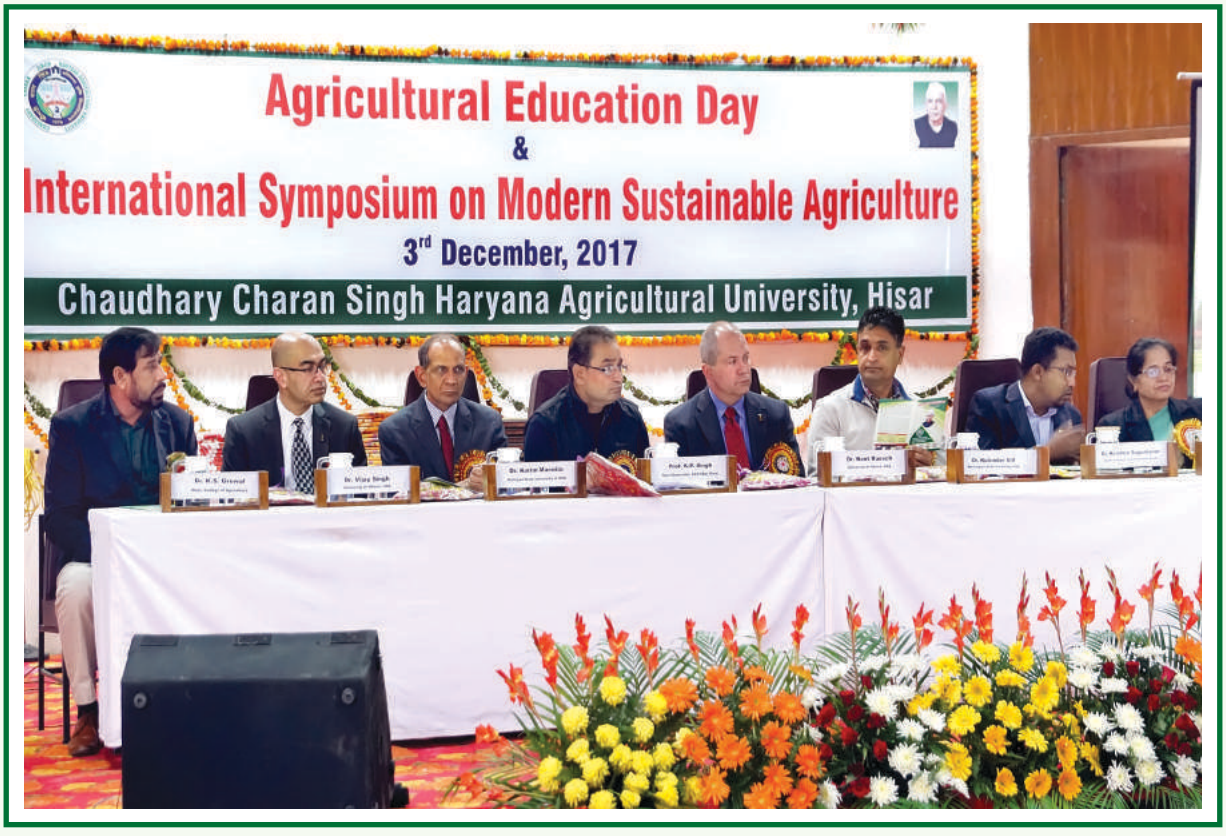
UNDER GRADUATE COURSE CATALOGUE



Chaudhary Charan Singh Haryana Agricultural University
Hisar - 125 004 (Haryana) India

2017


स्वर्ण जयंती द्वार
हरियाणा स्वर्ण जयन्ती द्वार


Agricultural Education Day
&
International Symposium on Modern Sustainable Agriculture
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Chaudhary Charan Singh Haryana Agricultural University, Hisar

FOREWORD



Progress implies change in the pre-determined desirable direction. The comfortable food grain situation in the country is due to skilled human resource, improved technology, highly responsive farming community and enabling policies of Government. Course Curriculum being the back bone of the academic programme of university, it is imperative to re-define the scope of Agricultural education in the State Agricultural Universities. Therefore, it is essential that a systematic and institutionalized training and teaching is provided to the graduates coming out not only to meet the expectations of different stakeholders but also to be a propeller of agricultural growth. It is, therefore, essential to modernize and upgrade the curriculum in order to instill a sense of confidence among the students, sharpen their skills and improve their knowledge and competence in the global context.

College of Agriculture, I.C. College of Home Sciences and College of Agricultural Engineering and Technology of the University offer B. Sc. (Hons.) Agriculture, B. Sc. (Hons.) Community Science and B.Tech (Agricultural Engineering) through 4-Year Programmes, respectively. Chaudhary Charan Singh Haryana Agricultural University has tradition of revision of Course Curriculum as per the recommendations of ICAR. Earlier, the University has revised Course Curriculum from Academic Session 2011-12 as per the recommendations of 4th Deans' Committee of ICAR for undergraduate programmes in all the colleges of the University. The Course Catalogue and Examination and Evaluation system as per the recommendations of 5th Deans' Committee have been implemented with effect from academic year 2017-18 from 1st year 4-Year Programmes of all the colleges and 3rd year 6-Year Programme of B. Sc. (Hons.) Agriculture. Modifications up to prescribed limit have been made to fulfill the regional requirements. Major emphasis has been given on experiential learning with several options of choosing module of experiential learning.

I place on record my appreciation for the good work done by Prof. (Dr.) K.S. Grewal, Dean, College of Agriculture, Prof. (Dr.) R. K. Jhorar, Dean, College of Agricultural Engineering and Technology, Prof. (Dr.) Rajvir Singh, Dean, College of Basic Sciences and Humanities, Prof. (Dr.) Parveen Punia and Prof. (Dr.) Saleem Siddiqui for the revision and finalization of Under Graduate Course Curriculum of the University along with Prof. (Dr.) K.S. Bangarwa as Nodal Officer (Implementation of 5th Deans' Committee of ICAR). I do hope the revised Course Curriculum of UG programmes in all the colleges of the University contained in this document will provide for updating, augmenting and revising academic framework to achieve quality agricultural education and science led transformation of India's food and agriculture system enabling our graduates to become job-providers rather than job seekers.

Prof. (Dr.) K.P. Singh
Vice-Chancellor
CCS HAU, Hisar

PREFACE



Globalized and demand driven market necessitate revising the content and delivery of curricula so that the graduates not only meet the expectations of different stake holders but also be propeller of agricultural and household growth. For India to occupy prominent position in the international market, it is important that our graduates also remain in the forefront of developing new technologies and disseminate them to the farming community. It is mandatory for any teaching organization to keep pace with the latest development of science and technology and incorporate these in their teaching and research programmes. Therefore, CCS Haryana Agricultural University initiated the process to revise Course Curriculum as per the recommendations of 5th Deans' Committee of ICAR for under graduate programmes in all the constituent colleges of the University. Modifications up to prescribed limit have been made to fulfill the regional requirements. Major emphasis has been given on experiential learning with sufficient number of options of choosing modules. Necessary amendments suggested by Departmental Advisory Committees duly approved by the Board of Studies of constituent colleges, were discussed in the Resident Instructions Committee, and finally approved by the Academic Council. The Course Catalogue and Examination and Evaluation system as per the recommendations of 5th Deans' Committee have been implemented with effect from academic year 2017-18 from 1st year 4-Year Programmes of all the colleges and 3rd year 6-Year Programme of B. Sc. (Hons.) Agriculture.

I appreciate the efforts made by Prof. (Dr.) R. K. Jhorar, Dean, College of Agricultural Engineering and Technology, Prof. (Dr.) Rajvir Singh, Dean, College of Basic Sciences and Humanities, Prof. (Dr.) Parveen Punia, Prof. (Dr.) Saleem Siddiqui and Prof. (Dr.) K.S. Bangarwa, Nodal Officer (Implementation of 5th Deans' Committee of ICAR) for revising and final preparation of Under Graduate Course Curriculum of the University. I highly appreciate the sincere efforts made by Dr. Rita Dahiya, Professor, Department of Soil Science, Dr. Shanti Balda, Professor, Department of Human Development and Family Studies, Dr. Vijaya Rani, HOD, Farm Machinery and Power Engineering, Dr. Jatesh Kathpalia, Assistant Scientist, Department of Sociology, Dr. Neelam M. Rose, Professor, Department of Textile and Apparel Designing and Dr. Neeraj Kumar, Principal Scientist, Department of Botany and Plant Physiology for the revision, coordination and compilation of Under Graduate Course Curriculum of the University.

The sincere efforts and help extended by Registrar, Dean, PGS, Directors and Officers of the university, the Heads of various teaching departments and galaxy of faculty members involved in the preparation of this document, is gratefully acknowledged.

Prof. (Dr.) K. S. Grewal
Dean, College of Agriculture
& Chairperson, Committee for
Finalization of Course Curriculum

ACRONYMS

ABM	Agricultural Business Management
AG ECON	Agricultural Economics
AGM	Agricultural Meteorology
AGRON	Agronomy
BIOINFO	Bioinformatics
BIO	Biology
BIOCHEM	Biochemistry
BOT	Botany
CCA	Co-curricular Activity
CE	Civil Engineering
CHEM	Chemistry
COMP	Computer Section
EE	Electrical and Electronics Engineering
EECM	Extension Education and Communication Management
ENG	English
ENT	Entomology
EXT	Extension Education
FMPE	Farm Machinery and Power Engineering
FN	Foods and Nutrition
FOR	Forestry
FRM	Family Resource Management
FST	Food Science and Technology
GP	Genetics and Plant Breeding
HDFS	Human Development and Family Studies
HECM	Home Science Extension Education and Communication Management
HORT	Horticulture
IACS	Internship/Industrial Attachment of Community Science
LPM	Livestock Production Management
Math	Mathematics
MBB	Molecular Biology and Biotechnology
ME	Mechanical Engineering
MGT	Business Management
MICRO	Microbiology
NC	Non Credit
NCC	National Cadet Corps
NEMA	Nematology
NSS	National Service Scheme
PFE	Processing and Food Engineering
PHY	Physics
PL PATH	Plant Pathology
RAWE	Rural Agricultural Work Experience
RBEE	Renewable and Bio-Energy Engineering
READY	Rural and Entrepreneurship Awareness Development Yojana
SOC	Sociology
SOILS	Soil Science
SST	Seed Science and Technology
STAT	Statistics
SWE	Soil and Water Engineering
TAD	Textile and Apparel Designing

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GENERAL INFORMATION

Chaudhary Charan Singh Haryana Agricultural University has revised Course Curriculum for undergraduate programmes in all the colleges of the University as per the recommendations of Fifth Deans' Committee of ICAR and implemented from Academic Session 2017-18.

