ethics*. CCS,
- Haryana Agricultural University, Hisar.
- Rao BSV. 2007. *Rural Development Strategies and Role of Institutions -Issues, Innovations and Initiatives*. Mittal Publ.
- Singh K.. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

PGS 506 **DISASTER MANAGEMENT** **1+0**
(e-Course)

Objective: To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion


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UNIT II: Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III: Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

Dr. Suresh Chandra

Associate Professor

Deptt. of Agric. Engg.

Dated of prepared; 25.07.2022

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Department of Agricultural Engineering

Course Curriculum

Degree: Ph.D. Agricultural Engineering (Process and Food Engineering)

S. No.	Course No.	Course Title	Credit hrs	Sub total
(A) Core Courses-major				
1	PFE-513	Storage Engineering and Handling of Agricultural Products	3(2-0-1)	15
2	PFE - 601	Textural and Rheological Characteristics of Food materials	3(2-0-1)	
3	PFE - 602	Advances in Food Processing	3(2-0-1)	
4	PFE - 604	Advances in Drying of Food Materials	3(2-0-1)	
5	PFE-605	Agricultural Waste and By-Products Utilization	3(2-0-1)	
(B) Core courses- minor				
6	FMPE 503	Testing and Evaluation of Tractors and Farm Equipments	3(2-0-1)	08
7	FMPE 510	Ergonomics and Safety in Farm Operations	3(2-0-1)	
8	FMPE 603	Energy Conservation and Management in Farm Machinery and Power Engineering	2(2-0-0)	
(C) Basic Supporting Courses				
9	STAT-512	Experimental Designs	3(2-0-1)	06
10	STAT 513	Statistical Methods for Social Sciences	3(2-0-1)	
(D) Non credits compulsory Courses				
11	PGS-501	Library And Information Service	1(0-0-1)	06
12	PGS-502	Technical writing and communication skills	1(0-0-1)	
13	PGS-503	Intellectual property and its management in agriculture	1(1-0-0)	
14	PGS-504	Basic concepts in laboratory techniques	1(0-0-1)	
15	PGS-505	Agricultural research, research ethics and rural development	1(1-0-0)	
16	PGS-506	Disaster management	1(1-0-0)	
(E) Seminar				
17	PFE-691	Doctoral Seminar -I	1	02
18	PFE-692	Doctoral Seminar – II	1	
(F) Thesis Research				
19	PFE-699	Doctoral Research	45	45
TOTAL (Credit Hours)				82


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New course implemented July 2021-22.

Ph.D. Agricultural Engineering (Process and Food Engineering) degree program

Semester	Course code	Courses offered	Credit hr (s)
I	PFE 513	Storage Engineering and Handling of Agricultural Products	3(2-0-1)
	PFE 605	Agricultural Waste and Byproduct Utilization	3(2-0-1)
	STAT 512	Experimental Design	3(2-0-1)
	FMPE 603	Energy Conservation and Management in Farm Machinery and Power Engineering	2(2-0-0)
	PGS-504	Basic concepts in laboratory techniques	1
	PGS-506	Disaster Management	1
	PGS-505	Agriculture research, research ethics and rural development	1
	PGS-501	Library and information Services	1
	PGS-503	Intellectual property and its management in agriculture	1
II	PFE 604	Advances in Drying of Food Materials	3(2-0-1)
	PFE 601	Textural and Rheological characteristics of Food Materials	3(2-0-1)
	FMPE 503	Testing and Evaluation of Tractors and Farm Equipment	3(2-0-1)
	FMPE 510	Ergonomics and Safety in Farm Operations	3(2-0-1)
	PGS-502	Technical writing and communication skills	1
III	PFE 602	Advances in Food Processing	3(3-0-0)
	STAT 513	Statistical Methods for Social Sciences	3(2-0-1)
IV	PFE 691	Doctoral Seminar I	1
	PFE 699	Doctoral Research	15
V	PFE 692	Doctoral Seminar II	1
	PFE 699	Doctoral Research	15
VI	PFE 699	Doctoral Research	15
Total Credits			82

Course Content (Ph.D.) Agric. Engg.

Core Courses-major syllabus

PFE-513: Storage Engineering and Handling of Agricultural Products 3(2-0-1)

UNIT I: Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements.

UNIT II: Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system.

UNIT III: Grain markets, cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation, BIS standards.


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UNIT IV: Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators; principles of fluidization; recent advances in handling of food materials.

Practical: Quality evaluation of stored products, design of storage structures, cold storage, load estimation, construction, maintenance, static pressure drop, experiment on controlled and modified atmosphere storage system, estimation of storage loss, and quality of stored products.

PFE – 601 Textural and Rheological Characteristics of Food materials

3(2-0-

1)

UNIT I: Texture classification. Relation of food texture with structure and rheology. Principles and practices of objective texture measurements, viscosity measurements.

UNIT II: Sensory methods of texture and viscosity measurements and their correlation. Rheological properties of foods.

UNIT III: Mathematical models and their application along with pipe line design and pump selection for non-Newtonian fluids. Recent advances in textural, rheological and viscoelastic characteristics of foods and their associated mathematical models.

Practical: Determination of viscosity of liquid foods, guminess, chewiness, springiness and hardness of various fruits, vegetables and processed foods using texture profile analysis. Determination of force-distance relationship. Sensory evaluation/ subjective measurement and correlation between subjective and objective measurements of foods.

PFE – 602 Advances in Food Processing

3(3-0-

0)

UNIT I: Preservation of foods – physical and chemical methods-microbiological aspects thermo bacteriology, process calculation and selection.

UNIT II: Low temperature preservation - cooling and cold storage – freeze concentration and membrane separation process - hurdle technology - principles and applications - food irradiation - advantages and applications, microwave processing - interaction with food materials- microwave equipment - hydrostatic pressure treatment of food - equipment, processing and effect on microorganisms.

UNIT III: Application of heat energy and ultrasound - inactivation of microorganisms and enzymes -electrical resistance heating of food - heat generation, ohmic heater, heating models - pulsed electric field preservation- principles and application - influence on microorganisms and food ingredients - decontamination of microorganisms by surface treatment.

UNIT IV: Extrusion cooking - recent developments, methods, equipment, design criteria of extruders.

PFE – 604 Advances in Drying of Food Materials

3(2-0-

1)

UNIT I: Importance of drying, principles of drying, moisture determination, equilibrium moisture content, determination of EMC, methods and isotherm models, psychrometry, psychrometric terms, construction and use of psychrometric charts.

UNIT II: Air flow and resistance, principles and equipments for air movement and heating, drying methods and theory of drying, driers, classification and other allied


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equipment, thin layer drying of cereal grains, deep bed and continuous flow drying, drying models.

UNIT III: Heat requirements and thermal efficiency of drying system, aeration, tempering and dehydration, operation of driers and their controls, selection of driers, performance testing of grain driers, drying characteristics of cereals, pulses and oilseeds, microwave drying, radio frequency drying and tunnel drying, principles and equipment.

UNIT IV: Drying of liquid foods, spray drying, drum drying, freeze drying, foam mat drying, heat pump drying, osmotic dehydration; Principles, methods, construction and adjustments, selection of dryers, heat utilization factor and thermal efficiency.

Practical: Experiments on batch type thin layer drier, fluidized bed drier, continuous flow mixing type drier, continuous flow non mixing type drier, sand medium drier (conduction type drying), agricultural waste fired furnace drier, spray dryer, drum dryer, foam mat drying and osmotic dehydration, to evaluate the thermal efficiency and heat utilization factor.

PFE-605 Agricultural Waste and By-Products Utilization

3(2-0-1)

UNIT I: Generation of by-products, agricultural and agro industrial byproducts/wastes, properties, on site handling, storage and processing.

UNIT II: Collection of wastes, utilization pattern as fuel, agricultural waste fired furnaces: Mechanism, construction and efficiency, suitability of wastes as fuel, fuel briquettes, briquetting process, equipment, factors affecting briquetting.

UNIT III: Utilization of wastes for paper production, production of particle board, utilization, by-products from rice mill, rice husk, rice bran, utilization.

UNIT IV: Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process.

Practical: Exercises on stepped grate and fixed grate rice husk furnaces, waste fired furnace, briquette machine, production of alcohol from waste materials, production and testing of paperboards and particleboards from agricultural wastes.

Core courses- minor

from Farm Machinery and Power Engg.

FMPE 503 Testing and Evaluation of Tractors and Farm Equipment 3(2+1)

Theory

UNIT I: Types of tests; test procedure, national and international codes.

UNIT II: Test equipment; usage and limitations. Power losses in dynamometers and hydraulic test equipment.

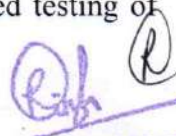
UNIT III: Prototype feasibility testing and field evaluation. Laboratory and field testing of selected farm equipment. Non-destructive testing techniques.

UNIT IV: Tractor performance testing, evaluation and interpretation of results.

UNIT V: Review and interpretation of test reports. Case studies.

Practical

- Laboratory and field testing of selected farm equipment. Interpretation and reporting of test results. Material testing and its chemical composition. Accelerated testing of fast wearing components. Non-destructive testing techniques.


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Suggested Readings

- Anonymous. 1983. *RNAM Test Code & Procedures for Farm Machinery*. Technical Series 12.
- Barger EL, Liljedahl JB & McKibben EC. 1967. *Tractors and their Power Units*. Wiley Eastern.
- *Indian Standard Codes for Agril. Implements*. Published by ISI, New Delhi.
- Inns FM. 1986. *Selection, Testing and Evaluation of Agricultural Machines and Equipment*. FAO Service Bull. No. 115.
- Lal R & Dutta PC. 1979. *Agricultural Engineering* (through solve examples). Saroj Parkashan,
- Metha ML, Verma SR, Mishra SK & Sharma VK. 1995. *Testing and Evaluation of Agricultural Machinery*. National Agricultural Technology Information Centre, Ludhiana.
- Nebraska Tractor Test Code for Testing Tractor, Nebraska, USA.
- Smith DW, Sims BG & O'Neill D H. 2001. *Testing and Evaluation of Agricultural Machinery and Equipment - Principle and Practice*.
- FAO Agricultural Services Bull. 110.

FMPE 510 Ergonomics and Safety in Farm Operations

3

(2+1)

Theory

UNIT I: Concept and design criteria for optimum mutual adjustment of man and his work: Importance of ergonomics and its application in agriculture, liberation and transfer of energy in human body, concept of indirect calorimeter, work physiology in various agricultural tasks.

UNIT II: Physiological stress indices and their methods of measurement: Mechanical efficiency of work, fatigue and shift work.

UNIT III: Anthropometry and Biomechanics: Anthropometric data and measurement techniques, joint movement and method of measurement, analysis and application of anthropometric data, measurement of physical and mental capacities.

UNIT IV: Human limitations in relation to stresses and demands of working environments. Mechanical environment; noise and vibration and their physiological effects, thermal environment; heat stress, thermal comfort, effect on performance and behavior, field of vision, color discrimination, general guidelines for designing visual display, safety standards at work

place during various farm operations and natural hazards on the farm. Farm safety legislation.

UNIT V: Man-machine system concept. Human factors in adjustment of man and his work. Design aspects of foot and hand controls on tractors and farm equipment. Design of operator's seat for tractors and agricultural equipment.

Practical

Laboratory experiments on measurement of physical and mental capacities and limitations of human-being in relation to the stress and environment, anthropometric measurements, study of human response to dust, noise and vibrations, case studies on ergonomics.

Suggested Readings

- Bridger RS. 1995. *Introduction to Ergonomics*. McGraw Hill.
- Charles D Reese. 2001. *Accident / Incident Prevention Techniques*. Taylor & Francis.
- Gavriel Salvendy. 1997. *Hand Book of Human Factors and Ergonomics*. John Wiley & Sons.


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- Kromer KHE. 2001. *Ergonomics*. Prentice Hall.

FMPE 603 Energy Conservation and Management in Farm Power and Machinery 2(2+0)

Theory

UNIT I: Energy requirement of different operations in agricultural production systems viz. crop, livestock and aquaculture.

UNIT II: Energy conservation through proper management and maintenance of farm machinery, planning and management of agricultural production systems for energy conservation and energy returns assessment.

UNIT III: Development of computer program for efficient energy management in a given agricultural production system. Energy use planning and forecasting for a given system.

Suggested Readings

- Mittal JP, Panesar BS, Singh S, Singh CP & Mannan KD. 1987. *Energy in Production Agriculture and Food Processing*. ISAE and School of Energy Studies, Ludhiana. ISAE Publ.
- Pimental D. 1980. *Handbook of Energy Utilization in Agriculture*. CRC Press.
- Mathews J & Knight AA. 1971. *Ergonomics in Agricultural Design*.
- National Institute of Agric. Engineering, Wrest Park Silsoe, Bedford.
- Mathews J Sanders, Cormicks MS & MCEj. 1976. *Human Factors in Engineering and Design*. 4th Ed. McGraw Hill.
- William D McArdle. 1991. *Exercise Physiology*. 1991. Lea & Febiger.
- Zander J. 1972. *Principles of Ergonomics*. Elsevier.
- Zander J. 1972. *Ergonomics in Machine Design*. Elsevier.

Non-Credits Course content

PGS 501 LIBRARY AND INFORMATION SERVICES

0+1

Objective: To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical: Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS

0+1

Objective: To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical


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Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- *Collins' Cobuild English Dictionary*. 1995. Harper Collins.
- Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
- Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
- Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- Richard WS. 1969. *Technical Writing*. Barnes & Noble.
- Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
- Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.

PGS 503 INTELLECTUAL PROPERTY AND ITS (e-Course) MANAGEMENT IN AGRICULTURE

1+0

Objective: The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory: Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbis FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.


REGISTRAR
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- *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABL.
- Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective: To acquaint the students about the basics of commonly used techniques in laboratory.

Practical: Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

- Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS 1+0 (e-Course) AND RURAL DEVELOPMENT PROGRAMMES

Objective: To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I: History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II: Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III: Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural

Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia MS. *Manual on International Research and Research Ethics*. CCS,
- Haryana Agricultural University, Hisar.
- Rao BSV. 2007. *Rural Development Strategies and Role of Institutions -Issues, Innovations and Initiatives*. Mittal Publ.
- Singh K.. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

PGS 506

DISASTER MANAGEMENT (e-Course)

1+0

Objective: To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II: Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III: Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

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Associate Professor

Deptt. of Agric. Engg.

Dated of prepared; 25.07.2022


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Course Curriculum

Master's and Ph.D. Programme

(As per Fifth Deans' Committee recommendation report of ICAR)



COLLEGE OF HORTICULTURE

**Sardar Vallabhbhai Patel University of
Agriculture & Technology,
Meerut (UP)**


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FRUIT SCIENCE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
Master's Programme		
FSC 501*	TROPICAL AND DRY LAND FRUIT PRODUCTION	2+1
FSC 502*	SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION	2+1
FSC 503*	BIODIVERSITY AND CONSERVATION OF FRUIT CROPS	2+1
FSC 504	CANOPY MANAGEMENT IN FRUIT CROPS	1+1
FSC 505	PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS	2+1
FSC 506*	BREEDING OF FRUIT CROPS	2+1
FSC 507	POST HARVEST TECHNOLOGY FOR FRUIT CROPS	2+1
FSC 508	GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS	2+1
FSC 509	BIOTECHNOLOGY OF HORTICULTURAL CROPS	2+1
FSC 510	ORGANIC HORTICULTURE	1+1
FSC 511	PROTECTED CULTIVATION	2+1
FSC 512	GAP FOR HORTICULTURAL CROPS	1+0
FSC 513	CLIMATE MANAGEMENT IN HORTICULTURAL PRODUCTION	1+0
FSC 591	MASTER'S SEMINAR	1+0
FSC 599	MASTER'S RESEARCH	20
Ph.D. Programme		
FSC 601**	ADVANCES IN BREEDING OF FRUIT CROPS	2+1
FSC 602**	ADVANCES IN PRODUCTION OF FRUIT CROPS	2+1
FSC 603	ADVANCES IN GROWTH REGULATION OF FRUIT CROPS	2+1
FSC 604	GENOMICS AND BIOINFORMATICS IN HORTICULTURE	2+1
FSC 605	BIOTIC AND ABIOTIC STRESS MANAGEMENT IN HORTICULTURAL CROPS	2+1
FSC 691	DOCTORAL SEMINAR I	1+0
FSC 692	DOCTORAL SEMINAR II	1+0
FSC 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Doctoral programme


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 S.V.B.P.U.A.&T., MEERUT

FRUIT SCIENCE

Course Contents

FSC 501 TROPICAL AND DRY LAND FRUIT PRODUCTION 3 (2+1)

Objective

To impart basic knowledge about the importance and management of tropical and dry land fruits grown in India.

Theory

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators, abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, honeybees in cross pollination, physiological disorders- causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones(AEZ) and industrial supports.

Crops

UNIT I:	Mango and Banana
UNIT II:	Citrus and Papaya
UNIT III:	Guava, Sapota and Jackfruit
UNIT IV:	Pineapple, Annonas and Avocado
UNIT V:	Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to tropical and arid zone orchards, Project preparation for establishing commercial orchards.

Suggested Readings

- ❖ Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. Temperate Fruits - Horticulture. Allied Publ.
- ❖ Bose TK, Mitra SK & Sanyal D. 2001. (Eds.). Fruits -Tropical and Subtropical. Naya Udyog.
- ❖ Chadha KL & Pareek OP. 1996. (Eds.). Advances in Horticulture. Vols. II- IV. Malhotra Publ. House.
- ❖ Nakasone HY & Paul RE. 1998. Tropical Fruits. CABI.
- ❖ Peter KV. 2008. (Ed.). Basics of Horticulture. New India Publ. Agency. Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. Management of Horticultural Crops. Parts I, II. New India Publ. Agency.
- ❖ Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency.
- ❖ Singh HP, Negi JP & Samuel JC. (Eds.). 2002. *Approaches for Sustainable Development of Horticulture*. National Horticultural Board.
- ❖ Singh HP, Singh G, Samuel JC & Pathak RK. (Eds.). 2003. Precision Farming in Horticulture. NCPAH, DAC/PFDC, CISH, Lucknow.


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FSC 502
Objective

SUBTROPICAL AND TEMPERATE FRUIT PRODUCTION 3 (2+1)

To impart basic knowledge about the importance and management of subtropical and temperate fruits grown in India.

Theory

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation, abiotic factors limiting fruit production, physiology of flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I:	Apple, pear, quince, grapes
UNIT II:	Plums, peach, apricot, cherries, hazelnut
UNIT III:	Litchi, loquat, persimmon, kiwifruit, strawberry
UNIT IV:	Nuts- walnut, almond, pistachio, pecan
UNIT V:	Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan, pomegranate

Practical

Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to tropical, subtropical, humid tropical and temperate orchards, Project preparation for establishing commercial orchards.

Suggested Readings

- ❖ Bose TK, Mitra SK & Sanyal D. (Ed.). 2002. Fruits of India – Tropical and Sub-tropical. 3rd Ed. Vols. I, II. Naya Udyog.
- ❖ Chadha KL & Pareek OP. 1996. (Eds.). Advances in Horticulture. Vol. I. Malhotra Publ. House.
- ❖ Chadha KL & Shikhamany SD. 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House.
- ❖ Janick J & Moore JN. 1996. Fruit Breeding. Vols.I-III. John Wiley & Sons. Nijjar GS. 1977. (Eds.). Fruit Breeding in India. Oxford & IBH.
- ❖ Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency.
- ❖ Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. Advances in Citriculture. Jagminder Book Agency.

FSC 503
Objective

BIODIVERSITY AND CONSERVATION OF FRUIT CROPS

3 (2+1)

Understanding the principles of biodiversity and strategies in germplasm conservation of fruit crops.

Theory

UNIT I

Biodiversity and conservation; issues and goals, centers of origin of cultivated fruits; primary and secondary centers of genetic diversity.


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UNIT II

Present status of gene centers; exploration and collection of germplasm; conservation of genetic resources – conservation *in situ* and *ex situ*.

UNIT III

Germplasm conservation- problem of recalcitrancy - cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine.

UNIT IV

Intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group.

UNIT V

GIS and documentation of local biodiversity, Geographical indication.

Crops

Mango, sapota, citrus, guava, banana, papaya, grapes, jackfruit, custard, apple, ber, aonla, malus, *Prunus* sp, litchi, nuts, coffee, tea, rubber, cashew, coconut, cocoa, palmyrah, arecanut, oil palm and betelvine.

Practical

Documentation of germplasm – maintenance of passport data and other records of accessions; field exploration trips, exercise on *ex situ* conservation – cold storage, pollen/seed storage, cryopreservation, visits to National Gene Bank and other centers of PGR activities. Detection of genetic constitution of germplasm, core sampling, germplasm characterization using molecular techniques.

Suggested Readings

- ❖ Frankel OH & Hawkes JG. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press.
- ❖ Peter KV & Abraham Z. 2007. Biodiversity in Horticultural Crops. Vol. I. Daya Publ. House.
- ❖ Peter KV. 2008. Biodiversity of Horticultural Crops. Vol. II. Daya Publ. House.

FSC 504 CANOPY MANAGEMENT IN FRUIT CROPS 2 (1+1)

Objective

To impart knowledge about the principles and practices in canopy management of fruit crops.

Theory

UNIT I

Canopy management - importance and advantages; factors affecting canopy development.

UNIT II

Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies.

UNIT III

Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

UNIT IV

Canopy management through plant growth inhibitors, training and pruning and management practices.

UNIT V

Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practical

Study of different types of canopies, training of plants for different canopy types, canopy development through pruning, use of plant growth inhibitors, geometry of planting; study on effect of different canopy types on production and quality of fruits.

Suggested Readings

- ❖ Chadha KL & Shikhamany SD. 1999. The Grape, Improvement, Production and Post Harvest Management. Malhotra Publ. House.
- ❖ Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. Management of Horticultural Crops. New India Publ. Agency.

FSC 505 PROPAGATION AND NURSERY MANAGEMENT FOR FRUIT CROPS 3 (2+1)

Objective

Familiarization with principles and practices of propagation and nursery management for fruit crops.

Theory

UNIT I

Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.

UNIT II

Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods.

UNIT III

Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship – Incompatibility. Rejuvenation through top working – Progeny orchard and scion bank.

UNIT IV

Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques - *in vitro* clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture. Hardening, packing and transport of micro-propagules.

UNIT V

Nursery – types, structures, components, planning and layout. Nursery management practices for healthy propagule production.

Practical

Anatomical studies in rooting of cutting and graft union, construction of propagation structures, study of media and PGR. Hardening – case studies, micropropagation, explant preparation, media preparation, culturing – *in vitro* clonal propagation, meristem culture, shoot tip culture, axillary bud culture, direct organogenesis, direct and indirect embryogenesis, micro grafting, hardening. Visit to TC labs and nurseries.

Suggested Readings

- ❖ Hartmann HT & Kester DE. 1989. Plant Propagation – Principles and Practices. Prentice Hall of India.
- ❖ Bose TK, Mitra SK & Sadhu MK. 1991. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prakash.
- ❖ Peter KV. (Ed.). 2008. Basics of Horticulture. New India Publ. Agency. Singh SP. 1989. Mist Propagation. Metropolitan Book Co.
- ❖ Rajan S & Baby LM. 2007. Propagation of Horticultural Crops. New India Publ. Agency.
- ❖ Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency.

FSC 506 Objective

BREEDING OF FRUIT CROPS

3 (2+1)

To impart comprehensive knowledge about the principles and practices of breeding of fruit crops.

Theory

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops

- UNIT I : Mango, banana and pineapple
UNIT II : Citrus, grapes, guava and sapota
UNIT III : Jackfruit, papaya, custard apple, aonla, avocado and ber
UNIT IV : Mangosteen, litchi, jamun, phalsa, mulberry, raspberry, kokam and nuts
UNIT V : Apple, pear, plums, peach, apricot, cherries and strawberry

Practical

Characterization of germplasm, blossom biology, study of anthesis, estimating fertility status, practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for resistance, developing breeding programme for specific traits, visit to research stations working on tropical, subtropical and temperate fruit improvement

Suggested Readings

- ❖ Bose TK, Mitra SK & Sanyal D. (Eds.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.
- ❖ Chadha KL & Pareek OP. 1996. (Eds.). *Advances in Horticulture*. Vol. I. Malhotra Publ. House.
- ❖ Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.
- ❖ Janick J & Moore JN. 1996. *Fruit Breeding*. Vols. I-III. John Wiley & Sons. Nijjar GS. 1977. (Eds.). *Fruit Breeding in India*. Oxford & IBH.
- ❖ Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.
- ❖ Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*. Jagminder Book Agency.


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FSC 507
Objective

POST HARVEST TECHNOLOGY FOR FRUIT CROPS 3(2+1)

To facilitate deeper understanding on principles and practices of post-harvest management of fruit crops.

Theory

UNIT I

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, and transpiration.

UNIT II

Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling.

UNIT III

Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage- ventilated, refrigerated, MAS, CA storage, physical injuries and disorders.

UNIT IV

Packing methods and transport, principles and methods of preservation, food processing, canning, fruit juices, beverages, pickles, jam, jellies, candies.

UNIT V

Dried and dehydrated products, nutritionally enriched products, fermented fruit beverages, packaging technology, processing waste management, food safety standards.

Practical

Analyzing maturity stages of commercially important horticultural crops, improved packing and storage of important horticultural commodities, physiological loss in weight of fruits and vegetables, estimation of transpiration, respiration rate, ethylene release and study of vase life extension in cut flower using chemicals, estimation of quality characteristics in stored fruits and vegetables, cold chain management - visit to cold storage and CA storage units, visit to fruit and vegetable processing units, project preparation, evaluation of processed horticultural products.

Suggested Readings

- ❖ Bhutani RC. 2003. *Fruit and Vegetable Preservation*. Biotech Books. Chadha KL & Pareek OP. (Eds.). 1996 *Advances in Horticulture*. Vol. IV. Malhotra Publ. House.
- ❖ Haid NF & Salunkhe SK. 1997. *Post Harvest Physiology and Handling of Fruits and Vegetables*. Grenada Publ.
- ❖ Mitra SK. 1997. *Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits*. CABI.
- ❖ Ranganna S. 1997. *Hand Book of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.
- ❖ Sudheer KP & Indira V. 2007. *Post Harvest Technology of Horticultural Crops*. New India Publ. Agency.
- ❖ Willis R, Mc Glassen WB, Graham D & Joyce D. 1998. *Post Harvest. An introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals*. CABI.


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Objective

To develop understanding of growth and development of horticultural crops which have implications in their management.

Theory**UNIT I**

Growth and development- definition, parameters of growth and development, growth dynamics, morphogenesis.

UNIT II

Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units, thermoperiodism.

UNIT III

Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors.

UNIT IV

Developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development.

UNIT V

Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

Practical

Understanding dormancy mechanisms in seeds, tubers and bulbs and stratification of seeds, tubers and bulbs, visit to arid, subtropical and temperate horticultural zones to identify growth and development patterns, techniques of growth analysis, evaluation of photosynthetic efficiency under different environments, study of growth regulator functions, hormone assays, understanding ripening phenomenon in fruits and vegetables, study of impact of physical manipulations on growth and development, study of chemical manipulations on growth and development, understanding stress impact on growth and development.

Suggested Readings

- ❖ Buchanan B, Gruissem W & Jones R. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley & Sons.
- ❖ Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. Wiley.
- ❖ Fosket DE. 1994. *Plant Growth and Development: a Molecular Approach*. Academic Press.
- ❖ Leopold AC & Kriedemann PE. 1985. *Plant Growth and Development*. 3rd Ed. McGraw-Hill.
- ❖ Peter KV. 2008. (Ed.) *Basics of Horticulture*. New India Publ. Agency.
- ❖ Roberts J, Downs S & Parker P. 2002. Plant Growth Development. In: *Plants* (I. Ridge, Ed.), pp. 221-274, Oxford University Press.
- ❖ Salisbury FB & Ross CW. 1992. *Plant Physiology*. 4th Ed. Wadsworth Publ.


REGISTRAR
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Understanding the principles, theoretical aspects and developing skills in biotechnology of horticultural crops.

Theory

UNIT I

Harnessing bio-technology in horticultural crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture.

UNIT II

Callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis.

UNIT III

Use of bioreactors and *in vitro* methods for production of secondary metabolites, suspension culture, nutrition of tissues and cells, regeneration of tissues, ex vitro, establishment of tissue cultured plants.