Undergraduate Programmes College-wise

Programme	Credit Requirements						Residential Limit (No. of Semesters)	
	Total Credits of Courses	Deficiency Courses	Core Courses	CCA, NCC/NSS & TUT	Supporting	Student Ready	Minimum	Maximum
College of Agriculture								
B. Sc. (Hons.) Agriculture, 4-Year Programme	196	Nil	109	16	31	40	8	12
B. Sc. (Hons.) Agriculture, 6-Year Programme	286	Nil	109	24	113	40	12	16
College of Agricultural Engineering and Technology								
B. Tech. (Agricultural Engineering), 4-Year Programme	195	Nil	110	14	31	40	8	12
IC College of Home Sciences								
B. Sc. (Hons.) Community Science, 4-Year Programme	210/198/200 for Arts/Bio/ Math	14/2/4 for Arts/ Bio/Math	112	14	30	40	8	12

1. **Examination and Evaluation system:** Examination and Evaluation system of Under Graduate programmes of University has been given below:
   - External theory : 50%
   - Internal Theory + Practical : 50%

i. **Courses with Theory and Practical:** Mid-term Exam (30%) + Assignment (5%) + Practical (15%). The Assignment may be included with practical.

ii. **Courses with only Theory:** Mid-term Exam (40%) + Assignment (10%)

iii. **Courses with only Practical:** 100% Internal

The mid-term examination shall be conducted during midterm examination week prescribed in the academic calendar and classes will be held as usual during the prescribed mid-term examination week. The concerned teacher shall be overall responsible for conducting the mid-term examination (fixing the date of examination as well as conducting of examination). The practical examination (internal) will be conducted during the practical examination week prescribed in the academic calendar and for final examination (External), date sheet will be provided by Dean of the respective colleges during final examination dates prescribed in the academic calendar.

The following will be allotment of marks for various examination of each course.

Nature of Examination	Nature of course		
	Courses with Theory and Practical	Courses with only Theory	Courses with only Practical
Midterm (Theory)	60	80	NA
Midterm (Practical)	NA	NA	60
Assignment	10	20	20
Final (Practical)	30	NA	120
Final (Theory)	100	100	NA
Total	**200**	**200**	**200**

After adding marks of all the examinations, the total will be divided by two for converting total marks out of 100 and combined (theory +practical) grade of each course will be awarded.

2. The Course Catalogue and Examination and Evaluation system as per the recommendation of Fifth Deans' Committee implemented with effect from academic year 2017-18 by starting from 1st year 4-Year Programmes of all the colleges and 3rd year 6-Year Programme of B. Sc. (Hons.) Agriculture. The recommendations of 5th Deans' Committee shall be implemented continuously throughout the programme. In rest of the existing classes (2nd year 4-Year Programme to 4th year 4-Year Programme in all the colleges and 4th year 6-Year Programme to 6th year 6-Year Programme of B.Sc. (Hons.) Agriculture and 2nd Year 6-year programme to 6th year 6-Year programme of B. Sc. (Hons.) Home Science, the old Course Catalogue and Examination system shall be followed. The old Course Catalogue and Examination system shall also be followed in 1st and 2nd year of 6-Year Programme of B. Sc. (Hons.) Agriculture.

3. Examination system is external for 50 % (Theory of final examination) whereas 50 % (Theory of midterm + Practical) will be internal. But internal examination system both for theory and practical also exists for the 1st and 2nd year of B. Sc. (Hons.) Agriculture 6-Year programmes. The following guidelines are to be followed for this internal examination. The weightage of mid-term, final and practical examination will be as per table given below:

Credit Hours	**Weightage/Marks**		
(Theory & Practical)	**Mid-term**	**Final**	**Practical**
1+0	40	60	-
1+1	20	30	50
2+1	25	45	30
2+2	20	30	50
3+1	30	45	25
3+2	25	35	40
2+0	40	60	-
3+0	40	60	-
1+2	10	20	70

- For a course only with practical: Practical examination will be conducted twice, mid-term and final. Distribution of marks will be in the ratio of 40:60.
- There will be one examination date-sheet each for mid-term and final examinations within the examination schedule.

4. Examination system for the students of B. Sc. (Hons.) Community Science 4 year programme for Arts, Maths and Bio streams: The students of B. Sc. (Hons.) Community Science, 4 year programme coming from Arts stream will have to clear PHY 100, CHEM 100, MATH 100, ZOO 100 and BOT 100. Further MATH 100 will have to be cleared by the students from Bio stream and ZOO 100 and BOT 100 will have to be cleared by students from Math stream. The examination system for the above said courses will be internal for both theory and practical.



College of Agriculture




GOVT.SR.SEC.SCHOOL


ग्राम सचिवालय दाण्डु
ग्रामीण कृषि कार्य अनुभव (RAWE)
C.C.S.H.A.U., Hisar
GOVT.SEN SEC.SCHOOL

COLLEGE OF AGRICULTURE

B. Sc. (Hons.) Agriculture, 4-Year/ 6-Year Programme*

Courses: Semester-wise

Course No.	Course Title	Credits
	Semester I/V	
AGM 101	Introductory Agro-meteorology and Climate Change	3 (2+1)
AGRON 101	Fundamentals of Agronomy	4 (3+1)
AGRON 103	Agriculture Heritage	1 (1+0)
BIOCHEM 101/MBB 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)
BOT 101/ ZOO 101	Introductory Biology (To be taught jointly by Botany and Zoology: For students from Math stream)	2 (1+1)[a]
ENG 101	Comprehension and Communication Skills in English	2 (1+1)
FOR 101	Introduction to Forestry	3 (2+1)
MATH 101	Elementary Mathematics (For students from Bio stream)	2 (1+1)[a]
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)
SOILS 101	Fundamentals of Soil Science	3 (2+1)
TUT 101	Tutorial (Human Values and Ethics)	1 (1+0) NC
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**27 (17+10)**
[a]Students will take either MATH 101 or BOT 101/ZOO 101 as per requirement.		
	Semester II/VI	
AG ECON 102	Fundamentals of Agricultural Economics	2 (2+0)
ENT 102	Fundamentals of Entomology	4 (3+1)
EXT 102	Fundamentals of Agricultural Extension Education	3 (2+1)
GP 102	Fundamentals of Genetics	3 (2+1)
MICRO 102	Agricultural Microbiology	2 (1+1)
PL PHY 102	Fundamentals of Crop Physiology	2 (1+1)
PL PATH 102	Fundamentals of Plant Pathology	4 (3+1)
STAT 102	Statistical Methods	2 (1+1)
SWE 101	Introductory Soil and Water Conservation Engineering	2 (1+1)
TUT	Tutorial	1 (1+0) NC
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**26 (17+9)**
	Semester III/VII	
AG ECON 201	Agricultural Finance and Cooperation	3 (2+1)
AGRON 201	Crop Production Technology – I *(Kharif* Crops*)*	3 (2+1)
FMPE 202	Farm Machinery and Power	2 (1+1)
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)

***Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme from 3rd year onwards will be same as for B. Sc. (Hons.) Agriculture, 4-Year Programme**

GP 201	Fundamentals of Plant Breeding	3 (2+1)
HORT 201	Fundamentals of Horticulture	2 (1+1)
LPM 201	Livestock and Poultry Management	4 (3+1)
VSC 201	Production Technology of Vegetables and Spices	3 (2+1)
TUT	Tutorial	1 (1+0) NC
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**27 (17+10)**
Semester IV/VIII		
AG ECON 202	Agricultural Marketing Trade and Prices	3 (2+1)
AGRON 202	Crop Production Technology –II *(Rabi* Crops*)*	3 (2+1)
AGRON 204	Farming System and Sustainable Agriculture	1 (1+0)
EXT 202	Communication Skill and Personality Development	2 (1+1)
HORT 202	Production Technology for Ornamental Crops, MAP and Landscaping	3 (2+1)
HORT 204	Production Technology for Fruit and Plantation Crops	2 (1+1)
RBEE 202	Renewable Energy and Green Technology	2 (1+1)
SOILS 202	Manures, Fertilizers and Soil Fertility Management	3 (2+1)
SOILS 204/ AGRON 206/ MICRO 204	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)
SST 202	Principles of Seed Technology	3 (2+1)
TUT	Tutorial	1 (1+0) NC
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**26 (16+10)**
Semester V/IX		
AGRON 301	Practical Crop Production – I (*Kharif* Crops)	1 (0+1)
AGRON 303	Geoinformatics and Nanotechnology for Precision Farming	2 (1+1)
AGRON 305	Weed Management	3 (2+1)
COMP 301/ AGRON 307/ AGM 301	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)
ENT 301	Pests of Crops and Stored Grain and their Management	3 (2+1)
EXT 301	Entrepreneurship Development and Business Communication	2 (1+1)
GP 301	Crop Improvement-I *(Kharif* Crops*)*	3 (2+1)
NEMA 301	Introductory Nematology	2 (1+1)
PL PATH 301	Diseases of *Kharif* Field Crops and Horticultural Crops and their Management -I	3 (2+1)
SOILS 301	Problematic Soils and their Management	2 (2+0)
TUT	Tutorial	1 (1+0) NC
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**25 (15+10)**
Semester VI/X		
AG ECON 302	Farm Management, Production and Resource Economics	2 (1+1)
AGRON 302	Practical Crop Production –II (*Rabi* Crops)	1 (0+1)
AGRON 304	Principles of Organic Farming	2 (1+1)
AGRON 306	Rainfed Agriculture and Watershed Management	2 (1+1)
ENT 302	Management of Beneficial Insects	2 (1+1)
FST 302	Basics of Food Science, Safety and Nutrition	4 (3+1)
GP 302	Crop Improvement-II *(Rabi* Crops)	3 (2+1)