UNIT IV

Physiology of hardening - hardening and field transfer, organ culture – meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion.

UNIT V

Construction and identification of somatic hybrids and cybrids, wide hybridization, *in vitro* pollination and fertilization, haploids, *in vitro* mutation, artificial seeds, cryopreservation, rapid clonal propagation, genetic engineering in horticulture crops, use of molecular markers. *In vitro* selection for biotic and abiotic stress, achievements of biotechnology in horticultural crops.

Practical

An exposure to low cost, commercial and homestead tissue culture laboratories, media preparation, inoculation of explants for clonal propagation, callus induction and culture, regeneration of plantlets from callus, sub-culturing, techniques on anther, ovule, embryo culture, somaclonal variation, *in vitro* mutant selection against abiotic stress, protoplast culture, fusion technique, development of protocols for mass multiplication, project development for establishment of commercial tissue culture laboratory.

Suggested Readings

- ❖ Bajaj YPS. (Ed.).1989. *Biotechnology in Agriculture and Forestry*. Vol. V, *Fruits*. Springer.
- ❖ Brown TA. 2001. *Gene Cloning and DNA Analysis and Introduction*. Blackwell Publ.
- ❖ Chopra VL & Nasim A. 1990. *Genetic Engineering and Biotechnology – Concepts, Methods and Applications*. Oxford & IBH.
- ❖ Gorden H & Rubsell S. 1960. *Hormones and Cell Culture*. AB Book Publ.
- ❖ Keshavachandran R & Peter KV. 2008. *Plant Biotechnology: Tissue Culture and Gene Transfer*. Orient & Longman (Universal Press).
- ❖ Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. 2007. *Recent Trends in Biotechnology of Horticultural Crops*. Vols. I, II. New India Publ. Agency.
- ❖ Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. *Biotechnology of Horticultural Crops*. Vols. I-III. Naya Prokash.
- ❖ Pierik RLM. 1987. *In vitro Culture of Higher Plants*. Martinus Nijhoff Publ.
- ❖ Skoog F & Miller CO. 1957. *Chemical Regulation of Growth and Formation in Plant*

Tissue Culture in vitro. Symp. Soc. Exp. Biol. 11: 118-131

- ❖ Vasil TK, Vasi M, While DNR & Bery HR. 1979. *Somatic Hybridization and Genetic Manipulation in Plants. Plant Regulation and World Agriculture*. Planum Press.
- ❖ Williamson R. 1981-86. *Genetic Engineering*. Vols. I-V. Academic Press.

FSC 510
Objective

ORGANIC HORTICULTURE

2 (1+1)

To develop understanding of organic horticulture production system including GAP.

Theory

UNIT I

Organic horticulture – definition, synonyms and misnomers, principles, methods, merits and demerits.

UNIT II

Organic farming systems, components of organic horticultural systems, different **organic inputs**, their role in organic horticulture, role of biofertilizers, biodynamics and the recent developments.

UNIT III

EM technology and its impact in organic horticulture, indigenous practices of organic farming, sustainable soil fertility management, weed management practices in organic farming, biological/natural control of **pests and diseases**, organic horticulture in quality improvement.

UNIT IV

GAP - Principles and management, **HACCP** exercise, certification of organic products and systems, agencies involved at **national** and **international** levels, standards evolved by different agencies.

UNIT V

Constraints in certification, organic horticulture and export, **IFOAM** and **global scenario of organic movement**, post-harvest management of organic produce.

Practical

Features of organic orchards, working out conversion plan, Input analysis- manures, nutrient status assessment of **manures**, **biocomposting**, biofertilizers and their application, panchagavya preparation and other organic nutrients application, methods of preparation of **compost, vermicompost, green manuring, preparation of neem products** and application, BD preparations and their role, EM technology and products, biological/natural control of pests and diseases, soil solarization, frame work for **GAP**, case studies, **HACCP analysis**, residue analysis in organic products, documentation for certification, visit to fields cultivated under organic practices

Suggested Readings

- ❖ Claude A, Vandana S, Sultan I, Vijaya L, Korah M & Bernard D. 2000.
- ❖ *The Organic Farming Reader*. Other Indian Press, Goa.
- ❖ Gaur AC, Neblakantan S & Dargan KS. 1984 *Organic Manures*. ICAR.
- ❖ Lampkin N & Ipswich. 1990. *Organic Farming*. Farming Press. London.
- ❖ Lampkin NH & Padel S. 1992. *The Economics of Organic Farming – An International Perspective*. CABI.
- ❖ Palaniappan & Annadurai. 2008. *Organic Farming- Theory and Practise*. Scientific Publ.
- ❖ Peter KV. 2008. (Ed.). *Basics of Horticulture*. New India Publ. Agency. New Delhi.
- ❖ Rao S. 1977. *Soil Microorganism and Plant Growth*. Oxford & IBH.


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FSC 511
Objective

PROTECTED FRUIT CULTURE

3 (2+1)

Understanding the principles, theoretical aspects and developing skills in protected cultivation of fruit crops.

Theory

UNIT I

Greenhouse – World scenario, Indian situation: present and future, Different agro-climatic zones in India, Environmental factors and their effects on plant growth.

UNIT II

Basics of greenhouse design, different types of structures – glasshouse, shade net, poly tunnels - Design and development of low cost greenhouse structures.

UNIT III

Interaction of light, temperature, humidity, CO₂, water on crop regulation - Greenhouse heating, cooling, ventilation and shading.

UNIT IV

Types of ventilation- Forced cooling techniques - Glazing materials - Micro irrigation and Fertigation.

UNIT V

Automated greenhouses, microcontrollers, waste water recycling, Management of pest and diseases – IPM.

Practical

Designs of greenhouse, low cost poly tunnels, nethouse- Regulation of light, temperature, humidity in greenhouses, media, greenhouse cooling systems, ventilation systems, fertigation systems, special management practices, project preparation for greenhouses, visit to greenhouses.

Suggested Readings

- ❖ Aldrich RA & Bartok JW. 1994. *Green House Engineering*. NRAES, Riley, Robb Hall, Cornell University, Ithaca, New York.
- ❖ Bhattacharjee BS. 1959. *Rose Growing in Tropics*. Thackarspink & Co.
- ❖ Laurie A, Kiplinger DD & Nelson KS. 1968. *Commercial Flower Forcing*. McGraw-Hill.
- ❖ Mears DR, Kim MK & Roberts WJ. 1971. Structural Analysis at an Experimental Cable-supported Air Inflated Green Houses. Trans. ASAE.
- ❖ Pant V Nelson. 1991. *Green House Operation and Management*. Bali Publ.
- ❖ Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2007. *Management of Horticultural Crops*. Parts I, II. New India Publ. Agency.

FSC 512

GAP FOR HORTICULTURAL CROPS 1 (1+0)

Objective

To impart comprehensive knowledge about the principles and practices of Good Agricultural Practices (GAP) for horticultural crops.

Theory

UNIT I

Genesis of GAP – definition/description, components listed by FAO, frame work.

UNIT II

Management of site history and soil, crop and fodder production, IPM, INM, IWM, irrigation

water, crop production and protection. Identification of ways of improving the productivity profitability, and resource efficiency. Harvest and post-harvest handling.

UNIT III

Animal production, product certification, animal waste management, animal health and welfare, harvest.

UNIT IV

On farm processing, storage, energy and waste management, human health, welfare, safety, wild life benefits.

UNIT V

Institutions involved in GAP certification. Indian agencies, EUREPGAP (European Retail Producers Group- Good Agricultural Practices), EUREP etc.

Suggested Readings

- ❖ Peter KV. 2008. *Basics in Horticulture*. New India Publ. Agency.

FSC 513 CLIMATE MANAGEMENT IN HORTICULTURAL PRODUCTION 1 (1+0)

Objective

To develop understanding about the impact and management of climate in horticultural production.

Theory

UNIT I

Introduction to climate change. Factors directly connected to climate change, average temperature, change in rainfall amount and patterns, rising atmospheric concentrations of CO₂, pollution levels such as tropospheric ozone, change in climatic variability and extreme events like receding of glaciers in Himalayas.

UNIT II

Sensors for climate registration and crop monitoring, phytomonitoring and biosensors, plants response to the climate changes, premature bloom, marginally overwintering or inadequate winter chilling hours, insect pests, longer growing seasons and shifts in plant hardiness for perennial fruit crops, flowering plants and other plant species.

UNIT III

Impact of climate changes on invasive insect, disease, weed, pests, horticulture yield, quality and sustainability, climate management in field production – mulching - use of plastic-windbreak- spectral changes- frost protection. Climate management in greenhouse- heating - vents - CO₂ injection - screens - artificial light.

UNIT IV

Climate management for control of pests, diseases, quality, elongation of growth and other plant processes- closed production systems around the world. Special protected cultivation now and in the future, growth chambers, production in space, biosphere, future aspects of closed production, future greenhouse, use of LED as artificial light, future sensor types etc. clean development mechanism, role of tropical trees.

Suggested Readings

- ❖ Peter KV. 2008. (Ed.). *Basics of Horticulture*. New India Publ. Agency.
- ❖ Rao GSLHV, Rao GGSN, Rao VUM & Ramakrishnan YS. 2008. *Climate Change and Agriculture over India*. ICAR.
- ❖ Rao GSLHV. 2008. *Agricultural Meteorology*. Prentice Hall.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

FSC 601**ADVANCES IN BREEDING OF FRUIT CROPS****3 (2+1)****Theory**

Evolutionary mechanisms, adaptation and domestication, Genetic resources, cytogenetics, cytomorphology, chemotaxonomy, genetics of important traits and their inheritance pattern, variations and natural selection, spontaneous mutations, incompatibility systems in fruits, recent advances in crop improvement efforts- introduction and selection, chimeras, apomixis, clonal selections, intergeneric, interspecific and intervarietal hybridization, mutation and polyploid breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, molecular and transgenic approaches in improvement of selected fruit crops.

Crops

- UNIT I: Mango and banana
UNIT II: Papaya, grapes and citrus
UNIT III: Guava and sapota
UNIT IV: Pineapple and avocado
UNIT V: Apple, pear, plums, peaches, apricot, cherries and strawberry

Practical

Description and cataloguing of germplasm, pollen viability tests, pollen germination-isozyme techniques-survey and clonal selection, observations on pest, disease and stress reactions in inbreds and hybrids, use of mutagenes and colchicine for inducing mutation and ploidy changes, practices in different methods of breeding fruit crops and in-vitro breeding techniques.

Suggested Readings

- ❖ Bose TK, Mitra SK & Sanyal D. (Ed.). 2002. *Fruits of India – Tropical and Sub-tropical*. 3rd Ed. Vols. I, II. Naya Udyog.
- ❖ Chadha KL & Pareek OP. (Eds.). 1996. *Advances in Horticulture*. Vol. I. Malhotra Publ. House.
- ❖ Chadha KL & Shikhamany SD. 1999. *The Grape: Improvement, Production and Post-Harvest Management*. Malhotra Publ. House.
- ❖ Gowen S. 1996. *Banana and Plantains*. Chapman & Hall.
- ❖ Janick J & Moore JN. 1996. *Fruit Breeding*. Vols. I-III. John Wiley & Sons.
- ❖ Nijjar GS. (Ed.). 1977. *Fruit Breeding in India*. Oxford & IBH.
- ❖ Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.
- ❖ Singh S, Shivankar VJ, Srivastava AK & Singh IP. (Eds.). 2004. *Advances in Citriculture*. Jagminder Book Agency.
- ❖ Stover RH & Simmonds NW. 1991. *Bananas*. Longman.

FSC 602**ADVANCES IN PRODUCTION OF FRUIT CROPS****3 (2+1)****Objective**

To keep abreast with latest developments and trends in production technology of fruit crops.

Theory

National and International scenario in fruit production, Recent advances in propagation - root stock influence, planting systems, High density planting, crop modeling, Precision farming, decision support systems - aspects of crop regulation- physical and chemical regulation effects on physiology and development, influence of stress factors, strategies to overcome stress effects, integrated and modern approaches in water and nutrient management, Total quality management(TQM) - Current topics.

Crops

- UNIT I: Mango and banana
UNIT II: Papaya, grapes and citrus

REGISTRAR
S.V.B.P.U.A.&T., MEERUT

- UNIT III: Guava, sapota, pomegranate and aonla
 UNIT IV: Pineapple, avocado, jack fruit and fig
 UNIT V: Apple, pear, plums, strawberry, peach, apricot, cherries and nut crops

Practical

Survey of existing fruit cropping systems and development of a model cropping system, Estimating nutrient deficiency- estimation of water use efficiency, soil test-crop response correlations, practices in plant growth regulation, studying physiological and biochemical responses, quality analysis.

Suggested Readings

- ❖ Bose TK, Mitra SK & Rathore DS. (Eds.). 1988. *Temperate Fruits – Horticulture*. Allied Publ.
- ❖ Bose TK, Mitra SK & Sanyal D. (Eds.). 2001. *Fruits -Tropical and Subtropical*. Naya Udyog.
- ❖ Bose TK, Mitra SK, Farooqi AA & Sadhu MK. 1999. *Tropical Horticulture*. Vol. I. Naya Prokash.
- ❖ Chadha KL & Pareek OP. (Eds.).1996. *Advances in Horticulture*. Vols. II- IV. Malhotra Publishing House.
- ❖ Chadha KL. 2001. *Handbook of Horticulture*. ICAR.
- ❖ Nakasone HY & Paull RE. 1998. *Tropical Fruits*. CABI.
- ❖ Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency.

FSC 603 ADVANCES IN GROWTH REGULATION OF FRUIT CROPS 3 (2+1) Objective

Appraisal on the advances in growth regulation of fruit crops.

Theory

UNIT I

Ecophysiological influences on growth and development of fruit crops- flowering, fruit set- Crop load and assimilate partitioning and distribution.

UNIT II

Root and canopy regulation, study of plant growth regulators in fruit culture- structure, biosynthesis, metabolic and morphogenetic effects of different plant growth promoters and growth retardants.

UNIT III

Absorption, translocation and degradation of phytohormones – internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, canopy management for fertigated orchards.

UNIT IV

Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy, fruit bud initiation, regulation of flowering, off season production.

UNIT V

Flower drop and thinning, fruitset and development, fruit drop, parthenocarpy, fruit maturity and ripening and storage, molecular approaches in crop growth regulation- current topics.

Practical

Root- shoot studies, quantifying the physiological and biochemical effects of physical and chemical growth regulation, bioassay and isolation through chromatographic analysis for auxins, gibberellins, experiments on growth regulation during propagation, dormancy, flowering, fruit set and fruit development stages.

Suggested Readings

- ❖ Buchanan B, Gruissem W & Jones R. 2002. *Biochemistry & Molecular Biology of Plants*. John Wiley & Sons.
- ❖ Epstein E. 1972. *Mineral Nutrition of Plants: Principles and Perspectives*. Wiley.
- ❖ Fosket DE. 1994. *Plant Growth and Development: A Molecular Approach*. Academic Press.
- ❖ Leopold AC & Kriedemann PE. 1985. *Plant Growth and Development*. 3rd Ed. McGraw-Hill.
- ❖ Radha T & Mathew L. 2007. *Fruit Crops*. New India Publ. Agency. Roberts J, Downs S & Parker P. 2002. Plant Growth Development. In: *Plants* (I. Ridge, Ed.), pp. 221-274, Oxford University Press.
- ❖ Salisbury FB & Ross CW. 1992. *Plant Physiology*. 4th Ed. Wadsworth Publ.

FSC 604

GENOMICS AND BIOINFORMATICS IN HORTICULTURE 3 (2+1)

Objective

Studies on the fundamentals and application of genomics and bioinformatics in horticulture.

Theory

UNIT I

Primer on bioinformatics and computational genomics, database fundamentals – biological databases, horticultural genome and protein databases, functional genomics.

UNIT II

Dynamic Programming Sequence Alignment, BLAST search engine, FASTA search engine, Microarrays- Microarray Clustering and Classification, Terminologies and Ontologies - EcoCYC knowledge base of E. Coli metabolism - Description of UMLS Semantic Network.

UNIT III

Multiple Sequence Alignment, MSA algorithm descriptions, Clustal W, 1D Motifs, Algorithms and Databases, methods for sequence weighting, BLOCKS database, Making BLOCK motifs, PROSITE database, 3D structure alignment, SCOP, DALI, LOCK, MUSTA algorithm for geometric hashing and multiple alignment.

UNIT IV

Hidden Markov models, Molecular energetics and dynamics, Protein structure prediction, Genetic networks - Modeling and Simulation of Genetic Regulatory Systems- KEGG database of genes and gene pathways/networks - EcoCYC database of metabolic pathways in E. Coli - EGF-signal pathway modeling, Gene finding algorithms - Genome Annotation Assessment Project for Arabidopsis, Comparative genomics algorithms, Genome Alignment.

UNIT V

3D structure computations, NMR, X-ray Crystallography, NMR Structure Determination, X-ray Crystallography Structure Determination, Distance Geometry Description, RNA secondary structure, Molecular Modeling and Drug discovery programs.

UNIT VI

Phylogenetic algorithms - Treebase database of phylogenetic information for plants mostly, Tree of Life Page, Samples from the Tree of Life, Ribosomal Database Project, Natural Language Processing, Proteomics, 3D Motifs, Applications and Integration with Horticulture, Final Thoughts.

Practical

Computers, Operating systems and Programming languages, Internet Resources, Horticultural Genome and Protein Databases, BLAST/RNA Structure, Sequence Alignment, Microarray Data Analysis, Ontology, MSA, HMMs, Identification of Functional Sites in Structures.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Suggested Readings

- ❖ Attwood TK & Parry Smith DJ. 2006. *Introduction to Bioinformatics*. Pearson Edu.
- ❖ Baxevanis AD. 2005. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. 3rd Ed. Wiley.
- ❖ Bourne PE & Weissig H. (Eds.). 2004. *Structural Bioinformatics*. John Wiley & Sons.
- ❖ Durbin R, Eddy SR, Krogh A & Mitchison G. 1999. *Biological Sequence Analysis: Probabilistic Model of Proteins and Nucleic Acids*. Cambridge Univ. Press.
- ❖ Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. 2007. *Recent Trends in Biotechnology of Horticultural Crops*. Vols. I, II. New India Publ. Agency.
- ❖ Kohane IS, Kho A & Butte AJ. 2002. *Microarrays for an Integrative Genomics*. MIT Press.
- ❖ Mount DW. 2001. *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbour Laboratory Press.

FSC 605 BIOTIC AND ABIOTIC STRESS MANAGEMENT IN HORTICULTURAL CROPS 3 (2+1)

Objective

To update knowledge on the recent research trends in the field of biotic and abiotic stress management in horticultural crops.

Theory

UNIT I

Stress – definition, classification, stresses due to water (high and low), temperature (high and low), radiation, wind, soil conditions (salinity, alkalinity, ion toxicity, fertilizer toxicity, etc.).

UNIT II

Pollution - increased level of CO₂, industrial wastes, impact of stress in horticultural crop production, stress indices, physiological and biochemical factors associated with stress, **horticultural crops suitable for different stress situations**.

UNIT III

Crop modeling for stress situations, **cropping system**, assessing the stress through remote sensing, understanding adaptive features of crops for survival under stress, interaction among different stress and their impact on crop growth and productivity.

UNIT IV

Greenhouse effect and methane emission and its relevance to abiotic stresses, use of anti transpirants and **PGRs** in stress management, mode of action and practical use, HSP inducers in stress management techniques of soil moisture conservation, mulching, hydrophilic polymers.

UNIT V

Rain water harvesting, **increasing** water use efficiency, skimming technology, contingency planning to mitigate different stress situations, **cropping systems**, **stability** and sustainability indices.

Practical

Seed treatment /hardening practices, container seedling production, analysis of soil moisture estimates (FC, ASM, PWP), analysis of plant stress factors,


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

RWC, chlorophyll fluorescence, chlorophyll stability index, ABA content, plant waxes, stomatal diffusive resistance, transpiration, photosynthetic rate etc. under varied stress situations, influence of stress on growth and development of seedlings and roots, biological efficiencies, WUE, solar energy conversion and efficiency, crop growth sustainability indices, economics of stress management, visit to orchards and water shed locations.

Suggested Readings

- ❖ Blumm A. 1988. *Plant Breeding for Stress Environments*. CRC. Christiansen MN & Lewis CF. 1982. *Breeding Plants for Less Favourable Environments*. Wiley Inter. Science.
- ❖ Gupta US. 1990. *Physiological Aspects of Dry Farming*.
- ❖ Hsiao TC. 1973. Plant Responses to Water Stress. *Ann. Rev. Plant Physiology* 24: 519-570.
- ❖ Kramer PJ. 1980. Drought Stress and the Origin of Adaptation. In: *Adaptation of Plants to Water and High Temperature Stress*. John Wiley & Sons.
- ❖ Levitt J. 1972. *Response of Plants to Environmental Stresses*. Academic Press.
- ❖ Maloo SR. 2003. *Abiotic Stress and Crop Productivity*. Agrotech Publ. Academy.
- ❖ Mussell H & Staples R. 1979. *Stress Physiology in Crop Plants*. Wiley Inter. Science.
- ❖ Nickell LG. 1983. *Plant Growth Regulating Chemicals*. CRC.
- ❖ Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency.
- ❖ Turener NC & Kramer PJ. 1980. *Adaptation of Plants to Water and High Temperature Stress*. John Wiley & Sons.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

VEGETABLE SCIENCE
Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
MASTER'S Courses		
VSC 501*	PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS	2+1
VSC 502*	PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS	2+1
VSC 503*	BREEDING OF VEGETABLE CROPS	2+1
VSC 504*	GROWTH AND DEVELOPMENT OF VEGETABLE CROPS	2+1
VSC 505	SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS	2+1
VSC 506	SYSTEMATICS OF VEGETABLE CROPS	1+1
VSC 507	PRODUCTION TECHNOLOGY OF UNDEREXPLOITED VEGETABLE CROPS	1+1
VSC 508	ORGANIC VEGETABLE PRODUCTION TECHNOLOGY	1+1
VSC 509	FUNDAMENTALS OF PROCESSING OF VEGETABLES	1+1
VSC 591	MASTER'S SEMINAR	1+0
VSC 599	MASTER'S RESEARCH	20
Ph.D. Courses		
VSC 601**	ADVANCES IN VEGETABLE PRODUCTION	2+1
VSC 602**	ADVANCES IN BREEDING OF VEGETABLE CROPS	2+1
VSC 603**	PROTECTED CULTIVATION OF VEGETABLE CROPS	1+1
VSC 604**	BIOTECHNOLOGY OF VEGETABLE CROPS	2+1
VSC 605	SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS	1+1
VSC 606	ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS	2+1
VSC 691	DOCTORAL SEMINAR I	1+0
VSC 692	DOCTORAL SEMINAR II	1+0
VSC 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; **Compulsory for Doctoral programme


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

VEGETABLE SCIENCE

Course Contents

VSC 501 PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS 3 (2+1)

Objective: To educate production technology of cool season vegetables.

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of:

- UNIT I Potato
- UNIT II Cole crops: cabbage, cauliflower, knoll kohl, sprouting broccoli, Brussels sprout
- UNIT III Root crops: carrot, radish, turnip and beetroot
- UNIT IV Bulb crops: onion and garlic
- UNIT V Peas and broad bean, green leafy cool season vegetables

Practical

Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics; Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides; study of physiological disorders; preparation of cropping scheme for commercial farms; visit to commercial greenhouse/polyhouse.

Suggested Readings

- ❖ Bose TK & Som MG. (Eds.). 1986. *Vegetable Crops in India*. Naya Prokash.
- ❖ Bose TK, Som G & Kabir J. (Eds.). 2002. *Vegetable Crops*. Naya Prokash.
- ❖ Bose TK, Som MG & Kabir J. (Eds.). 1993. *Vegetable Crops*. Naya Prokash.
- ❖ Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.
- ❖ Chadha KL & Kalloo G. (Eds.). 1993-94. *Advances in Horticulture* Vols. V-X. Malhotra Publ. House.
- ❖ Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.
- ❖ Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad & Sons.
- ❖ Decoteau DR. 2000. *Vegetable Crops*. Prentice Hall.
- ❖ Edmond JB, Musser AM & Andrews FS. 1951. *Fundamentals of Horticulture*. Blakiston Co.
- ❖ Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
- ❖ Gopalakrishnan TR. 2007. *Vegetable Crops*. New India Publ. Agency.
- ❖ Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
- ❖ Rana MK. 2008. *Olericulture in India*. Kalyani Publ.
- ❖ Rana MK. 2008. *Scientific Cultivation of Vegetables*. Kalyani Publ.
- ❖ Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- ❖ Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. Aman Publ. House.

- ❖ Salunkhe DK & Kadam SS. (Ed.). 1998. Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker.
- ❖ Shanmugavelu KG. 1989. Production Technology of Vegetable Crops. Oxford & IBH.
- ❖ Singh DK. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.
- ❖ Singh SP. (Ed.). 1989. Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.
- ❖ Thamburaj S & Singh N. (Eds.). 2004. Vegetables, Tuber Crops and Spices. ICAR.
- ❖ Thompson HC & Kelly WC. (Eds.). 1978. Vegetable Crops. Tata McGraw- Hill.

VSC 502 PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS 3 (2+1)

Objective

To teach production technology of warm season vegetables.

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures, economics of crop production and seed production of:

UNIT I Tomato, eggplant, hot and sweet peppers

UNIT II Okra, beans, cowpea and clusterbean

UNIT III Cucurbitaceous crops

UNIT IV Tapioca and sweet potato

UNIT V Green leafy warm season vegetables

Practical

Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics; study of physiological disorders and deficiency of mineral elements, preparation of cropping schemes for commercial farms; experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substances and herbicides; seed extraction techniques; identification of important pests and diseases and their control; maturity standards; economics of warm season vegetable crops.

Suggested Readings

- ❖ Bose TK & Som MG. (Eds.). 1986. *Vegetable Crops in India*. Naya Prokash.
- ❖ Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.
- ❖ Bose TK, Som MG & Kabir J. (Eds.). 2002. *Vegetable Crops*. Naya Prokash.
- ❖ Brown HD & Hutchison CS. *Vegetable Science*. JB Lippincott Co.
- ❖ Chadha KL & Kalloo G. (Eds.). 1993-94. *Advances in Horticulture*. Vols. V-X. Malhotra Publ. House.
- ❖ Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.
- ❖ Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad & Sons.
- ❖ Decoteau DR. 2000. *Vegetable Crops*. Prentice Hall.
- ❖ Edmond JB, Musser AM & Andrews FS. 1964. *Fundamentals of Horticulture*. Blakiston Co
- ❖ Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops: Production Technology*. Vol. II. Kalyani.
- ❖ Gopalakrishanan TR. 2007. *Vegetable Crops*. New India Publ. Agency.

- ❖ Hazra P & Som MG. (Eds.). 1999. *Technology for Vegetable Production and Improvement*. Naya Prokash.
- ❖ Kalloo G & Singh K (Ed.). 2000. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
- ❖ Nayer NM & More TA 1998. *Cucurbits*. Oxford & IBH Publ.
- ❖ Palaniswamy & Peter KV. 2007. *Tuber Crops*. New India Publ. Agency.
- ❖ Pandey AK & Mudranalay V. (Eds.). *Vegetable Production in India: Important Varieties and Development Techniques*.
- ❖ Rana MK. 2008. *Olericulture in India*. Kalyani.
- ❖ Rana MK. 2008. *Scientific Cultivation of Vegetables*. Kalyani.
- ❖ Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- ❖ Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. Aman Publ. House.
- ❖ Salunkhe DK & Kadam SS. (Ed.). 1998. *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker.
- ❖ Shanmugavelu KG. 1989. *Production Technology of Vegetable Crops*. Oxford & IBH.
- ❖ Singh DK. 2007. *Modern Vegetable Varieties and Production Technology*. International Book Distributing Co.
- ❖ Singh NP, Bharadwaj AK, Kumar A & Singh KM. 2004. *Modern Technology on Vegetable Production*. International Book Distributing Co.
- ❖ Singh SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre.
- ❖ Thamburaj S & Singh N. 2004. *Vegetables, Tuber Crops and Spices*. ICAR.
- ❖ Thompson HC & Kelly WC. (Eds.). 1978. *Vegetable Crops*. Tata Mc Graw Hill.

VSC 503
Objective

BREEDING OF VEGETABLE CROPS

3 (2+1)

To educate principles and practices adopted for breeding of vegetable crops.