HORT 302/ VSC 302	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)
PFE 305	Protected Cultivation and Secondary Agriculture	2 (1+1)
PL PATH 302	Diseases of *Rabi* Field Crops and Horticultural Crops and their Management-II	3 (2+1)
TUT	Tutorial	1 (1+0) NC
CCA	Co-curricular Activity	1 (0+1)
	Total Credits	**25 (14+11)**
Semester VII/XI		
AGRON 491/ AG ECON 491/ EXT 491	[1]Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Agronomy, Agricultural Economics and Extension Education)	20 (0+20)
	Total Credits	**20 (0+20)**
Semester VIII/XII		
[2]Experiential Learning Programme/Hands on Training - A student has to get registered 20 credits opting for two modules of 10 (0+10) credits each from the list of nine modules.		10 (0+10) 10 (0+10)
	Total Credits	**20 (0+20)**

Description of Student READY (Rural Entrepreneurship Awareness Development Yojana)

[1]**Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA)**			
Sr. No.	**Activities**	**No. of weeks**	**Credit Hours**
1.	General orientation and on campus training by different faculties	1	
2.	Village attachment/ Unit attachment in University/ College/ KVK/ Research Station	10	
3.	Agro-Industrial Attachment	6	
4.	Project Report Preparation, Presentation and Evaluation	1	
Total weeks for RAWE and AIA		**18**	**20 (0+20)**

RAWE: Component-I
Village Attachment Training Programme

Sr. No.	**Activity**	**Duration**
1.	Orientation and Survey of Village	1 week
2.	Agronomical Interventions	2 week
3.	Plant Protection Interventions	2 week
4.	Soil Improvement Interventions (Soil sampling and testing)	2 week
5.	Fruit and Vegetable Production Interventions	1 week
6.	Animal Production Interventions	1 week
7.	Extension and Transfer of Technology Activities	1 week

RAWE Component –II

Agro- Industrial Attachment

- Students would be attached with the Agro and Cottage industries and Commodities Boards for a period of 6 weeks to get an experience of the industrial environment and working**.**
- Industries include Seed/Sapling production, Pesticides-insecticides, Post harvest-processing-value addition, Agri-finance institutions, etc.

Activities and Tasks during Agro-Industrial Attachment Programme

- Acquaintance with industry and staff
- Study of structure, functioning, objective and mandates of the industry
- Study of various processing units and hands-on trainings under supervision of industry staff
- Ethics of industry
- Employment generated by the industry
- Contribution of the industry promoting environment
- Learning business network including outlets of the industry
- Skill development in all crucial tasks of the industry
- Documentation of the activities and task performed by the students
- Performance evaluation, appraisal and ranking of students

Evaluation of RAWE Programme

Attendance: Minimum attendance - 85%.

Records: Students would complete the record work/report writing/ presentations, etc. based on daily field observations recorded in notebooks and weekly diaries maintained by them.

Evaluation Procedure: Students shall be evaluated component-wise under village attachment and agro-industrial attachment. The respective component In-Charge/Instructor(s), Agro-industrial Official and Course Coordinator will evaluate the students as under:

ACTIVITY		**Max. Marks**
1. Village attachment training		
a.	KVK/ARS/NGO scientist	50
b.	Report Preparation	10
c.	University Committee (Presentation and Viva-voce)	40
2. Industrial attachment training		
a.	Industry official	50
b.	Report Preparation	10
c.	University Committee (Presentation and Viva-voce)	40

Assessment Parameters (RAWE and AIA):

	Parameters	Marks (%)
A.	**Village Attachment**	
	Regularity	10
	Initiative and creativity	10
	General conduct and discipline	10
	Work performance	20
B.	**Industrial Attachment**	
	Initiative and compliance	10
	General conduct and discipline	10
	Project planning and implementation	10
	Work performance	20

[2] **Student READY Modules for Skill Development and Entrepreneurship:** A student has to get registered 20 credits opting for two modules of 10 (0+10) credits each from the list of nine modules in the Semester VIII/XII.

Module	Title	Credits
Module 1	Agro-advisory Services (To be taught jointly by Agricultural Meteorology and Extension Education)	10 (0+10)
Module 2	Organic Production Technology	10 (0+10)
Module 3	Beekeeping	10 (0+10)
Module 4	Mushroom Cultivation	10 (0+10)
Module 5	Seed Production and Technology	10 (0+10)
Module 6	Soil, Plant, Water and Fertilizer Testing Services	10 (0+10)
Module 7	Commercial Vegetable Production	10 (0+10)
Module 8	Bioagents and Biofertilizers Production	10 (0+10)
Module 9	Food Processing	10 (0+10)

Evaluation of Experiential Learning Programme/ Hands on Training

Sr. No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output Delivery	10
6.	Technical Skill Development	10
7.	Entrepreneurship Skills	10
8.	Business Networking Skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
	Total	**100**

B. Sc. (Hons.) Agriculture, 6-Year Programme
Bridge Courses: Semester-wise
(For 1st year and 2nd year)

Course No.	Course Title	Credits
Semester I		
BIO 1	Biology-I	5 (4+1)
CHEM 1	Principles of Chemistry-I	5 (4+1)
COMP 1	Computer Techniques-I	2 (0+2)
ENG 1	Composition and Elementary Grammar	3 (2+1)
MATH 1	Algebra and Trigonometry	5 (5+0)
PHY 1	Principles of Physics-I	5 (4+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits (Bio/Math streams)	**22 (15+7) / 22 (16+6)**
Semester II		
BIO 2	Biology-II	5 (4+1)
CHEM 2	Principles of Chemistry-II	5 (4+1)
COMP 2	Computer Techniques-II	3 (0+3)
ENG 2	Applied Grammar and Comprehension	3 (2+1)
MATH 2	Coordinate Geometry, Calculus and Elementary Statistics	5 (5+0)
PHY 2	Principles of Physics-II	5 (4+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits (Bio/Math streams)	**23 (15+8) / 23 (16+7)**
Semester III		
BIO 21	Biology-III	5 (4+1)
CHEM 21	Principles of Chemistry-III	5 (4+1)
COMP 21	Computer Techniques-III	2 (0+2)
ENG 21	English Composition and Comprehension	3 (2+1)
MATH 21	Matrices, Determinants, Differential Calculus and Probability	5 (5+0)
PHY 21	Principles of Physics-III	5 (4+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits (Bio/Math streams)	**22 (15+7) / 22 (16+6)**
Semester IV		
BIO 22	Biology-IV	5 (4+1)
CHEM 22	Principles of Chemistry-IV	5 (4+1)
COMP 22	Computer Techniques-IV	3 (0+3)
ENG 22	Functional English	3 (2+1)
MATH 22	Integral Calculus, Vectors and 3D Geometry	5 (5+0)
PHY 22	Principles of Physics-IV	5 (4+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits (Bio/Math streams)	**23 (15+8) / 23 (16+7)**

Note: Courses of B. Sc. (Hons.) Agriculture, 4-Year Programme will be applicable for B. Sc. (Hons.) Agriculture, 6-Year Programme from 3rd year onwards.

B. Sc. (Hons.) Agriculture, 4-Year Programme/6-Year Programme
Core Courses : Department-wise
College of Agriculture

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
	Agricultural Economics		
AG ECON 102	Fundamentals of Agricultural Economics	2 (2+0)	II/VI
AG ECON 201	Agricultural Finance and Cooperation	3 (2+1)	III/VII
AG ECON 202	Agricultural Marketing Trade and Prices	3 (2+1)	IV/VIII
AG ECON 203/ FOR 201/ AGM 201/ SOILS 201/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III/VII
AG ECON 302	Farm Management, Production and Resource Economics	2 (1+1)	VI/X
	Total Credits	**13 (10+3)**	
	Agricultural Meteorology		
AGM 101	Introductory Agro-meteorology and Climate Change	3 (2+1)	I/V
AGM 201/ FOR 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III/VII
AGM 301/ COMP 301/ AGRON 307	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**8 (6+2)**	
	Agronomy		
AGRON 101	Fundamentals of Agronomy	4 (3+1)	I/V
AGRON 103	Agriculture Heritage	1 (1+0)	I/V
AGRON 201	Crop Production Technology – I (*Kharif* Crops)	3 (2+1)	III/VII
AGRON 202	Crop Production Technology – II (*Rabi* Crops)	3 (2+1)	IV/VIII
AGRON 204	Farming System and Sustainable Agriculture	1 (1+0)	IV/VIII
AGRON 206/ SOILS 204/ MICRO 204	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
AGRON 301	Practical Crop Production - I (*Kharif* Crops)	1 (0+1)	V/IX
AGRON 302	Practical Crop Production - II (*Rabi* Crops)	1 (0+1)	VI/X
AGRON 303	Geoinformatics and Nanotechnology for Precision Farming	2 (1+1)	V/IX
AGRON 304	Principles of Organic Farming	2 (1+1)	VI/X
AGRON 305	Weed Management	3 (2+1)	V/IX
AGRON 306	Rainfed Agriculture and Watershed Management	2 (1+1)	VI/X
AGRON 307/ COMP 301/ AGM 301	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**27 (16+11)**	

Entomology			
ENT 102	Fundamentals of Entomology	4 (3+1)	II/VI
ENT 301	Pests of Crops and Stored Grain and their Management	3 (2+1)	V/IX
ENT 302	Management of Beneficial Insects	2 (1+1)	VI/X
	Total Credits	**9 (6+3)**	
Extension Education			
EXT 102	Fundamentals of Agricultural Extension Education	3 (2+1)	II/VI
EXT 202	Communication Skills and Personality Development	2 (1+1)	IV/VIII
EXT 301	Entrepreneurship Development and Business Communication	2 (1+1)	V/IX
	Total Credits	**7 (4+3)**	
Forestry			
FOR 101	Introduction to Forestry	3 (2+1)	I/V
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III/VII
	Total Credits	**6 (5+1)**	
Genetics and Plant Breeding			
GP 102	Fundamentals of Genetics	3 (2+1)	II/VI
GP 201	Fundamentals of Plant Breeding	3 (2+1)	III/VII
GP 301	Crop Improvement-I (*Kharif* Crops)	3 (2+1)	V/IX
GP 302	Crop Improvement-II (*Rabi* Crops)	3 (2+1)	VI/X
	Total Credits	**12 (8+4)**	
Horticulture			
HORT 201	Fundamentals of Horticulture	2 (1+1)	III/VII
HORT 202	Production Technology for Ornamental Crops, MAP and Landscaping	3 (2+1)	IV/VIII
HORT 204	Production Technology for Fruit and Plantation Crops	2 (1+1)	IV/VIII
HORT 302/ VSC 302	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	VI/X
	Total Credits	**9 (5+4)**	
Nematology			
NEMA 301	Introductory Nematology	2 (1+1)	V/IX
	Total Credits	**2 (1+1)**	
Plant Pathology			
PL PATH 102	Fundamentals of Plant Pathology	4 (3+1)	II/VI
PL PATH 301	Diseases of *Kharif* Field Crops and Horticultural Crops and their Management -I	3 (2+1)	V/IX
PL PATH 302	Diseases of *Rabi* Field Crops and Horticultural Crops and their Management-II	3 (2+1)	VI/X
	Total Credits	**10 (7+3)**	