Theory

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act.

- UNIT I Potato and tomato
- UNIT II Eggplant, hot pepper, sweet pepper and okra
- UNIT III Peas and beans, amaranth, chenopods and lettuce
- UNIT IV Gourds, melons, pumpkins and squashes
- UNIT V Cabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca

Practical

Selection of desirable plants from breeding population observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations; induction of flowering, palanological studies, selfing and crossing techniques in vegetable crops; hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops, demonstration of sib-mating and mixed population; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

Suggested Readings

- ❖ Allard RW. 1999. Principles of Plant Breeding. John Wiley & Sons. Basset MJ. (Ed.). 1986. Breeding Vegetable Crops. AVI Publ.
- ❖ Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ. 2005. Plant Genetic Resources: Horticultural Crops. Narosa Publ. House.
- ❖ Fageria MS, Arya PS & Choudhary AK. 2000. Vegetable Crops: Breeding and Seed Production. Vol. I. Kalyani.
- ❖ Gardner EJ. 1975. Principles of Genetics. John Wiley & Sons.
- ❖ Hayes HK, Immer FR & Smith DC. 1955. Methods of Plant Breeding. McGraw-Hill.
- ❖ Hayward MD, Bosermark NO & Romagosa I. (Eds.). 1993. Plant Breeding- Principles and Prospects. Chapman & Hall.
- ❖ Kalloo G. 1988. Vegetable Breeding. Vols. I-III. CRC Press.
- ❖ Kalloo G. 1998. Vegetable Breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
- ❖ Kumar JC & Dhaliwal MS. 1990. Techniques of Developing Hybrids in Vegetable Crops. Agro Botanical Publ.
- ❖ Paroda RS & Kalloo G. (Eds.). 1995. Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Region. FAO.
- ❖ Peter KV & Pradeep Kumar T. 2008. Genetics and Breeding of Vegetables. Revised, ICAR.
- ❖ Rai N & Rai M. 2006. Heterosis Breeding in Vegetable Crops. New India Publ. Agency.
- ❖ Ram HH. 1998. Vegetable Breeding: Principles and Practices. Kalyani. Simmonds NW. 1978. Principles of Crop Improvement. Longman.
- ❖ Singh BD. 1983. Plant Breeding. Kalyani.
- ❖ Singh PK, Dasgupta SK & Tripathi SK. 2004. Hybrid Vegetable Development. International Book Distributing Co.
- ❖ Swarup V. 1976. Breeding Procedure for Cross-pollinated Vegetable Crops. ICAR.

VSC 504

GROWTH AND DEVELOPMENT OF VEGETABLE CROPS

3 (2+1)

Objective

To teach the physiology of growth and development of vegetable crops.

Theory

UNIT I

Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production.

UNIT II

Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

UNIT III

Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance.

UNIT IV

Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

UNIT V


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Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.

Practical

Preparation of solutions of plant growth substances and their application; experiments in breaking and induction of dormancy by chemicals; induction of parthenocarpy and fruit ripening; application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; growth analysis techniques in vegetable crops.

Suggested Readings

- ❖ Bleasdale JKA. 1984. *Plant Physiology in Relation to Horticulture*. 2nd Ed. MacMillan.
- ❖ Gupta US. (Ed.). 1978. *Crop Physiology*. Oxford & IBH.
- ❖ Krishnamoorti HN. 1981. *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-Mc Graw Hill.
- ❖ Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency. Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (Eds.). 2001. *Laboratory Manual of Analytical Techniques in Horticulture*. Agrobios.
- ❖ Wien HC. (Ed.). 1997. *The Physiology of Vegetable Crops*. CABI.

VSC 505 SEED PRODUCTION TECHNOLOGY OF VEGETABLE CROPS 3(2+1)

Objective

To educate principles and methods of quality seed and planting material production in vegetable crops.

Theory

UNIT I

Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed industry in India.

UNIT II

Genetical and agronomical principles of seed production; methods of seed production; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behavior, seed development and maturation; methods of hybrid seed production.

UNIT III

Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control.

UNIT VI

Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology.

UNIT V

Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, cole crops, bulb crops, leafy vegetables, okra, vegetatively propagated vegetables.

Practical

Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing; testing, releasing and notification procedures of varieties; floral biology; rouging of off-type; methods of hybrid seed production in important vegetable and spice crops; seed extraction techniques; handling of seed processing and seed testing equipments; seed sampling; testing of vegetable seeds for seed purity, germination, vigour and health; visit to seed processing units, seed testing laboratory and seed production farms.

Suggested Readings

- ❖ Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
- ❖ Agrawal RL. (Ed.). 1997. *Seed Technology*. Oxford & IBH.
- ❖ Bendell PE. (Ed.). 1998. *Seed Science and Technology: Indian Forestry Species*. Allied Publ.
- ❖ Fageria MS, Arya PS & Choudhary AK. 2000. *Vegetable Crops: Breeding and Seed Production*. Vol. I. Kalyani.
- ❖ George RAT. 1999. *Vegetable Seed Production*. 2nd Ed. CABI.
- ❖ Kumar JC & Dhaliwal MS. 1990. *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- ❖ More TA, Kale PB & Khule BW. 1996. *Vegetable Seed production Technology*. Maharashtra State Seed Corp.
- ❖ Rajan S & Baby L Markose. 2007. *Propagation of Horticultural Crops*. New India Publ. Agency.
- ❖ Singh NP, Singh DK, Singh YK & Kumar V. 2006. *Vegetable Seed Production Technology*. International Book Distributing Co.
- ❖ Singh SP. 2001. *Seed Production of Commercial Vegetables*. Agrotech Publ. Academy.

VSC 506 SYSTEMATICS OF VEGETABLE CROPS 2(1+1)

Objective

To teach morphological, cytological and molecular taxonomy of vegetable crops.

Theory

UNIT I

Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops.

UNIT II

Origin, history, evolution and distribution of vegetable crops, botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables.

UNIT III

Cytological level of various vegetable crops; descriptive keys for important vegetables.

UNIT IV

Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops.

Practical

Identification, description, classification and maintenance of vegetable species and varieties; survey, collection of allied species and genera locally available; preparation of keys to the species and varieties; methods of preparation of herbarium and specimens.

Suggested Readings

- ❖ Chopra GL. 1968. *Angiosperms - Systematics and Life Cycle*.
- ❖ S. Nagin, Dutta AC. 1986. *A Class Book of Botany*. Oxford Univ. Press. Pandey BP. 1999. *Taxonomy of Angiosperm*. S. Chand & Co.
- ❖ Peter KV & Pradeep Kumar T. 2008. *Genetics and Breeding of Vegetables*. (Revised), ICAR.
- ❖ Soule J. 1985. *Glossary for Horticultural Crops*. John Wiley & Sons.
- ❖ Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M & Dhillon BS. 2001. *Minimal Descriptors of Agri-Horticultural Crops*. Part-II: Vegetable Crops. NBPGR, New Delhi.
- ❖ Vasistha. 1998. *Taxonomy of Angiosperm*. Kalyani.

- ❖ Vincent ER & Yamaguchi M. 1997. World Vegetables. 2nd Ed. Chapman & Hall.

**VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITED
VEGETABLE CROPS 2(1+1)**

Objective

To educate production technology of underutilized vegetable crops.

Theory

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of:

- UNIT I Asparagus, artichoke and leek
- UNIT II Brussels's sprout, Chinese cabbage, broccoli, kale and artichoke.
- UNIT III Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu (chenopods) and chekurmanis.
- UNIT IV Elephant foot yam, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.
- UNIT V Sweet gourd, spine gourd, pointed gourd, Oriental pickling melon and little gourd (kundru).

Practical

Identification of seeds; botanical description of plants; layout and planting; cultural practices; short-term experiments of underexploited vegetables.

Suggested Readings

- ❖ Bhat K. L. 2001. *Minor Vegetables - Untapped Potential*. Kalyani.
- ❖ Indira P & Peter KV. 1984. *Unexploited Tropical Vegetables*. Kerala Agricultural University, Kerala.
- ❖ Peter KV. (Ed.). 2007-08. *Underutilized and Underexploited Horticultural Crops*. Vols. I-IV. New India Publ. Agency.
- ❖ Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall
- ❖ Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M & Dhillon BS. 2001. *Minimal Descriptors of Agri-Horticultural Crops. Part-II: Vegetable Crops*. NBPGR, New Delhi.

VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 2(1+1)

Objective

To educate principles, concepts and production of organic farming in vegetable crops.

Theory

UNIT I

Importance, principles, perspective, concept and component of organic production of vegetable crops.

UNIT II

Organic production of vegetables crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops.

UNIT III

Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT IV


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Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, Panchagavya, Biodynamics, preparation etc Pest and disease management in organic farming; **ITK's in organic farming**. Role of botanicals and bio-control agents.

UNIT V

GAP and GMP- **Certification of organic products**; organic production and export - opportunity and challenges.

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, water management, organic soil amendment for root disease, weed management in organic horticulture. **Visit to organic fields and marketing centers.**

Suggested Readings

- ❖ Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios.
- ❖ Gehlot G. 2005. Organic Farming; Standards, Accreditation Certification and Inspection. Agrobios.
- ❖ Palaniappan SP & Annadorai K. 2003. Organic Farming, Theory and Practice. Scientific Publ.
- ❖ Pradeep kumar T, Suma B, Jyothibhaskar & Satheesan KN. 2008. Management of Horticultural Crops. New India Publ. Agency.
- ❖ Shivashankar K. 1997. Food Security in Harmony with Nature. 3rd IFOAM- ASIA, Scientific Conf.. 1- 4 December, 1997, UAS, Bangalore.

VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 2 (1+1)

Objective

To educate principles and practices of processing of vegetable crops.

Theory

UNIT I

History of food preservation. Present status and future prospects of vegetable preservation industry in India.

UNIT II

Spoilage of fresh and processed horticultural produce; biochemical changes and enzymes associated with spoilage of horticultural produce; principal spoilage organisms, food poisoning and their control measures. Role of microorganisms in food preservation.

UNIT III

Raw materials for processing. Primary and minimal processing; processing equipments; Layout and establishment of processing industry, **FPO licence**. Importance of hygiene; Plant sanitation.

UNIT IV

Quality assurance and quality control, **TQM, GMP**. Food standards – **FPO, PFA, etc.** Food laws and regulations.

UNIT V

Food safety – **Hazard analysis and critical control points (HACCP)**. Labeling and labeling act, nutrition labeling.

UNIT VI

Major value added products from vegetables. Utilization of byproducts of vegetable processing industry; **Management of waste from processing factory.**


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UNIT VII

Investment analysis. Principles and methods of sensory evaluation of fresh and processed vegetables.

Practical

Study of machinery and equipments used in processing of horticultural produce; Chemical analysis for nutritive value of fresh and processed vegetables; Study of different types of spoilages in fresh as well as processed horticultural produce; Classification and identification of spoilage organisms; Study of biochemical changes and enzymes associated with spoilage; Laboratory examination of vegetable products; Sensory evaluation of fresh and processed vegetables; Study of food standards – National, international, CODEX Alimentarius; Visit to processing units to study the layout, equipments, hygiene, sanitation and residual / waste management.

Suggested Readings

- ❖ Arthey D & Dennis C. 1996. *Vegetable Processing*. Blackie/Springer- Verlag.
- ❖ Chadha DS. 2006. The Prevention of Food Adulteration Act. Confed. of Indian Industry.
- ❖ Desrosier NW. 1977. Elements and Technology. AVI Publ. Co. FAO. 1997. Fruit and Vegetable Processing. FAO.
- ❖ FAO. CODEX Alimentarius: Joint FAO/WHO Food Standards Programme. 2nd Ed. Vol. VB. Tropical Fresh Fruits and Vegetables. FAO.
- ❖ FAO. Food Quality and Safety Systems – Training Manual on Food Hygiene and HACCP. FAO.
- ❖ Fellow's P. 1988. Food Processing Technology. Ellis Horwood International.
- ❖ Frazier WC & Westhoff DC. 1995. Food Microbiology. 4th Ed. Tata McGraw Hill.
- ❖ Giridharilal GS, Siddappa & Tandon GL. 1986. Preservation of Fruits and Vegetables. ICAR.
- ❖ Gisela J. 1985. Sensory Evaluation of Food – Theory and Practices. Ellis Horwood.
- ❖ Graham HD. 1980. Safety of Foods. AVI Publ. Co.
- ❖ Hildegrade H & Lawless HT. 1997. Sensory Evaluation of Food. CBS. Joslyn M & Heid. Food Processing Operations. AVI Publ. Co.
- ❖ Mahindru SN. 2004. Food Safety: Concepts and Reality. APH Publ. Corp.
- ❖ Ranganna S. 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw Hill.
- ❖ Shapiro R. 1995. Nutrition Labeling Handbook. Marcel Dekker.
- ❖ Srivastava RP & Kumar S. 2003. Fruit and Vegetable Preservation: Principles and Practices. 3rd Ed. International Book Distri. Co.
- ❖ Tressler & Joslyn MA. 1971. Fruit and Vegetable Juice Processing Technology. AVI Publ. Co.
- ❖ Verma LR & Joshi VK. 2000. Post-harvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management. Indus Publ. Co.

VSC 601

ADVANCES IN VEGETABLE PRODUCTION 3 (2+1)

Objective

To keep abreast with latest developments and trends in production technology of vegetable crops.

Theory

Present status and prospects of vegetable cultivation; nutritional and medicinal values; climate


REGISTRAR
S.V.B.P.U.A.&T., MEEBUT

and soil as critical factors in vegetable production; choice of varieties; nursery management; modern concepts in water and weed management; physiological basis of growth, yield and quality as influenced by chemicals and growth regulators; role of organic manures, inorganic fertilizers, micronutrients and biofertilizers; response of genotypes to low and high nutrient management, nutritional deficiencies, disorders and correction methods; different cropping systems; mulching; containerized culture for year round vegetable production; low cost polyhouse; net house production; crop modeling, organic gardening; vegetable production for pigments, export and processing of:

UNIT I	Tomato, brinjal, chilli, sweet pepper and potato
UNIT II	Cucurbits, cabbage, cauliflower and knol-khol
UNIT III	Bhendi, onion, peas and beans, amaranthus and drumstick
UNIT IV	Carrot, beet root and radish
UNIT V	Sweet potato, tapioca, elephant foot yam and taro

Practical

Seed hardening treatments; practices in indeterminate and determinate vegetable growing and organic gardening; portrays and ball culture; diagnosis of nutritional and physiological disorders; analysis of physiological factors like anatomy; photosynthesis; light intensity in different cropping situation; assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages, maturity indices; dryland techniques for rainfed vegetable production; production constraints; analysis of different cropping system in various situation like cold and hot set; vegetable waste recycling management; quality analysis ;marketing survey of the above crops; visit to vegetable and fruit malls and packing houses.

Suggested Readings

- ❖ Bose TK & Som NG. 1986. *Vegetable Crops of India*. Naya Prokash.
- ❖ Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. *Vegetable Crops*. Vols. I-III. Naya Udyog.
- ❖ Brewster JL. 1994. *Onions and other Vegetable Alliums*. CABI. FFTC. Improved Vegetable Production in Asia. Book Series No. 36.
- ❖ Ghosh SP, Ramanujam T, Jos JS, Moorthy SN & Nair RG. 1988. *Tuber Crops*. Oxford & IBH.
- ❖ Gopalakrishnan TR. 2007. *Vegetable Crops*. New India Publishing Agency.
- ❖ Kallo G & Singh K. (Ed.). 2001. *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publ. House.
- ❖ Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabeerathuma S & Pallai SV. 1996. *Tropical Tuber Crops, Problems, Prospects and Future Strategies*. Oxford & IBH.
- ❖ Sin MT & Onwueme IC. 1978. *The Tropical Tuber Crops*. John Wiley & Sons.
- ❖ Singh NP, Bhardwaj AK, Kumar A & Singh KM. 2004. *Modern Technology on Vegetable Production*. International Book Distr. Co.
- ❖ Singh PK, Dasgupta SK & Tripathi SK. 2006. *Hybrid Vegetable Development*. International Book Distr. Co.

VSC 602 ADVANCES IN BREEDING OF VEGETABLE CROPS 3(2+1)
Objective

To update knowledge on the recent research trends in the field of breeding of vegetable crops with special emphasis on tropical, subtropical and temperate crops grown in India.

Theory

Evolution, distribution, cytogenetics, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and

pollination, hybridization, inter-varietal, inter-specific and inter-generic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, *in vitro* breeding; breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for pest, disease, nematode and multiple resistance of:

UNIT I	Tomato, brinjal, chilli, sweet pepper and potato
UNIT II	Cucurbits, Cabbage, cauliflower and knol-khol
UNIT III	Bhendi, onion, peas and beans, amaranthus and drumstick
UNIT IV	Carrot, beet root and radish
UNIT V	Sweetpotato, tapioca, elephant foot yam and taro

Practical

Designing of breeding experiments, screening techniques for abiotic stresses, screening and rating for pest, disease and nematode resistance, estimation of quality and processing characters, screening for-quality improvement, estimation of heterosis and combining ability, induction and identification of mutants and polyploids, distant hybridization and embryo rescue techniques.

Suggested Readings

- ❖ Acta Horticulture. Conference on Recent Advance in Vegetable Crops.Vol. 127.
- ❖ Chadha KL, Ravindran PN & Sahijram L. 2000. Biotechnology in Horticultural and Plantation Crops. Malhotra Publ. House.
- ❖ Chadha KL. 2001. Hand Book of Horticulture. ICAR.
- ❖ Dhillon BS, Tyagi RK, Saxena S & Randhawa GJ. 2005. Plant Genetic Resources: Horticultural Crops. Narosa Publ. House.
- ❖ Janick JJ. 1986. Horticultural Science. 4th Ed. WH Freeman & Co.
- ❖ Kaloo G & Singh K. 2001. Emerging Scenario in Vegetable Research and Development. Research Periodicals and Book Publ. House.
- ❖ Kaloo G. 1994. Vegetable Breeding. Vols. I-III. Vedams eBooks.
- ❖ Peter KV & Pradeep Kumar T. 2008. Genetics and Breeding of Vegetables. (Revised Ed.). ICAR.
- ❖ Ram HH. 2001. Vegetable Breeding. Kalyani.

VSC 603

PROTECTED CULTIVATION OF VEGETABLE CROPS 2(1+1)

Objective

To impart latest knowledge in growing of vegetable crops under protected environmental condition.

Theory

Crops: Tomato, capsicum, cucumber, melons and lettuce

UNIT I

Importance and scope of protected cultivation of vegetable crops; principles used in protected cultivation, energy management, low cost structures; training methods; engineering aspects.

UNIT II

Regulatory structures used in protected structures; types of greenhouse/polyhouse/nethouse, hot beds, cold frames, effect of environmental factors, viz. temperature, light, CO₂ and humidity on growth of different vegetables, manipulation of CO₂, light and temperature for


 REGISTRAR
 S.V.B.P.U.A.&T., MEERUT

vegetable production, fertigation.

UNIT III

Nursery raising in protected structures like poly-tunnels, types of benches and containers, different media for growing nursery under cover.

UNIT IV

Regulation of flowering and fruiting in vegetable crops, technology for raising tomato, sweet pepper, cucumber and other vegetables in protected structures, training and staking in protected crops, varieties and hybrids for growing vegetables in protected structures.

UNIT V

Problem of growing vegetables in protected structures and their remedies, insect and disease management in protected structures; soil-less culture, use of protected structures for seed production.

Practical

Study of various types of structures, methods to control temperature, CO₂ light, media, training and pruning, maintenance of parental lines and hybrid seed production of vegetables, fertigation and nutrient management, control of insect-pests and disease in greenhouse; economics of protected cultivation, visit to established green/polyhouse/net house/shade house in the region.

Suggested Readings

- ❖ Anonymous 2003. *Proc. All India Seminar on Potential and Prospects for Protective Cultivation*. Organised by Institute of Engineers, Ahmednagar. Dec.12-13, 2003.
- ❖ Chandra S & Som V. 2000. Cultivating Vegetables in Green House. *Indian Horticulture* 45: 17-18.
- ❖ Prasad S & Kumar U. 2005. *Greenhouse Management for Horticultural Crops*. 2nd Ed. Agrobios.
- ❖ Tiwari GN. 2003. *Green House Technology for Controlled Environment*. Narosa Publ. House.

VSC 604

BIOTECHNOLOGY OF VEGETABLE CROPS

3 (2+1)

Objective

To teach advances in biotechnology for improvement of vegetable crops.

Theory

Crops: Tomato, eggplant, hot and sweet pepper, potato, cabbage, cauliflower, tapioca, onion, cucurbits.

UNIT I

In vitro culture methods and molecular approaches for crop improvement in vegetables, production of haploids, disease elimination in horticultural crops, micro grafting, somoclonal variants, *in vitro* techniques to overcome fertilization barriers, *in vitro* production of secondary metabolites.

UNIT II

Protoplast culture and fusion; construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, *in vitro* conservation.

UNIT III

In vitro mutation for biotic and abiotic stresses, recombinant DNA methodology, gene transfer methods, tools, methods, applications of rDNA technology.


REGISTRAR
S.V.B.P.U.A.E.T., MEERUT

UNIT IV

Quality improvement, improvement for biotic and abiotic stresses, transgenic plants.

UNIT V

Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars etc., achievements, problems and future thrusts in horticultural biotechnology.

Practical

Establishment of axenic explants, callus initiation and multiplication, production of suspension culture, cell and protoplast culture, fusion, regeneration and identification of somatic hybrids and cybrids; Identification of embryonic and non-embryonic calli, development of cell lines; *in vitro* mutant selection for biotic and abiotic stresses, *In vitro* production and characterization of secondary metabolites, isolated microspore culture, isolation and amplification of DNA, gene transfer methods, molecular characterization of transgenic plants.

Suggested Readings

- ❖ Bajaj YPS. (Ed.). 1987. Biotechnology in Agriculture and Forestry. Vol.XIX. Hitech and Micropropagation. Springer.
- ❖ Chadha KL, Ravindran PN & Sahijram L. (Eds.). 2000. Biotechnology of Horticulture and Plantation Crops. Malhotra Publ. House.
- ❖ Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer Publ. Glover MD. 1984. Gene Cloning: The Mechanics of DNA Manipulation.
- ❖ Chapman & Hall. Gordon H & Rubsell S. 1960. Hormones and Cell Culture. AB Book Publ.
- ❖ Keshavachandran R & Peter KV. 2008. Plant Biotechnology: Tissue Culture and Gene Transfer. Orient & Longman (Universal Press).
- ❖ Keshavachandran R et al. 2007. Recent Trends in Biotechnology of Horticultural Crops. New India Publ. Agency.
- ❖ Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. Biotechnology of Horticultural Crops. Vols. I-III.
- ❖ Naya Prokash. Pierik RLM. 1987. In vitro Culture of Higher Plants. Martinus Nijhoff Publ.
- ❖ Prasad S. 1999. Impact of Plant Biotechnology on Horticulture. 2nd Ed. Agro Botanica.
- ❖ Sharma R. 2000. Plant Tissue Culture. Campus Books.
- ❖ Singh BD. 2001. Biotechnology. Kalyani.
- ❖ Skoog Y & Miller CO. 1957. Chemical Regulation of Growth and Formation in Plant Tissue Cultured in vitro. Attidel. II Symp. on Biotechnology Action of Growth Substance.
- ❖ Vasil TK, Vasi M, While DNR & Bery HR. 1979. Somatic Hybridization and Genetic Manipulation in Plants. Plant Regulation and World Agriculture. Planum Press.
- ❖ Williamson R. 1981-86. Genetic Engineering. Vols. I-V.

VSC 605

SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS 2 (1+1)

Objective

To educate the recent trends in the certification, processing and storage of vegetable crops.

Theory

UNIT I

Seed certification, objectives, organization of seed certification, minimum seed certification standards of vegetable crops, field inspection, specification for certification.

UNIT II

Seed processing, study of seed processing equipments seed cleaning and upgrading, Seed packing and handling, equipment used for packaging of seeds, procedures for allocating lot number.

UNIT III

Pre-conditioning, seed treatment, benefits, types and products, general principles of seed storage, advances in methods of storage, quality control in storage, storage containers, seed longevity and deterioration, sanitation, temperature and relative humidity control.

UNIT IV

Seed testing; ISTA rules for testing, moisture, purity germination, vigor test, seed sampling, determination of genuineness of varieties, seed viability, seed health testing; seed dormancy and types of dormancy, factors responsible for dormancy.

UNIT V

Seed marketing, demand forecast, marketing organization, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy.

Practical

Seed sampling, purity, moisture testing, seed viability, seed vigor tests, seed health testing, seed cleaning, grading and packaging; handling of seed testing equipment and processing machines; seed treatment methods, seed priming and pelleting; field and seed inspection, practices in rouging, seed storage, isolation distances, biochemical tests, visit to seed testing laboratories and processing plants, mixing and dividing instruments, visit to seed processing unit and warehouse visit and know about sanitation standards.

Suggested Readings

- ❖ Agrawal PK & Dadlani M. 1992. Techniques in Seed Science and Technology. South Asian Publ.
- ❖ Singh N, Singh DK, Singh YK & Kumar V. 2006. Vegetable Seed Production Technology. International Book Distr. Co.
- ❖ Singh SP. 2001. Seed Production of Commercial Vegetables. Agrotech Publ. Academy.
- ❖ Tanwar N S & Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, GOI, New Delhi.
- ❖ Rajan S & Baby L Markose 2007. Propagation of Horticultural Crops. New India Publ. Agency.

VSC 606

ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS 3(2+1)

Objective

To update knowledge on the recent research trends in the field of breeding of vegetable crops with special emphasis on tropical, subtropical and temperate crops grown in India.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Theory

UNIT I

Environmental stress and its types, soil parameters including pH, classification of vegetable crops based on susceptibility and tolerance to various types of stress; root stock, use of wild species, use of anti-transpirants.

UNIT II

Mechanism and measurements of tolerance to drought, water logging, soil salinity, frost and heat stress in vegetable crops.

UNIT III

Soil-plant-water relations under different stress conditions in vegetable crops production and their management practices.

UNIT IV

Techniques of vegetable growing under water deficit, water logging, salinity and sodicity.

UNIT V

Techniques of vegetable growing under high and low temperature conditions, use of chemicals in alleviation of different stresses.

Practical

Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops, measurement of tolerance to various stresses in vegetable crops, short term experiments on growing vegetable under water deficit, water-logging, salinity and sodicity, high and low temperature conditions, and use of chemicals for alleviation of different stresses.

Suggested Readings

- ❖ Dwivedi P & Dwivedi RS. 2005. Physiology of Abiotic stress in Plants. Agrobios.
- ❖ Lerner HR (Ed.). 1999. Plant Responses to Environmental Stresses. Marcel Decker.
- ❖ Maloo SR. 2003. Abiotic Stresses and Crop Productivity. Agrotech Publ. Academy.


REGISTRAR
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FLORICULTURE AND LANDSCAPE ARCHITECTURE

Course Structure – at a Glance

CODE	COURSE TITLE	CREDITS
Master's Programme		
FLA.501*	BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS	2+1
FLA.502*	PRODUCTION TECHNOLOGY OF CUT FLOWERS	2+1
FLA.503*	PRODUCTION TECHNOLOGY OF LOOSE FLOWERS	2+1
FLA.504*	LANDSCAPING AND ORNAMENTAL GARDENING	2+1
FLA.505	PROTECTED FLORICULTURE	2+1
FLA.506	VALUE ADDITION IN FLOWERS	2+1
FLA.507*	TURFING AND TURF MANAGEMENT	2+1
FLA.508	CAD FOR OUTDOOR AND INDOORSCAPING	2+1
FLA 591	MASTER'S SEMINAR	1+0
FLA 599	MASTER'S RESEARCH	20
Ph.D. Programme		
FLA 601**	ADVANCES IN BREEDING OF FLOWER CROPS	2+1
FLA 602**	ADVANCES IN FLOWER PRODUCTION TECHNOLOGY	2+1
FLA 603	ADVANCES IN PROTECTED AND PRECISION FLORICULTURE	1+1
FLA 604**	ADVANCES IN LANDSCAPE ARCHITECTURE	1+2
FLA 605	ADVANCES IN BIOCHEMISTRY AND BIOTECHNOLOGY OF FLOWERS	2+1
FLA 691	DOCTORAL SEMINAR I	1+0
FLA 692	DOCTORAL SEMINAR II	1+0
FLA 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Doctoral programme


 REGISTRAR
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Course Contents

FLA 501 BREEDING OF FLOWER CROPS AND ORNAMENTAL PLANTS 3 (2+1) Objective

To impart comprehensive knowledge about the principles and practices of breeding of flower crops and ornamental plants.