Seed Science and Technology			
SST 202	Principles of Seed Technology	3 (2+1)	IV/VIII
	Total Credits	**3 (2+1)**	
Soil Science			
SOILS 101	Fundamentals of Soil Science	3 (2+1)	I/V
SOILS 201/ FOR 201/ AGM 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III/VII
SOILS 202	Manure, Fertilizers and Soil Fertility Management	3 (2+1)	IV/VIII
SOILS 204/ AGRON 206/ MICRO 204	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
SOILS 301	Problematic Soils and their Management	2 (2+0)	V/IX
	Total Credits	**13 (10+3)**	
Vegetable Science			
VSC 201	Production Technology for Vegetables and Spices	3 (2+1)	III/VII
VSC 302/ HORT 302	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	VI/X
	Total Credits	**5 (3+2)**	

Student READY (Rural Entrepreneurship Awareness Development Yojana)
Department-wise
College of Agriculture

Agricultural Economics, Agronomy and Extension Education			
Course No.	**Course Title**	**Credits**	**Semester**
AGRON 491/ AG ECON 491/ EXT 491	Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Agronomy, Agricultural Economics and Extension Education)	20 (0+20)	VII/XI
	Total Credits	**20 (0+20)**	
Agricultural Meteorology and Extension Education			
Module 1	Agro-advisory Services (To be taught jointly by the Agricultural Meteorology and Extension Education)	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Agronomy			
Module 2	Organic Production Technology	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Entomology			
Module 3	Beekeeping	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Plant Pathology			
Module 4	Mushroom Cultivation	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

Seed Science and Technology			
Module 5	Seed Production and Technology	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Soil Science			
Module 6	Soil, Plant , Water and Fertilizer Testing Services	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Vegetable Science			
Module 7	Commercial Vegetable Production	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

College of Basic Sciences and Humanities

Microbiology			
Module 8	Bioagents and Biofertilizers Production	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

Centre for Food Science and Technology

Module 9	Food Processing	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

Supporting Courses from College of Agricultural Engineering and Technology

Farm Machinery and Power Engineering			
FMPE 202	Farm Machinery and Power	2 (1+1)	III/VII
	Total Credits	**2 (1+1)**	
Processing and Food Engineering			
PFE 305	Protected Cultivation and Secondary Agriculture	2 (1+1)	VI/X
	Total Credits	**2 (1+1)**	
Renewable and Bio- energy Engineering			
RBEE 202	Renewable Energy and Green Technology	2 (1+1)	IV/VIII
	Total Credits	**2 (1+1)**	
Soil and Water Engineering			
SWE 101	Introductory Soil and Water Conservation Engineering	2 (1+1)	II/VI
	Total Credits	**2 (1+1)**	

Supporting Courses from College of Basic Sciences and Humanities

Botany and Plant Physiology			
BOT 101/ ZOO 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
PL PHY 102	Fundamentals of Crop Physiology	2 (1+1)	II/VI
	Total Credits	**4 (2+2)**	
Chemistry and Biochemistry			
BIOCHEM 101/ MBB 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	I/V
	Total Credits	**3 (2+1)**	

Computer Section			
COMP 301/ AGM 301/ AGRON 307	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**2 (1+1)**	
Languages and Haryanvi Culture			
ENG 101	Comprehension and Communication Skills in English	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	
Mathematics, Statistics and Physics			
MATH 101	Elementary Mathematics	2 (1+1)	I/V
STAT 102	Statistical Methods	2 (1+1)	II/VI
	Total Credits	**4 (2+2)**	
Microbiology			
MICRO 102	Agricultural Microbiology	2 (1+1)	II/VI
	Total Credits	**2 (1+1)**	
Molecular Biology, Biotechnology and Bioinformatics			
MBB 101 / BIOCHEM 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	I/V
	Total Credits	**3 (2+1)**	
Sociology			
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)	I/V
	Total Credits	**2 (2+0)**	
Zoology			
ZOO101/ BOT 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	

Other Supporting Courses

Centre for Food Science and Technology			
FST 302	Basics of Food Science, Safety and Nutrition	4 (3+1)	VI/X
	Total Credits	**4 (3+1)**	
Livestock Production and Management			
LPM 201	Livestock and Poultry Management	4 (3+1)	III/VII
	Total Credits	**4 (3+1)**	

B. Sc. (Hons.) Agriculture, 6-Year Programme
Bridge Courses: Department-wise
College of Basic Sciences and Humanities

Course No.	Course Title	Credits	Semester
Botany and Plant Physiology			
BIO 1	Biology-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	I
BIO 2	Biology-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	II
BIO 21	Biology-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	III
BIO 22	Biology-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Chemistry and Biochemistry			
CHEM 1	Principles of Chemistry-I	5 (4+1)	I
CHEM 2	Principles of Chemistry-II	5 (4+1)	II
CHEM 21	Principles of Chemistry-III	5 (4+1)	III
CHEM 22	Principles of Chemistry-IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Computer Section			
COMP 1	Computer Techniques-I	2 (0+2)	I
COMP 2	Computer Techniques-II	3 (0+3)	II
COMP 21	Computer Techniques-III	2 (0+2)	III
COMP 22	Computer Techniques-IV	3 (0+3)	IV
	Total Credits	**10 (0+10)**	
Languages and Haryanvi Culture			
English			
ENG 1	Composition and Elementary Grammar	3 (2+1)	I
ENG 2	Applied Grammar and Comprehension	3 (2+1)	II
ENG 21	English Composition and Comprehension	3 (2+1)	III
ENG 22	Functional English	3 (2+1)	IV
	Total Credits	**12 (8+4)**	
Mathematics, Statistics and Physics			
Mathematics			
MATH 1	Algebra and Trigonometry	5 (5+0)	I
MATH 2	Coordinate Geometry, Calculus and Elementary Statistics	5 (5+0)	II
MATH 21	Matrices, Determinants, Differential Calculus and Probability	5 (5+0)	III
MATH 22	Integral Calculus, Vectors and 3D Geometry	5 (5+0)	IV
	Total Credits	**20 (20+0)**	
Physics			
PHY 1	Principles of Physics-I	5 (4+1)	I
PHY 2	Principles of Physics-II	5 (4+1)	II
PHY 2 1	Principles of Physics-III	5 (4+1)	III
PHY 22	Principles of Physics-IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	

Supporting Courses for B. Tech. (Agricultural Engineering) Programme Department-wise

Course No.	Course Title	Credits	Semester
Business Management			
ABM 102	Entrepreneurship Development and Business Management	3 (2+1)	II
	Total Credits	**3 (2+1)**	
Agronomy			
AGRON 203	Principles of Agronomy	3 (2+1)	III
	Total Credits	**3 (2+1)**	
Forestry/Agricultural Meteorology/Soil Science/Agricultural Economics			
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	II
	Total Credits	**3 (3+0)**	
Horticulture			
HORT 203	Principles of Horticultural Crops and Plant Protection	2 (1+1)	III
	Total Credits	**2 (1+1)**	
Soil Science			
SOILS 103	Principles of Soil Science	3 (2+1)	I
	Total Credits	**3 (2+1)**	

Supporting Courses for B. Sc. (Hons.) Community Science Programme Department-wise

Course No.	Course Title	Credits	Semester
Agricultural Economics			
AG ECON 303	Economics and Marketing	3 (2+1)	VI
	Total Credits	**3 (2+1)**	
Forestry/Agricultural Meteorology/Soil Science/Agricultural Economics			
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III
	Total Credits	**3 (3+0)**	

COURSE CONTENTS: DEPARTMENT-WISE
AGRICULTURAL ECONOMICS

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
AG ECON 102	Fundamentals of Agricultural Economics	2 (2+0)	II/VI
AG ECON 201	Agricultural Finance and Cooperation	3 (2+1)	III/VII
AG ECON 202	Agricultural Marketing Trade and Prices	3 (2+1)	IV/VIII
AG ECON 203/ FOR 201/ AGM 201/ SOILS 201/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3+0)	Agri.: III/VII B.Tech.: II CS : III
AG ECON 302	Farm Management, Production and Resource Economics	2 (1+1)	VI/X
AG ECON 303	Economics and Marketing [For B. Sc. (Hons.) Community Science]	3 (2+1)	VI
	Total Credits	**16 (12+4)**	
AG ECON 491/ AGRON 491/ EXT 491	Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Agronomy, Agricultural Economics and Extension Education)	20 (0+20)	VII/XI
	Total Credits	**20 (0+20)**	

AG ECON 102	FUNDAMENTALS OF AGRICULTURAL ECONOMICS	2 (2 + 0)	SEM II/VI

Theory

Economics: meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macro economics, positive and normative analysis; nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior; basic concepts: goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare; agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development; agricultural planning and development in the country; demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle; consumer's equilibrium and derivation of demand curve, concept of consumer surplus; elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity; production: process, creation of utility, factors of production, input output relationship; laws of returns: law of variable proportions and law of returns to scale; cost: cost concepts, short run and long run cost curves; supply: stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply; market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets; price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points; distribution theory: meaning, factor market and pricing of factors of production; concepts of rent, wage, interest and profit; national income: meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement; population: importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programmes on population control; money: barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general

price index, inflation and deflation; banking: role in modern economy, types of banks, functions of commercial and central bank, credit creation policy; agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure; tax: meaning, direct and indirect taxes, agricultural taxation, VAT; economic systems: concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

Suggested Readings :

1. Dewett, K.K. (2013). Modern Economic Theory, Sultan Chand Publishers, New Delhi 110 001.
2. Lekhi, R.K. and Singh, J. (2015). Agricultural Economics: An Indian Perspective, Tenth Revised Edition, Kalyani Publishers, New Delhi -110 002.
3. Singh, C.B. and Singh, R. K. (2001). A Textbook of Agricultural Economics, University Science Press, Laxmi Publications Pvt. Ltd. New Delhi-110 002.
4. Subha Raddy, S., Raghu Ram, P., Neelkanta Sastry, T.V. and Bhavani Devi, I. (2004). Agricultural Economics, Reprint2014, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.
5. Sundharam, K.P.M. and Vaish, M.C. (2013). Principles of Economics, Thirteen Edition, Printice-Hall of India Private Limited, New Delhi.