Theory

UNIT I

Principles -- Evolution of varieties, origin, distribution, genetic resources, genetic divergence-
Patents and Plant Variety Protection in India.

UNIT II

Genetic inheritance -- of flower colour, doubleness, flower size, fragrance, post harvest life.

UNIT III

Breeding methods suitable for sexually and asexually propagated flower crops and ornamental plants-- introduction, selection, domestication, polyploid and mutation breeding for varietal development, Role of heterosis, Production of hybrids, Male sterility, incompatibility problems, seed production of flower crops.

UNIT IV

Breeding constraints and achievements made in commercial flowers - rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, dahlia, gerbera, gladioli, orchids, anthurium, aster, heliconia, lilliums, nerium.

UNIT V

Breeding constraints and achievements made in ornamental plants – petunia, hibiscus, bougainvillea, Flowering annuals (zinnia, cosmos, dianthus, snap dragon, pansy) and ornamental foliage-- Introduction and selection of plants for waterscaping and xeriscaping.

Practical

Description of botanical features– Cataloguing of cultivars, varieties and species in flowers, floral biology, selfing and crossing, evaluation of hybrid progenies, seed production-Induction of mutants through physical and chemical mutagens, induction of polyploidy, screening of plants for biotic, abiotic stresses and environmental pollution, *in vitro* breeding in flower crops and ornamental plants.

Suggested Readings

- ❖ Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- ❖ Chadha KL & Choudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- ❖ Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- ❖ Chaudhary RC. 1993. *Introduction to Plant Breeding*. Oxford & IBH. Singh BD. 1990. *Plant Breeding*. Kalyani.

FLA 502 PRODUCTION TECHNOLOGY OF CUT FLOWERS 3(2+1) Objective

To impart basic knowledge about the importance and production technology of cut flowers grown in India.

Theory

UNIT I

Scope of cut flowers in global trade, Global Scenario of cut flower production, Varietal

wealth and diversity, area under cut flowers and production problems in India- Patent rights, nursery management, media for nursery, special nursery practices.

UNIT II

Growing environment, open cultivation, protected cultivation, soil requirements, artificial growing media, soil decontamination techniques, planting methods, influence of environmental parameters, light, temperature, moisture, humidity and CO₂ on growth and flowering.

UNIT III

Flower production – water and nutrient management, fertigation, weed management, rationing, training and pruning, disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM, production for exhibition purposes.

UNIT IV

Flower forcing and year round flowering through physiological interventions, chemical regulation, environmental manipulation.

UNIT V

Cut flower standards and grades, harvest indices, harvesting techniques, post-harvest handling, Methods of delaying flower opening, Pre-cooling, pulsing, packing, Storage & transportation, marketing, export potential, institutional support, Agri Export Zones.

Crops: Cut rose, cut chrysanthemum, carnation, gerbera, gladioli, tuberose, orchids, anthurium, aster, lilioms, bird of paradise, heliconia, alstroemeria, alpinia, ornamental ginger, bromeliads, dahlia, gypsophilla, limonium, statice, stock, cut foliages and fillers.

Practical

Botanical description of varieties, propagation techniques, mist chamber operation, training and pruning techniques, practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking, harvesting techniques, post-harvest handling, cold chain, project preparation for regionally important cut flowers, visit to commercial cut flower units and case study.

Suggested Readings

- ❖ Arora JS. 2006. *Introductory Ornamental horticulture*. Kalyani. Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash. Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Chadha KL & Chaudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- ❖ Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- ❖ Lauria A & Ries VH. 2001. *Floriculture – Fundamentals and Practices*. Agrobios.
- ❖ Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.
- ❖ Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- ❖ Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FLA 503

PRODUCTION TECHNOLOGY FOR LOOSE FLOWERS 3(2+1)

Objective

To impart basic knowledge about the importance and management of loose flowers grown in India.

Theory

UNIT I

Scope of loose flower trade, Significance in the domestic market/export, Varietal wealth and

diversity, propagation, sexual and asexual propagation methods, propagation in mist chambers, nursery management, pro-tray nursery under shadenets, transplanting techniques

UNIT II

Soil and climate requirements, field preparation, systems of planting, precision farming techniques.

UNIT III

Water and nutrient management, weed management, rationing, training and pruning, pinching and disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM.

UNIT IV

Flower forcing and year round flowering, production for special occasions through physiological interventions, chemical regulation.

UNIT V

Harvest indices, harvesting techniques, post-harvest handling and grading, pre-cooling, packing and storage, value addition, concrete and essential oil extraction, transportation and marketing, export potential, institutional support, Agri Export Zones.

Crops: Jasmine, scented rose, chrysanthemum, marigold, tuberose, crossandra, nerium, hibiscus, barleria, celosia, gomphrena, non-traditional flowers (Nyctanthes, Tabernaemontana, ixora, lotus, lilies, tecoma, champaka, pandanus).

Practical

Botanical description of species and varieties, propagation techniques, mist chamber operation, training and pruning techniques, practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking, harvesting techniques, post-harvest handling, storage and cold chain, project preparation for regionally important commercial loose flowers, visits to fields, essential oil extraction units and markets.

Suggested Readings

- ❖ Arora JS. 2006. *Introductory Ornamental Horticulture*. Kalyani. Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- ❖ Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Chadha KL & Chaudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- ❖ Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- ❖ Lauria A & Ries VH. 2001. *Floriculture – Fundamentals and Practices*. Agrobios.
- ❖ Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.
- ❖ Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- ❖ Sheela VL. 2007. *Flowers in Trade*. New India Publ. Agency.
- ❖ Valsalakumari PK, Rajeevan PK, Sudhadevi PK & Geetha CK. 2008.
- ❖ *Flowering Trees*. New India Publ. Agency.

FLA 504

LANDSCAPING AND ORNAMENTAL GARDENING 3(2+1)

Objective

Familiarization with principles and practices of landscaping and ornamental gardening.

Theory

UNIT I

Landscape designs, types of gardens, English, Mughal, Japanese, Persian, Spanish, Italian,

Vanams, Buddha garden; Styles of garden, formal, informal and free style gardens.

UNIT II

Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporates.

UNIT III

Garden plant components, arboretum, shrubbery, fernery, palmatum, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers, carpet beds, bamboo groves; Production technology for selected ornamental plants.

UNIT IV

Lawns, Establishment and maintenance, special types of gardens, vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, colour wheels, temple garden, sacred groves.

UNIT V

Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.

Practical

Selection of ornamental plants, practices in preparing designs for home gardens, industrial gardens, institutional gardens, corporates, avenue planting, practices in planning and planting of special types of gardens, burlapping, lawn making, planting herbaceous and shrubbery borders, project preparation on landscaping for different situations, visit to parks and botanical gardens, case study on commercial landscape gardens.

Suggested Readings

- ❖ Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.
- ❖ Nambisan KMP. 1992. *Design Elements of Landscape Gardening*. Oxford & IBH.
- ❖ Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- ❖ Sabina GT & Peter KV. 2008. *Ornamental Plants for Gardens*. New India Publ. Agency.
- ❖ Valsalakumari et al. 2008. *Flowering Trees*. New India Publ. Agency.
- ❖ Woodrow MG. 1999. *Gardening in India*. Biotech Books.

FLA 505

PROTECTED FLORICULTURE

3 (2 + 1)

Objective

Understanding the principles, theoretical aspects and developing skills in protected cultivation of flower crops.

Theory

UNIT I

Prospects of protected floriculture in India; Types of protected structures – Greenhouses, polyhouses, shade houses, rain shelters etc., Designing and erection of protected structures; Low cost/Medium cost/High cost structures – economics of cultivation; Location specific designs; Structural components; Suitable flower crops for protected cultivation.

UNIT II

Environment control – management and manipulation of temperature, light, humidity, air and CO₂; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation.

UNIT III

Containers and substrates, soil decontamination, layout of drip and fertigation system, water

and nutrient management, weed management, physiological disorders, IPM and IDM.

UNIT IV

Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.

UNIT V

Harvest indices, harvesting techniques, post-harvest handling techniques, Precooling, sorting, grading, packing, storage, quality standards.

Practical

Study of various protected structures, practices in design, layout and erection of different types of structures, practices in preparatory operations, soil decontamination techniques, practices in environmental control systems, practices in drip and fertigation techniques, special horticultural practices, determination of harvest indices and harvesting methods, post-harvest handling, packing methods, project preparation, visit to commercial greenhouses.

Suggested Readings

- ❖ Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Bose TK & Yadav LP. 1989. *Commercial Flowers*. Naya Prokash.
- ❖ Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- ❖ Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.
- ❖ Nelson PV. 1978. *Green House Operation and Management*. Reston Publ. Co.
- ❖ Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios
- ❖ Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- ❖ Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FLA 506
Objective

VALUE ADDITION IN FLOWERS

3(2+1)

To develop understanding of the scope and ways of value addition in flowers.

Theory

UNIT I

Prospects of value addition, National and global scenario, production and exports, Women empowerment through value added products making, supply chain management.

UNIT II

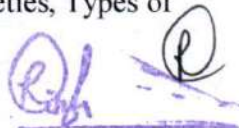
Types of value added products, value addition in loose flowers, garlands, veni, floats, floral decorations, value addition in cut flowers, flower arrangement, styles, Ikebana, morebana, free style, bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands, etc.; Selection of containers and accessories for floral products and decorations.

UNIT III

Dry flowers– Identification and selection of flowers and plant parts; Raw material procurement, preservation and storage; Techniques in dry flower making – Drying, bleaching, dyeing, embedding, pressing; Accessories; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; Packing and storage.

UNIT IV

Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Packing and storage, Selection of species and varieties, Types of


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S.V.B.P.U.A.&T., MEERUT

pigments, carotenoids, anthocyanin, chlorophyll, betalains; Significance of natural pigments, Extraction methods; Applications.

Practical

Practices in preparation of bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands with fresh flowers; Techniques in flower arrangement; Techniques in floral decoration; Identification of plants for dry flower making; Practices in dry flower making; Preparation of dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths, etc.; Visit to dry flower units, concrete and essential oil extraction units.

Suggested Readings

- ❖ Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Chadha KL. 1995. *Advances in Horticulture*. Vol. XII. Malhotra Publ. House.
- ❖ Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices* Agrobios.
- ❖ Prasad S & Kumar U. 2003. *Commercial Floriculture*. Agrobios.
- ❖ Reddy S, Janakiram B, Balaji T, Kulkarni S & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FLA 507

TURFING AND TURF MANAGEMENT

3(2+1)

Objective

To develop understanding of the principles and management of turfing.

Theory

UNIT I

Prospects of landscape industry; History of landscape gardening, site selection, basic requirements, site evaluation, concepts of physical, chemical and biological properties of soil pertaining to turf grass establishment.

UNIT II

Turf grasses - Types, species, varieties, hybrids; Selection of grasses for different locations; Grouping according to climatic requirement- Adaptation; Turfing for roof gardens.

UNIT III

Preparatory operations; Growing media used for turf grasses - Turf establishment methods, seeding, sprigging/dibbling, plugging, sodding/turfing, turf plastering, hydro-seeding, astro-turfing.

UNIT IV

Turf management – Irrigation, nutrition, special practices, aerating, rolling, soil top dressing, use of turf growth regulators (TGRs) and micronutrients, Turf mowing -- mowing equipments, techniques to minimize wear and compaction, weed control, biotic and abiotic stress management in turfs.

UNIT V

Establishment and maintenance of turfs for playgrounds, viz. golf, football, hockey, cricket, tennis, rugby, etc.

Practical

Identification of turf grasses, Preparatory operations in turf making, Practices in turf establishment, Layout of macro and micro irrigation systems, Water and nutrient management; Special practices – mowing, raking, rolling, soil top dressing, weed management; Biotic and abiotic stress management; Project preparation for turf establishment, visit to IT parks, model cricket and golf grounds, airports, corporates, Govt. organizations; Renovation of lawns; Turf economics.


REGISTRAR
S.V.S.P.U.A.&T., MEERUT

Suggested Readings

- ❖ Nick-Christians 2004. *Fundamentals of Turfgrass Management*.
www.amazon.com

FLA 508 Objective

CAD FOR OUTDOOR AND INDOORSCAPING

3 (2+1)

To impart basic knowledge about the operation of **Computer Aided Designing (CAD)** in landscape garden designing.

Theory

UNIT I

Exposure to CAD (Computer Aided Designing) – Applications of CAD in landscape garden designing, 2D drawing by AUTOCAD, 3D drawing by ARCHICAD, 3D drawing by 3D MAX software, Creating legends for plant and non-plant components, Basics of Photoshop software in garden designing.

UNIT II

2D drawing methods, AUTOCAD Basics, Coordinate systems in AUTOCAD LT 2007, Point picking methods, Toolbars and Icons, File handling functions, Modifying tools, Modifying comments, Isometric drawings, Drafting objects.

UNIT III

Using patterns in AUTOCAD drawing, Dimension concepts, Hyperlinking, Script making, Using productivity tools, e-transmit file, making sample drawing for outdoor and indoor garden by AUTOCAD 2D Drawing techniques, **Drawing web format design**, Making layout.

UNIT IV

3D drawing methods, **ARCHICAD file system**, Tools and Infobox, modification tools, structural elements, GDL objects (**Grid Dimensional Linking**), Creation of garden components through ARCHICAD.

UNIT V

ARCHICAD organization tools, Dimensioning and detailing of designs, Attribute settings of components, Visualization tools for landscape preview, Data management, plotting and accessories for designing, Inserting picture using photoshop, Making sample drawing for outdoor and indoor gardens.

Practical

Practices in point picking methods, Using tool bars and icons, Using modifying tools and modifying comments, Isometric drawings, Using productivity tools, Drawing designs by **AUTOCAD for home garden**, **institutional garden** and special types of garden, Using tools and info-box for 3D drawing, Creation of garden components with ARCHICAD, Organization, dimensioning, detailing and visualization tools with ARCHICAD, Using Photoshop package for 3D picture insertion, Drawing designs with ARCHICAD for home garden, interior garden designing, **IT parks**, Corporates, Theme parks and Ecotourism spots.

Suggested Readings

- ❖ Christine Wein-Ping Yu 1987. *Computer-aided Design: Application to Conceptual Thinking in Landscape Architecture*. amazon.com


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

FLA 601
Objective

ADVANCES IN BREEDING OF FLOWER CROPS 3 (2+1)

To update knowledge on the recent research trends in the field of breeding of flower crops with special emphasis on crops grown in India.

Theory

UNIT I

Origin and evolution of varieties, distribution, Genetic resources, genetic divergence, Plant introduction, selection and domestication, Inheritance of important characters, Genetic mechanisms associated with flower colour and flower size, doubleness, fragrance and post-harvest life, Plant Variety Protection Act.

UNIT II

Specific objectives of breeding in flower crops, Methods of breeding suited to seed and vegetatively propagated flower crops, Introduction, selection, polyploidy and mutation breeding in the evolution of new varieties, Exploitation of heterosis, utilization of male sterility-Incompatibility problems, *In Vitro* breeding.

UNIT III

Breeding for resistance to pests, diseases, nematodes and other biotic and abiotic stresses in flower crops.

UNIT IV

Specific breeding problems and achievements made in rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, gerbera, gladioli, orchids and anthurium.

UNIT V

Specific breeding problems and achievements made in aster, petunia, liliiums, heliconia, bird of paradise, hibiscus and bougainvillea.

Practical

Description of crops and cultivars; Cataloguing of species and cultivars, floral biology, selfing and crossing, evaluation of hybrid progenies; Induction of mutants; Physical and chemical mutagens; Induction of polyploidy; Screening of plants for biotic and abiotic stresses and environmental pollution; *in-vitro* breeding in flower crops.

Suggested Readings

- ❖ Arora JS. 2006. *Introductory Ornamental Horticulture*. Kalyani.
- ❖ Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Choudhary RC. 1993. *Introduction to Plant Breeding*. Oxford & IBH.
- ❖ Singh BD. 1990. *Plant Breeding*. Kalyani.

FLA 602
Objective

ADVANCES IN FLOWER PRODUCTION TECHNOLOGY 3 (2+1)

To keep abreast with latest developments and trends in production technology of flower crops.

Theory

UNIT I

Commercial flower production; Scope and importance; Global Scenario in cut flower production and trade, varietal wealth and diversity; Soil and Environment; Special characteristics and requirements; cut flower, loose flowers, dry flowers and floral oil trade.

UNIT II

Propagation and multiplication; IPR issues related to propagation of materials; Greenhouse management; Soil/media decontamination techniques; Micro irrigation; nutrition and fertigation; slow release fertilizers and biofertilizers; influence of environmental parameters, light, temperature, moisture, humidity and CO₂ on growth and flowering; regulation for quality flowers.

UNIT III

Flower forcing and year-round flowering through physiological interventions; Chemical regulation; Environmental manipulation; Harvest indices; Harvesting techniques; Post-harvest handling; Precooling, pulsing, packing, marketing; Export potential; Agri Export Zones.

UNIT IV

Crop specific practices – rose, anthurium, orchids, carnation, gladioli, gerbera, lilliums, heliconia, bird of paradise, *Jasminum* sp., marigold, tuberose, crossandra.

UNIT V

Floral oil industry, floral concrete production, extraction methods, recent advances.

Practical

Varietal wealth in flower crops; Greenhouse management; Soil decontamination techniques; Micro irrigation; Nutrition and fertigation. Special practices- Pinching, netting, disbudding, defoliation and chemical pruning; Photoperiodic and chemical induction of flowering; Assessing harvest indices; Post-harvest handling; Tissue analysis; Preparation of floral decorative; Extraction of floral concrete and oils; case studies; visit to commercial cut flower units.

Suggested Readings

- ❖ Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Chadha KL & Choudhury B. 1992. *Ornamental Horticulture in India*. ICAR.
- ❖ George S & Peter KV. 2008. *Plants in a Garden*. New India Publ. Agency.
- ❖ Lauria A & Victor HR. 2001. *Floriculture – Fundamentals and Practices*. Agrobios.
- ❖ Randhawa GS & Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publ.
- ❖ Reddy S, Janakiram B, Balaji T, Kulkarni. S & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FLA 603

ADVANCES IN PROTECTED AND PRECISION FLORICULTURE 2(1+1)

Objective

Appraisal on the advances in protected and precision farming of flower crops.

Theory

UNIT I

Prospects of protected floriculture in India, growing structures, basic considerations in establishment and operation of green houses, functioning and maintenance.

UNIT II

Environmental control systems in greenhouse, containers, substrate culture, soil decontamination techniques.

UNIT III

Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of rose, chrysanthemum, carnation, orchids, anthurium, gerbera, lilliums, cut foliage; Harvest indices – harvesting, PH handling, marketing, export.

UNIT IV

Precision floriculture, Principles and concepts, Enabling technologies of precision farming, GPS, GIS, Remote sensing, sensors.

UNIT V

Variability management in precision farming, mapping, variable rate technology, precision equipments, computers and robotics in precision farming, post-harvest process management in floriculture using precision farming.

Practical

Growing structures, basic considerations in establishment and operation of greenhouses, Environmental control systems in greenhouse, containers, substrate culture, soil decontamination techniques, Crop regulation, special horticultural practices under protected cultivation, precision equipments, computers and robotics in precision farming, post-harvest process management in floriculture using precision farming.

Suggested Readings

- ❖ Bhattacharjee SK. 2006. *Advances in Ornamental Horticulture*. Vols. I-VI. Pointer Publ.
- ❖ Bose TK, Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Reddy S, Janakiram B, Balaji T, Kulkarni S, & Misra RL. 2007. *Hightech Floriculture*. Indian Society of Ornamental Horticulture, New Delhi.

FLA 604

ADVANCES IN LANDSCAPE ARCHITECTURE

3(1+2)

Objective

To update knowledge on the recent trends in the field of landscape architecture and developing practical skills.

Theory

UNIT I

Commercial landscape gardening- History, Plant identification and ecology, Materials of garden design, Design making by different garden styles and types.

UNIT II

Expenses to model landscaping units of all category, Creativity and communication skills for landscape architect, Way of designing a commercial landscape project.

UNIT III

Assessing site and plants adaptability for different locations, Landscape engineering (Topographical) survey and designing concept), special techniques in garden landscaping (Burlaping, waterscaping, hardscaping, lawn making, topiary styles specializing, bioaesthetic planning).

UNIT IV

Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan, Handling soft landscape materials (AUTOCAD & ARCHICAD), GIS as a tool for spatial designing.

UNIT V

Contemporary landscaping, Environmental landscaping, Industrial and institutional landscaping, Public and private garden making, play ground landscaping, Case study with the successful landscapist, Budget / Project cost estimating, Execution strategies, Assessing a successful design in site.

Practical

Commercial landscaping, Plant identification, Materials of garden design, Design making by different garden styles and types. Way of designing a commercial landscape project, visit to model ornamental nursery. Assessing site and plants adaptability for different locations, Landscape engineering (Topographical survey and designing concept), special techniques in garden landscaping (Burlaping, waterscaping, hardscaping, lawn making, topiary styles specializing, bioaesthetic planning). Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan, Handling soft landscape materials (AUTOCAD & ARCHICAD), GIS as a tool for spatial designing. Contemporary landscaping, Environmental landscaping, Industrial and institutional landscaping, Public and private garden making, play ground landscaping, Case study with the successful landscapist, Budget/Project cost estimating, Execution.

Suggested Readings

- ❖ Bose TK, Maiti RG, Dhua RS & Das, P. 1999. *Floriculture and Landscaping*. Naya Prokash.
- ❖ Nambisan KMP. 1992. *Design Elements of Landscape Gardening*. Oxford & IBH.

FLA 605 ADVANCES IN BIOCHEMISTRY AND BIOTECHNOLOGY OF FLOWERS 3 (2+1)

Objective

Appraisal on the advances in biochemistry of flowers and application of biotechnology in flower crops.

Theory

UNIT I

Biochemistry of flowers: Principle involved in the formation of pigments – chlorophyll, xanthophylls, carotenoids, flavonoids and anthocyanins. Chemistry and importance of secondary metabolites in rose, jasmine, marigold, tuberose, carnation, orchids, lilliums and bougainvillea. Biochemistry and utilization commercial products (select items).

UNIT II

Recent trends- Extraction of biocolours and their value addition, uses in food and textile industries. Biochemistry of post harvest management of cut flowers.

UNIT III

Biotechnology – tools techniques and role in floriculture industry, physical factors and chemical factors influencing the growth and development of plant cell, tissue and organs, cytodifferentiation, organogenesis, somatic embryogenesis.

UNIT IV

In vitro lines for biotic and abiotic stress – Meristem culture for disease elimination, production of haploids through anther and pollen culture – embryo and ovule culture, micrografting, wide hybridization and embryo rescue techniques, construction of somatic hybrids and cybrids, regeneration and characterization of hybrids and cybrids, *in vitro* pollination and fertilization, hardening media, techniques and establishment of tissue culture plants in the primary and secondary nursery.

UNIT V

Somoclonal variation and its applications – variability induction through *in vitro* mutation, development of cell suspension cultures, types and techniques, *in vitro* production of secondary metabolites, role of bioreactors in production of secondary metabolites, quantification and quality analysis of secondary metabolites using HPLC, *in vitro* conservation and cryo-preservation techniques.

UNIT VI


REGISTRAR
S.V.B.P.U.A.&T., MEGHALAYA

Gene cloning, genetic engineering: vectors and methods of transformation– electroporation, particle bombardment, *Agrobacterium* mediated, transgenic plants in flower crops, medicinal and aromatic crops, isolation of DNA, RNA, quantification, Polymerase Chain Reaction for amplification; AGE & PAGE techniques; identification of molecular markers.

UNIT VII

Construction of c- DNA library, DNA fingerprinting technique in economic flower crop varieties, molecular approaches to control ethylene response, improving shelf life, improving resistance for environmental stress, approaches to improve flower development, pigment production, secondary metabolite production, post harvest biotechnology of flowers, ornamental plants, achievements of bio-technology in flower crops.

Practical

Extraction of flower pigments – xanthophylls, carotenoids and anthocyanins. Plant nutrient stock- growth regulators- media preparation and sterilization- *In vitro* seed germination- callus culture and organ culture- Cell suspension culture – cell plating and regeneration- clonal propagation through Meristem culture, induction of multiple shoots- Anther- Pollen- Ovule and Embryo culture- Synthetic seed production, *in vitro* mutation induction, *in vitro* rooting – hardening at primary and secondary nurseries, Project preparation for establishment of low, medium and high cost tissue culture laboratories, DNA isolation from economic flower crop varieties – Quantification and amplification, DNA and Protein profiling – molecular markers for economic flower crops, restriction enzymes, vectors for cloning and particle bombardment, DNA fingerprinting of flower crop varieties .

Suggested Readings

- ❖ Chopra VL & Nasim. 1990. Genetic Engineering and Biotechnology – Concepts, Methods and Applications. Oxford & IBH.
- ❖ Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer Publ.
- ❖ Dey PM & Harborne JB. 1997. Plant Biochemistry. 2nd Ed. Academic Press.
- ❖ Glover MD. 1984. Gene Cloning: The Mechanics of DNA Manipulation. Chapman & Hall.
- ❖ Goodwin TW & Mercer EI. 2003. Introduction to Plant Biochemistry. CBS.
- ❖ Gordon H & Rubsell S. 1960. Hormones and Cell Culture. AB Book Publ.
- ❖ Keshavachandran R & Peter KV. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Orient & Longman (Universal Press).
- ❖ Keshavachandran R, Nazeem PA, Girija D, John PS & Peter KV. (Eds.). 2007. Recent Trends in Horticultural Biotechnology. Vols. I, II. New India Publishing Agency.
- ❖ Panopoulos NJ. (Ed.). 1981. Genetic Engineering in Plant Sciences. Praeger Publ.
- ❖ Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK & Mohanadas S. 2001. Biotechnology of Horticultural Crops. Vols. I-III. Naya Prokash.
- ❖ Pierik RLM. 1987. *In vitro* Culture of Higher Plants. Martinus Nijhoff Publ.
- ❖ Prasad S. 1999. Impact of Plant Biotechnology on Horticulture. 2nd Ed. Agro Botanica.
- ❖ Sharma R. 2000. Plant Tissue Culture. Campus Books International. Singh BD. 2001. Biotechnology. Kalyani.
- ❖ Skoog Y & Miller CO. 1957. Chemical Regulation of Growth and Formation in Plant Tissue Culture *in vitro*. Symp. Soc. Exp. Biol. 11: 118-131.
- ❖ Vasil TK, Vasi M, While DNR & Bery HR. 1979. Somatic Hybridization and Genetic Manipulation in Plants. Plant Regulation and World Agriculture. Planum Press.
- ❖ Williamson R. 1981-86. Genetic Engineering. Vols. I-V. www.amazon.com

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503 (e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 1 (0+1)

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e- resources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 1 (0+1)

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.
To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).


HEAD OF THE DEPARTMENT
S.V.B.P.U.A.&T., MERRUT

Practical

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

- ❖ *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
- ❖ *Collins' Cobuild English Dictionary*. 1995. Harper Collins.
- ❖ Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
- ❖ Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
- ❖ James HS. 1994. *Handbook for Technical Writing*. NTC Business Books. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
- ❖ Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
- ❖ Richard WS. 1969. *Technical Writing*. Barnes & Noble.
- ❖ Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
- ❖ Abhishek Sethi J & Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
- ❖ Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE1+0 (e-Course)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of **intellectual property rights (IPR)** related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in **TRIPS Agreement**; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio- diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; **National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and**

Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- ❖ Erbisch FH & Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
- ❖ Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
- ❖ *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC & Aesthetic Technologies.
- ❖ Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*. Academic Foundation.
- ❖ Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
- ❖ Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
- ❖ *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

PGS 504

BASIC CONCEPTS IN LABORATORY TECHNIQUES

1(0+1)

Objective


To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separator funnel, condensers, micropipettes and vascupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. **Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;** Electric wiring and earthing. **Preparation of media and methods of sterilization;** Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

- ❖ Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
- ❖ Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory**UNIT I**

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- ❖ Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- ❖ Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
- ❖ Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
- ❖ Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

- ❖ Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.
- ❖ Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.
- ❖ Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.


REGISTRAR
S.V.B.P.U.A.&T., MEERUT