AG ECON 201	AGRICULTURAL FINANCE AND COOPERATION	3 (2 + 1)	SEM III/VII

Theory

Agricultural finance: meaning, scope and significance, credit needs and its role in Indian agriculture; agricultural credit: meaning, definition, need, classification; credit analysis: 4 R's, and 3C's of credits; sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, micro financing including KCC; lead bank scheme, RRBs, scale of finance and unit cost; an introduction to higher financing institutions – RBI, NABARD, ADB, IMF, World Bank, Insurance and Credit Guarantee Corporation of India; cost of credit; recent development in agricultural credit; preparation and analysis of financial statements – balance sheet and income statement; basic guidelines for preparation of project reports- Bank norms, SWOT analysis; agricultural cooperation: meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture; agricultural cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC and NAFED.

Practical

Determination of most profitable level of capital use; optimum allocation of limited amount of capital among different enterprise; analysis of progress and performance of cooperatives using published data; analysis of progress and performance of commercial banks and RRBs using published data; visit to a commercial bank, cooperative bank and cooperative society to acquire firsthand knowledge of their management, schemes and procedures; estimation of credit requirement of farm business – a case study; preparation and analysis of balance sheet – a case study; preparation and analysis of income statement – a case study; appraisal of a loan proposal – a case study; techno-economic parameters for preparation of projects; preparation of bankable projects for various agricultural products and its value added products; seminar on selected topics.

Suggested Readings :

1. Gaurav Dutt and Ashwani Mahajan (2016). Indian Economy, Sultan Chand Publishers, New Delhi 110 001.
2. Pandey, U.K. (1990). An Introduction to Agricultural Finance, Third edition, S. Chand Publishers, New Delhi 110 001.

3. Raju, V.T. and Rao, D. V. S.(2014). Agricultural Finance, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.

4. Subba Reddy, S. and Raghu Ram, P. (2017) . Agricultural Finance and Management. Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.

5. Sudarsan Reddy, G. (2010). Financial Management Principles and Practices, Second Revised Edition, Himalaya Publishing House, New Delhi -110 001.

AG ECON 202	AGRICULTURAL MARKETING TRADE AND PRICES	3 (2 + 1)	SEM IV/VIII

Theory

Agricultural Marketing: concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets**;** demand, supply and producer's surplus of agri-commodities: nature and determinants of demand and supply of farm products, producer's surplus– meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches– cost based and competition based pricing; market promotion– advertising, personal selling, sales promotion and publicity– their meaning and merits & demerits; marketing process and functions: marketing process-concentration, dispersion and equalization; exchange functions–buying and selling; physical functions– storage, transport and processing; facilitating functions– packaging, branding, grading, quality control and labeling (Agmark); market functionaries and marketing channels: types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; integration, efficiency, costs and price spread: meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; role of Govt. in agricultural marketing: public sector institutions- CWC, SWC, FCI, CACP & DMI– their objectives and functions; cooperative marketing in India; risk in marketing: types of risk in marketing; speculation & hedging; an overview of futures trading; agricultural prices and policy: meaning and functions of price; administered prices; need for agricultural price policy; trade: concept of international trade and its need, theories of absolute and comparative advantage; present status and prospects of international trade in agri-commodities; GATT and WTO; agreement on agriculture (AoA) and its implications on Indian agriculture; IPR.

Practical

Plotting and study of demand and supply curves and calculation of elasticities**;** study of relationship between market arrivals and prices of some selected commodities; computation of marketable and marketed surplus of important commodities; study of price behaviour over time for some selected commodities; construction of index numbers; visit to a local market to study various marketing functions performed by different agencies; identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; visit to market institutions– NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; application of principles of comparative advantage of international trade.

Suggested Readings :

1. Acharya, S.S. and Agarwal, N.L. (2011). Agricultural Marketing in India, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.

2. Kohls, Richard L. and Uhl, Joseph N. (2009). Marketing of Agricultural Products, Ninth Edition, PHI Learning Private Limited, New Delhi- 110 001.

3. Mamoria, C.B. and Joshi, R.L. (1996). Principles and Practices of Marketing in India, Sultan Chand Publishers, New Delhi 110 001.

4. Nirmal Ravi Kumar, K. and Guntuboyina, K. C. (2017). Agricultural Marketing, Daya Publishing House, A Division of Astral International Pvt. Ltd. New Delhi – 110 002.

5. Subha Raddy, S., Raghu Ram, P., Neelkanta Sastry T.V. and Bhavani Devi (2004). Agricultural Economics, Reprint2014, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.

AG ECON 203/ FOR 201/ AGM 201/ SOILS 201/ CHEM 201	**ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]**	**3 (3 + 0)**	**SEM Agri.: III/VII B.Tech.: II CS : III**

Theory

Multidisciplinary nature of environmental studies: definition, scope and importance; natural resources: renewable and non-renewable resources, natural resources and associated problems; forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forest and tribal people, wasteland management through tree plantations; water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies; land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles; ecosystems: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers, energy flow in the ecosystem; ecological succession, food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of the ecosystem: forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries); biodiversity and its conservation: introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India; value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels, India as a mega-diversity nation; hot-sports of biodiversity; threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity; environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards; solid waste management: causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; peaceful uses of chemistry; recycling and reusing the biodegradable and dry waste; social issues and environment: from unsustainable to sustainable development, 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, nuclear accidents and holocaust dies; wasteland reclamation; consumerism and waste products; environment protection act; air (prevention and control of pollution) act; water (prevention and control of pollution) act; wildlife protection act; forest conservation act; issues involved in enforcement of environmental legislation; 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.

Disaster management

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; man made disasters: nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents; disaster management: effect to migrate natural disaster 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 :

1. Anil, K Gupta and Nair, Sreeja S. (2012). Environmental Extremes: Disaster Risk Management addressing Climate Change, NIDM, New Delhi.
2. Baskar, Sushmitha and Baskar, R. (2007). Environmental Studies for Undergraduate Courses. Unicorn Books, New Delhi.
3. Bharucha Erach (2004). Environmental Science for Undergraduate Courses. University Grants Commission, New Delhi
4. Dwivedi, A.P. (1992). Agroforestry: Principles and Practices. Oxford & IBH.
5. Singh, Y.K. (2006). Environmental Science. New Age International (p) Limited, New Delhi.

AG ECON 302	FARM MANAGEMENT, PRODUCTION AND RESOURCE ECONOMICS	2 (1 + 1)	SEM VI/X

Theory

Meaning and concept of farm management, objectives and relationship with other sciences; meaning and definition of farms, its types and characteristics, factor determining types and size of farms; principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage; meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labor income and farm business income; farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises; importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts; meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises; concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies**,** crop/livestock/machinery insurance– weather based crop insurance, features, determinants of compensation; concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources; positive and negative externalities in agriculture, inefficiency and welfare loss, solutions, important issues in economics and management of common property resources of land, water, pasture, forest resources, etc.

Practical

Preparation of farm layout; determination of cost of fencing of a farm; computation of depreciation cost of farm assets; application of equi-marginal returns/opportunity cost principle in allocation of farm resources; determination of most profitable level of inputs use in a farm production process; determination of least cost combination of inputs; selection of most profitable enterprise combination; application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises; preparation of farm plan and budget, farm records and accounts and profit & loss accounts; collection and analysis of data on various resources in India.

Suggested Readings :

1. Dhondyal, S. P. (1990). Farm Management: An Economic Analysis, Friends Publications, Krishnapuri (Delhi Gate) Meerut-250 002.
2. Johl, S.S. and Kapoor, T.R. (2009). Fundamentals of Farm Business Management, Indian Society of Soil Science, IARI, New Delhi.
3. Lekhi, R.K. and Singh, J. (2015). Agricultural Economics: An Indian Perspective, Tenth Revised Edition, Kalyani Publishers, New Delhi -110 002.
4. Raju, V.T. and Rao, D. V. S. (2006). Economics of Farm Production and Management, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.
5. Subha Raddy, S., Raghu Ram, P., Neelkanta Sastry, T.V. and Bhavani Devi, I. (2004). Agricultural Economics, Reprint2014, Oxford & IBH Publishing CO. Pvt. Ltd. New Delhi.

AG ECON 303	ECONOMICS AND MARKETING [For B. Sc. (Hons.) Community Science]	3 (2 + 1)	SEM VI

Theory

Terms and definitions in economics; basic concepts in economics, divisions of economics, methods of economic investigation, demand and supply, factors affecting demand and supply; basic concepts of national income (GDP, GNP, NNP etc), role of agriculture sector in national GDP; marketing-definition, marketing process, need for marketing, role of marketing, marketing functions, classification of markets, marketing channels, marketing costs, margins and price spread, marketing efficiency, integration, constraints in marketing of agricultural produce, market news and intelligence; SWOT analysis, crisis management; meaning and definition of project, project cycle, techno-economic parameters for formulation or preparation of projects.

Practical

Techno-economic parameters for preparation of project, estimation of payback period, NPW and benefit-cost ratio (BCR) of projects, preparation of bankable projects for various agricultural products and its value added products; identification of marketing channel, calculation of marketing costs, margins and price spread, identification of market structure and visit to different markets.

Suggested Readings :

1. Acharya, S.S. and Aggarwal, N.L. (2011). Agricultural Marketing in India. Fifth Edition. Oxford and IBH Publishing Company Pvt. Ltd.
2. Ahuja, H.L. (2007). Advanced Economic Theory. S Chand and Company.
3. Chandra, P. (1984). Projects: Preparation, Appraisal & Implementation. McGraw Hill Inc.
4. Dewett, K.K. (2005). Modern Economic Theory. S Chand and Company.
5. Gupta, R.D. and Lekhi, R.K. (1982). Elementary Economic Theory. Kalyani Publishers.

AGRICULTURAL METEOROLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
AGM 101	Introductory Agro-meteorology and Climate Change	3 (2+1)	I/V
AGM 201/ FOR 201/ SOILS 201/ AG ECON 203 / CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3+0)	Agri.: III/VII B.Tech.: II CS : III
AGM301/ COMP 301/ AGRON307	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**8 (6+2)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 1	Agro-advisory Services (To be taught jointly by Agricultural Meteorology and Extension Education)	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

AGM 101	INTRODUCTORY AGRO-METEOROLOGY AND CLIMATE CHANGE	3 (2 + 1)	SEM I/V

Theory

Earth atmosphere- its composition, extent and structure; atmospheric weather variables; atmospheric pressure, its variation with height; wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, energy balance of earth; atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; artificial rainmaking; monsoon- mechanism and importance in Indian agriculture, weather hazards- drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; agriculture and weather relations; modifications of crop microclimate, climatic normals for crop and livestock production; weather forecasting- types of weather forecast and their uses; climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.

Practical

Visit of agro-meteorological observatory, site selection of observatory, exposure of instruments and weather data recording; measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law; measurement of albedo and sunshine duration, computation of radiation intensity using BSS; measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis; measurement of soil temperature and computation of soil heat flux; determination of vapor pressure and relative humidity; determination of dew point temperature;

measurement of atmospheric pressure and analysis of atmospheric conditions; measurement of wind speed and wind direction, preparation of windrose; measurement, tabulation and analysis of rain; measurement of open pan evaporation and evapotranspiration; computation of PET and AET.

Suggested Readings :

1. Critchfield, H.J. (1960). General Climatology. Prentice Hall Englewood Cliffs, NJ.
2. Kakde, J.R. (1985). Agricultural Climatology. Metropolitan Book Co. New Delhi.
3. Mavi, H.S. (2003). Introduction of Agrometeorology, Oxford and IBH Publishing Company Pvt. Limited, New Delhi.
4. Prasada Rao, G.S.L.H.V. (2003). Agricultural Meteorology, Oxford and IBH Publishing Company Pvt. Limited, New Delhi.
5. Prasada Rao, G.S.L.H.V., Rao, G.G.S.N. and Rao, V.U.M. (2010). Climate Change and Agriculture over India. Prentice Hall India Learning Private Limited, New Delhi.

AGM 201/ FOR 201/ SOILS 201/ AGECON 203/ CHEM 201	**ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]**	**3 (3+0)**	**SEM Agri.: III/VII B.Tech.: II CS : III**

Theory

Multidisciplinary nature of environmental studies: definition, scope and importance; natural resources: renewable and non-renewable resources, natural resources and associated problems; forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forest and tribal people, wasteland management through tree plantations; water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies; land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles; ecosystems: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers, energy flow in the ecosystem; ecological succession, food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of the ecosystem: forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries); biodiversity and its conservation: introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India; value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels, India as a mega-diversity nation; hot-sports of biodiversity; threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity; environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards;

solid waste management: causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; peaceful uses of chemistry; recycling and reusing the biodegradable and dry waste; social issues and environment: from unsustainable to sustainable development, 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, nuclear accidents and holocaust dies; wasteland reclamation; consumerism and waste products; environment protection act; air (prevention and control of pollution) act; water (prevention and control of pollution) act; wildlife protection act; forest conservation act; issues involved in enforcement of environmental legislation; 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.

Disaster management

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; man made disasters: nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents; disaster management: effect to migrate natural disaster 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 :

1. Anil, K Gupta and Nair, Sreeja S. (2012). Environmental Extremes: Disaster Risk Management addressing Climate Change, NIDM, New Delhi.
2. Baskar, Sushmitha and Baskar, R. (2007). Environmental Studies for Undergraduate Courses. Unicorn Books, New Delhi.
3. Bharucha Erach (2004). Environmental Science for Undergraduate Courses. University Grants Commission, New Delhi.
4. Dwivedi, A.P. (1992). Agroforestry: Principles and Practices. Oxford & IBH.
5. Singh, Y.K. (2006). Environmental Science. New Age International (p) Limited, New Delhi.

AGM 301/ COMP 301/ AGRON 307	AGRICULTURAL INFORMATICS (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1 + 1)	SEM V/IX

Theory

Introduction to computers, anatomy of computers, memory concepts, units of memory, operating system, definition and types, applications of MS-Office for creating, editing and formatting a document, data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, database, concepts and types, creating database, uses of DBMS in agriculture, internet and World Wide Web (WWW), concepts and components; computer programming, general concepts, introduction to visual basic, java, fortran, C/ C++, etc, concepts and standard input/output operations; e-agriculture, concepts, design and development; application of innovative ways to use

information and communication technologies (IT) in agriculture; computer models in agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation; smartphone mobile apps in agriculture for farm advises; geospatial technology, concepts, techniques, components and uses for generating valuable agri-information; decision support systems, concepts, components and applications in agriculture, preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of computer components, accessories, practice of important DOS commands; introduction of different operating systems such as windows, Unix/ Linux, creating, files & folders, file management; use of MS-WORD and MS Power-point for creating, editing and presenting a scientific document; MS-EXCEL - creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: creating database, preparing queries and reports, demonstration of agri-information system; introduction to World Wide Web (WWW) and its components; introduction of programming languages such as Visual Basic, Java, Fortran, C, C++; hands on practice on crop simulation models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost; use of smart phones and other devices in agro-advisory and dissemination of market information; introduction of geospatial technology for generating information important for agriculture; hands on practice on preparation of decision support system; preparation of contingent crop planning.

Suggested Readings :

1. Balagurusamy, E. (1987). Office Automation and Word Processing, Mc Graw-Hill Education, New Delhi.
2. Basandra, Suresh K. (2010). Computer Today, Galgotia Publications Pvt. Ltd.
3. Sinha, P.K. (1992). Computer Fundamentals–Concept, System and Application, BPB, Publication, New Delhi.
4. Vanitha, G. and Kalpana, M. (2011). Agro-Informatics, New India Publishing Agency, New Delhi.
5. Xavier, C. (1998). Introduction to Computers and Basic Programming, New Age International , New Delhi.

Module 1	**AGRO-ADVISORY SERVICES (To be taught jointly by Agricultural Meteorology and Extension Education)**	**10 (0+10)**	**SEM VIII/XII**

Weekly activities	
Week	**Activities**
1	Exposure and operation of meteorological instruments/ equipments in agromet observatories, automatic weather station – data logger and sensors, measurement of weather variables, computation and interpretation of data
2	Practical knowledge of different methods of weather forecast and their significance for agriculture at short, medium and long range levels
3	Use of satellite imageries and synoptic charts in weather forecasting
4	Methodology of special forecasts for drought, floods, high winds, cold waves, frost and heat waves, hail storms, cyclones and advisory for protection against such extreme events

5	Basic knowledge of agro advisory services of India and their role in development of agriculture, preparation of weather-based agro-advisories using various approaches and synoptic charts
6	Compilation of agromet bulletin, district, state and national level, flow chart of dissemination of agro advisory service, use of ICT in preparation and dissemination of agro-advisories, online and offline agro-advisory services bulletin generation
7	Development of survey proforma and analysis of impact the agro-advisory adopted village to monitor farmers' risk perceptions, attitudes and to assess, mitigation and adaptation strategies to abnormal biotic and abiotic stress through agro-advisory services
8	Analyze the significant, adoption and decision support at farm level through agro-advisory services
9	Evaluation of dissemination, adoption and impact of agro advisory services, preparation of crop weather calendars
10	Computation of agro climatic requirement of different *rabi* and *kharif* crops
11	Preparation of crop contingency advisory plan for different conditions of SW Monsoon, quantification of weather-pests-diseases of different crops, vegetable and fruit crops
12	Organizing PRA techniques in a village to identify the agricultural problems, simulating exercises on communication, fixing the priorities and preparation of project on agricultural problems
13	Organization of group discussion and method of demonstration, planning and writing the scripts of radio and television or audio/visual/print aids and information material for farming community
14	Preparation of district wise crop benefit ration of stockholder due adoption through agro-advisory services (practical report of individual)
15	Visit of KVK/FTC/Radio Station/TV station/NGO/Kisan Mela, etc.,
16	Visit of agromet-advisory division and weather forecasting centre, India Meteorological Department, New Delhi and National Centre of Medium Range Weather Forecasting Centre (NCMRWF) Noida to expand the practical knowledge of students

AGRONOMY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
AGRON 101	Fundamentals of Agronomy	4 (3+1)	I/V
AGRON 103	Agriculture Heritage	1 (1+0)	I/V
AGRON 201	Crop Production Technology – I (*Kharif* Crops)	3 (2+1)	III/VII
AGRON 202	Crop Production Technology – II (*Rabi* Crops)	3 (2+1)	IV/VIII
AGRON 203	Principles of Agronomy (For B.Tech. Agricultural Engineering)	3 (2+1)	III
AGRON 204	Farming System and Sustainable Agriculture	1 (1+0)	IV/VIII
AGRON206/ SOILS 204/ MICRO 204	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
AGRON 301	Practical Crop Production - I *(Kharif* Crops*)*	1 (0+1)	V/IX
AGRON 302	Practical Crop Production - II *(Rabi* Crops*)*	1 (0+1)	VI/X
AGRON 303	Geoinformatics and Nanotechnology for Precision Farming	2 (1+1)	V/IX
AGRON 304	Principles of Organic Farming	2 (1+1)	VI/X
AGRON 305	Weed Management	3 (2+1)	V/IX
AGRON 306	Rainfed Agriculture and Watershed Management	2 (1+1)	VI/X
AGRON 307/ COMP 301/ AGM 301	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**30 (18+12)**	
AGRON 491/ AG ECON 491/ EXT 491	Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Agronomy, Agricultural Economics and Extension Education)	20 (0+20)	VII/XI
	Total Credits	**20 (0+20)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 2	Organic Production Technology	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

AGRON 101	FUNDAMENTALS OF AGRONOMY	4 (3 + 1)	SEM I/V

Theory

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil plant water relationship, water retention, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, water logging, drainage; growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers and tillage implements; effect of sowing depth on germination and seedling vigour; identification of weeds in crops; methods of herbicide and fertilizer application; study of yield contributing characters and yield estimation; seed germination and

viability test; numerical exercises on fertilizer requirement, plant population, herbicides and water requirement; use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill; study of soil moisture measuring methods; measurement of field capacity, bulk density and infiltration rate; measurement of irrigation water.

Suggested Readings :

1. Panda, S.C. (2003). Cropping and Farming Systems. Agrobios Publications.
2. Panda, S.C. (2003). Principles and Practices of Water Management. Agrobios Publications.
3. Reddy T. Yallamanda and Reddi G.H. Sankara. (2016). Principles of Agronomy, Kalyani Publications, New Delhi.
4. Singh, S.S. (2006). Principles and Practices of Agronomy. Kalyani Publications, New Delhi.
5. Yawalkar, K.S., Agrawal, J.P. and Bokde, S. (2000). Manures and Fertilizers. Agri-Horti Publications.

AGRON 103	AGRICULTURE HERITAGE	1 (1 + 0)	SEM I/V

Theory

Introduction of Indian agricultural heritage, status of farmers in society; advice by sages to kings on their duties towards farmers, soil management in ancient, medieval & pre-modern India and its relevance in modern day sustainable agriculture, heritage of crop & water management, plant growth and development & plant protection through vrikshayurveda and traditional knowledge; heritage of medicinal plants and their relevance today, seed health in ancient & medieval history and its relevance to present day agriculture, description of Indian civilization and agriculture by travelers from China, Europe and United States, our journey in agriculture, green revolution and its impact and concerns, vision for the future.

Suggested Readings :

1. Choudhary, S.L., Sharma, G.S. and Nene, Y.L. (2000). Ancient and medievel history of Indian agriculture and its relevance to sustainable agriculture in the 21st century. Proceedings of the summer school held from 28 May to 17 June 1999. Rajasthan College of Agriculture, Udaipur, India
2. Nene, Y.L. and Choudhary, S.L. (2002). Agricultural heritage of India. Asian Agri – History foundation, Secundrabad.
3. Randhawa, M.S., 1980–86. A histroy of Agriculture in India. Vol. I, II, III and IV. Indian council of Agricultural Research, New Delhi.
4. Raychaudhuri, S.P. (1964). Agriculture in ancient India. Indian council of Agricultural Research, New Delhi.
5. Sadhale Nalini (Tr) (1996). Surapala's Vrikshayurveda (The science of plant life). Asian. History Bulletin No. 1. Asian – Agri – History foundation, Secundrabad.

AGRON 201	CROP PRODUCTION TECHNOLOGY – I (*KHARIF* CROPS)	3 (2 + 1)	SEM III/VII

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops; cereals– rice, maize, sorghum and pearl millet, pulses- pigeonpea, mungbean and urdbean; oilseeds- groundnut, and soybean; fibre crops- cotton & jute; forage crops-sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice; sowing of soybean, pigeonpea and mungbean; maize,

groundnut and cotton; effect of seed size on germination and seedling vigour of *kharif* season crops, effect of sowing depth on germination of *kharif* crops; identification of weeds in *kharif* season crops; top dressing and foliar feeding of nutrients; study of yield contributing characters and yield calculation of *kharif* season crops; study of crop varieties and important agronomic experiments at experimental farm; study of forage experiments, morphological description of *kharif* season crops, visit to research centres of related crops.

Suggested Readings :

1. Das, P.C. (2014). Oilseed crops of India, Kalyani Publications, New Delhi.
2. Kumar, S., Singh B., Dhaka, A. K. and Pannu, R.K. (2012). Mannual of Field crops-I (*Kharif* Crops), CCS HAU Publication.
3. Package of Practices for *Kharif* Crops. (2015). CCS HAU Publication.
4. Singh, C., Singh, P. and Singh, R. (2011). Modern techniques of raising field crops, Oxford & IBH Co Pvt. Ltd.
5. Singh, S.S. and Singh, R. (2016). Crop Management, Kalyani Publication, New Delhi.

AGRON 202	CROP PRODUCTION TECHNOLOGY – II (*RABI* CROPS)	3 (2 + 1)	SEM IV/VIII

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops; cereals– wheat and barley, pulses-chickpea, lentil, peas, oilseeds- rapeseed, mustard and sunflower; sugar crops- sugarcane; forage crops- berseem, lucerne and oat.

Practical

Sowing methods of wheat and sugarcane; identification of weeds in *rabi* season crops; study of morphological characteristics of *rabi* crops; study of yield contributing characters of *rabi* season crops; yield and juice quality analysis of sugarcane; study of important agronomic experiments of *rabi* crops at experimental farms; study of *rabi* forage experiments; visit to research stations of related crops.

Suggested Readings :

1. Das, P.C. (2014). Oilseed crops of India, Kalyani Publications, New Delhi.
2. Kumar, S., Singh B., Dhaka, A. K. and Pannu, R.K. (2012). Mannual of Field crops-I (*Kharif* Crops), CCS HAU Publication.
3. Package of Practices for *Kharif* Crops. (2015). CCS HAU Publication.
4. Singh, C., Singh, P. and Singh, R. (2011). Modern techniques of raising field crops, Oxford & IBH Co Pvt. Ltd.
5. Singh, S.S. and Singh, R. (2016). Crop Management, Kalyani Publication, New Delhi.

AGRON 203	PRINCIPLES OF AGRONOMY (For B.Tech. Agricultural Engineering)	3 (2 + 1)	SEM III

Theory

Introduction and scope of agronomy; classification of crops, effect of different weather parameters on crop growth and development; principles of tillage, tilth and its characteristics; crop seasons; methods, time and depth of sowing of major field crops; methods and time of application of manures and fertilizers; organic farming: sustainable agriculture; soil water plant relationship, crop coefficients, water requirement of crops and critical stages for irrigation, weeds and their control, crop rotation, cropping systems, relay cropping and mixed cropping.

Practical

Identification of crops and their varieties, seeds, manures, fertilizers and weeds; fertilizer application methods; different weed control methods; practice of ploughing, practice of puddling, practice of sowing.

Suggested Readings :

1. Balasubramaniyan, P. and Palaniappan, S.P. (2001). Principles and Practices of Agronomy. Agrobios.
2. Singh, S.S. (2006). Principles and Practices of Agronomy - Kalyani.
3. Yawalkar, K.S, Agrawal, J.P. and Bokde, S. (2000). Manures and Fertilizers - Agri-Horti Publ.
4. Rao, V.S. (2000). Principles of Weed Science. Oxford & IBH.
5. Sharma, A. (2002). *Hand Book of Organic Farming* Agrobios.

AGRON 204	FARMING SYSTEM AND SUSTAINABLE AGRICULTURE	1 (1 + 0)	SEM IV/VIII

Theory

Farming system-scope, importance, and concept; types and systems of farming system and factors affecting types of farming; farming system components and their maintenance; cropping system and pattern, multiple cropping system; efficient cropping system and their evaluation; allied enterprises and their importance; tools for determining production and efficiencies in cropping and farming system; sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability; integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages; site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques; resource cycling and flow of energy in different farming system, farming system and environment; visit of IFS model in different agro-climatic zones of nearby states university/institutes and farmers field.

Suggested Readings :

1. Palaniappan, S.P. and Sivaraman, K. (1996). Cropping Systems in the Tropics; Principles and Management. New Age.
2. Panda, S.C. (2003). Cropping and Farming Systems, Agrobios Publications.
3. Reddy, S.R. (2000). Principles of Crop Production, Kalyani Publications.
4. Sankaran, S. and Mudaliar, T.V.S. (1997). Principles of Agronomy, The Bangalore Printing & Publ. Co.
5. Singh, S.S. (2006). Principles and Practices of Agronomy, Kalyani Publications.

AGRON 206/ SOILS 204/ MICRO 204	AGRICULTURAL WASTE MANAGEMENT (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1 + 1)	SEM IV/VIII

Theory

Introduction to agricultural waste management; nature and characteristics of agricultural waste and their impact on the environment; kinds of wastes; classification, role of soil and plants in waste management, sources of waste, impact of waste on soil and plant quality; biological processes of waste management, utilization and recycling of agricultural waste, potential of recyclable crop residues and its management, in-situ management of agriculture waste, composting and

vermicomposting for bio-conservation of biodegradable waste, biogas technology, agricultural waste and water, air and animal resources, impacts of waste on human, animal health and environment; management of bedding & litter, wasted feed, run-off from feed lots and holding areas and waste water form dairy parlors, agro-waste recycling through farming system, waste management machineries, environmental benefit of waste management.

Practical

Collection and preparation agricultural waste sample; determination of pH, EC, CEC, heavy metals, BOD, COD, TSS, TDS, NH_4, total P, and dissolved reactive P; nutrient status (N, P, K, secondary and micronutrients), analysis of agricultural waste; waste management equipment operation, maintenance and safety hazards, computer software and models; survey of different agri- wastes from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals; preparation of compost, vermicomposting, biogas and analysis of compost.

Suggested Readings :

1. Chongrak, P. (1996). Organic Wastes Reclying, John Wiley and Sons.
2. Kapoor, K. K., Sharma, P. K., Dudeja, S. S. and Kundu, B. S. (2005). Management of Organic Wastes for Crop Production, Proceedings of the National Symposium on Management of Organic Wastes for Crop Production.
3. Raymond, C. L. (2012). Agricultural Waste Management: Problems, Processes and Approaches, Academic Press, New York.
4. Sannigrahi, A.K. (2011). Agriculture And Waste Management For sustainable Future, New India Publishing Agency, Pitam Pura New Delhi.
5. Srivastav, M. L. (2007). Waste Management, Shree Publications and Distributors, New Delhi.

AGRON 301	PRACTICAL CROP PRODUCTION - I (*KHARIF* CROPS)	1 (0 + 1)	SEM V/IX

Practical

Crop planning, raising field crops in multiple cropping systems: field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce; emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies; preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

AGRON 302	PRACTICAL CROP PRODUCTION - II *(RABI* CROPS*)*	1 (0 + 1)	SEM VI/X

Practical

Crop planning, raising field crops in multiple cropping systems: field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce; emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies; preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

AGRON 303	GEOINFORMATICS AND NANOTECHNOLOGY FOR PRECISION FARMING	2 (1 + 1)	SEM V/IX

Theory

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; geo-informatics: definition, concepts, tool and techniques; their use in precision agriculture; crop discrimination and yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; spatial data and their management in GIS; geodesy and its basic principles; remote sensing concepts and application in agriculture; image processing and interpretation; global positioning system (GPS), components and its functions; system simulation- concepts and principles, introduction to crop simulation models and their uses for optimization of agricultural inputs; STCR approach for precision agriculture; nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors; use of nanotechnology in tillage, seed, water, fertilizer, plant protection for scaling-up farm productivity.

Practical

Introduction to GIS software, spatial data creation and editing; introduction to image processing software; visual and digital interpretation of remote sensing images; generation of spectral profiles of different objects; supervised and unsupervised classification and acreage estimation; multispectral remote sensing for soil mapping; creation of thematic layers of soil fertility based on GIS; creation of productivity and management zones; fertilizers recommendations based of VRT and STCR techniques; crop stress (biotic/abiotic) monitoring using geospatial technology; use of GPS for agricultural survey; formulation, characterization and applications of nanoparticles in agriculture; projects formulation and execution related to precision farming.

Suggested Readings :

1. Krishna, K. R. (2013). Precision Farming Soil Fertility and Productivity Aspects, Apple Academic Press, New Jersey.
2. Otto Huisman and Rolf A. D. (2009). Principles of Geographic Information Systems, ITC Educational Text book.
3. Reddy, S.R. (1999). Geoinformatics and Nanotechnology for Precision Farming, Kalyani Publications.
4. Suarau, O., Oshunsanya and OrevaOghene Aliku. (2016). GIS Applications in Agronomy.
5. Zhang, Q. (2016). Precision Agriculture Technology for Crop Farming, CRC Press, New York.

AGRON 304	PRINCIPLES OF ORGANIC FARMING	2 (1 + 1)	SEM VI/X

Theory

Organic farming, principles and its scope in India; initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; organic ecosystem and their concepts; organic nutrient resources and its fortification; restrictions to nutrient use in organic farming; choice of crops and varieties in organic farming; fundamentals of insect, pest, disease and weed management under organic mode of production; operational structure of NPOP; certification process and standards of organic farming; processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical

Visit of organic farms to study the various components and their utilization; preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; indigenous

technology knowledge (ITK) for nutrient, insect, pest disease and weed management; cost of organic production system; post harvest management; quality aspect, grading, packaging and handling.

Suggested Readings :

1. Lampin, N. (1990). Organic Farming. Press Books, lpswitch, UK.
2. Palaniappan, S.P. and Anandurai, K. (1999). Organic Farming –Theory and Practice, Scientific Publications.
3. Sharma, A. (2002). Hand Book of Organic Farming, Agrobios.
4. Subba Rao, N.S. (2002). Soil Microbiology, Oxford & IBH Publications.
5. Veeresh, G.K., Shivashanka, K. and Suiglachar, M.A. (1997). Organic Farming and Sustainable Agriculture, Association for Promotion of Organic Farming, Bangalore.

AGRON 305	WEED MANAGEMENT	3 (2 + 1)	SEM V/IX

Theory

Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem; classification, reproduction and dissemination of weeds; crop-weed competition, concept of weed management, it's principles and methods, herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use; introduction to mode of action of herbicides and selectivity; allelopathy and its application for weed management; bio-herbicides and their application in agriculture; concept of herbicide mixture and utility in agriculture; herbicide compatibility with nutrients and their application; integration of herbicides with non chemical methods of weed management; herbicide resistance and its management.

Practical

Techniques of weed preservation; weed identification and their losses study; biology of important weeds; study of herbicide formulations and mixture of herbicide; herbicide and nutrient compatibility study; shift of weed flora study in long term experiments; study of methods of herbicide application, spraying equipments; calculations of herbicide doses and weed control efficiency and weed index.

Suggested Readings :

1. Aldrich, R.J. and Kramer, R.J. (1997). Principles in Weed Management. Panima Publications.
2. Gupta, O.P. (2007). Weed Management – Principles and Practices. Agrobios Publications.
3. Mandal, R.C. (1990). Weed, Weedicides and Weed Control - Principles and Practices. Agro-Botanical Publications.
4. Rao, V.S. (2000). Principles of Weed Science. Oxford & IBH publications.
5. Zimdahl, R.L. (1999). Fundamentals of Weed Science. 2nd Ed. Academic Press.

AGRON 306	RAINFED AGRICULTURE AND WATERSHED MANAGEMENT	2 (1 + 1)	SEM VI/X

Theory

Rainfed agriculture: introduction, types, history of rainfed agriculture & watershed in India; problems and prospects of rainfed agriculture in India; soil and climatic conditions prevalent in rainfed areas; drought: types, effect of water deficit on physio-morphological characteristics of the plants, mechanism of crop adaptation under moisture deficit condition; water harvesting: importance, its techniques, efficient utilization of water through soil and crop management practices,

management of crops in rainfed areas, contingent crop planning for aberrant weather conditions, concept, objective, principles and components of watershed management, factors affecting watershed management.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons; studies on cropping pattern of different dry land areas in the country and demarcation of dry land area on map of India; interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops; critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation; studies on cultural practices viz; mulching, plant density, depth of sowing, thinning and leaf removal for mitigating moisture stress; characterization and delineation of model watershed; field demonstration on soil & moisture conservation measures; field demonstration on construction of water harvesting structures; visit to rainfed research station/watershed.

Suggested Readings :

1. Das, N.R. (2007). Tillage and Crop Production. Scientific Publications.
2. Gupta, U.S. (Ed.). (1995). Production and Improvements of Crops for Drylands. Oxford & IBH.
3. Rao, S.C. and Ryan, J. (2007). Challenges and Strategies of Dryland Agriculture. Scientific Publ.
4. Singh, R.P. (2005). Sustainable Development of Dryland Agriculture in India. Scientific Publications.
5. Venkateshwarlu, J. (2004). Rainfed Agriculture in India. Research and Development Scenario. ICAR publication.

AGRON 307/ COMP 301/ AGM 301	**AGRICULTURAL INFORMATICS (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)**	**2 (1 + 1)**	**SEM V/IX**

Theory

Introduction to computers, anatomy of computers, memory concepts, units of memory, operating system, definition and types, applications of MS-Office for creating, editing and formatting a document, data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, database, concepts and types, creating database, uses of DBMS in agriculture, internet and World Wide Web (WWW), concepts and components; computer programming, general concepts, introduction to visual basic, java, fortran, C/ C++, etc, concepts and standard input/output operations; e-agriculture, concepts, design and development; application of innovative ways to use information and communication technologies (IT) in agriculture; computer models in agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation; smartphone mobile apps in agriculture for farm advises; geospatial technology, concepts, techniques, components and uses for generating valuable agri-information; decision support systems, concepts, components and applications in agriculture, preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of computer components, accessories, practice of important DOS commands; introduction of different operating systems such as windows, Unix/ Linux, creating, files & folders, file

management; use of MS-WORD and MS Power-point for creating, editing and presenting a scientific document; MS-EXCEL - creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: creating database, preparing queries and reports, demonstration of agri-information system; introduction to World Wide Web (WWW) and its components; introduction of programming languages such as Visual Basic, Java, Fortran, C, C++; hands on practice on crop simulation models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost; use of smart phones and other devices in agro-advisory and dissemination of market information; introduction of geospatial technology for generating information important for agriculture; hands on practice on preparation of decision support system; preparation of contingent crop planning.

Suggested Readings :

1. Balagurusamy, E. (1987). Office Automation and Word Processing, Mc Graw-Hill Education, New Delhi.
2. Basandra, Suresh K. (2010). Computer Today, Galgotia Publications Pvt. Ltd.
3. Sinha, P.K. (1992). Computer Fundamentals – Concept, System and Application, BPB, Publication, New Delhi.
4. Vanitha, G. and Kalpana, M. (2011). Agro-Informatics, New India Publishing Agency, New Delhi
5. Xavier, C. (1998). Introduction to Computers and Basic Programming, New Age International, New Delhi.

Module 2	**ORGANIC PRODUCTION TECHNOLOGY**	**10 (0+10)**	**SEM VIII/XII**
Weekly activities			
Week	**Activities**		
1	Organic production technology concept and it's principles, organic farming and national economy		
2	Soil health management using organic sources and nutrient recycling, types of green manuring and incorporation of green manure crop in soil		
3	Biomass production and N accumulation of green manure crops		
4	Insect- pest management under organic production		
5	Weed management under organic production		
6	Organic production of major crops: wheat, maize, summer pulses and fodder		
7	Horticultural and vegetable crops		
8	Vermicompost production methodology		
9	Preparation of vermiculture bed		
10	Watering the vermibeds		
11	Harvesting of vermicompost and earthworm, calculation of nutritive value of vermicompost		
12	Storing and packing of vermicompost, residue management under organic farming		
13	Aerobic and anaerobic methods of making compost, identification and nursery raising of important agro-forestry tress and tress for shelter belts		
14	Quality analysis of organic inputs and products, computation of relative economics of organic production programmes		
15	Socio-economic impacts, marketing and export potential of organic products, and visit to an organic farm		
16	Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms		

BUSINESS MANAGEMENT

Course No.	Course Title	Credits	Semester
Core course			
ABM 102	Entrepreneurship Development and Business Management (For B.Tech. Agri cultural Engineering)	3 (2+1)	**II**
	Total Credits	**3 (2+1)**	

ABM 102	ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT (For B.Tech. Agricultural Engineering)	3 (2 + 1)	SEM II

Theory

Management: management functions, planning, organizing, directing, motivation, ordering, leading, supervision, communication and control; financial management: importance of financial statements, balance sheet, profit and loss statement, analysis of financial statements, liquidity ratios, leverage ratios; coverage ratios, turnover ratios, profitability ratios; agro-based industries, project, project life cycle, project appraisal and evaluation techniques, undiscounted measures, payback period, proceeds per rupee of outlay; discounted measures, net present value (NPV), benefit-cost ratio (BCR), internal rate of return (IRR), net benefit investment ratio (N/K ratio); importance of agribusiness in Indian economy, international trade: WTO agreements, provisions related to agreements in agricultural and food commodities; agreements on agriculture (AOA), domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, trade related intellectual property rights (TRIPS); entrepreneurship development (ED): concept of entrepreneur and entrepreneurship, assessing overall business environment in Indian economy, entrepreneurial and managerial characteristics, entrepreneurship development programmes (EDP), generation, incubation and commercialization of ideas and innovations, motivation and entrepreneurship development, globalization and the emerging business entrepreneurial environment; role of ED in economic development of a country; overview of Indian economic, social, political systems and their implications for decision making by individual entrepreneurs; social responsibility of business; SWOT analysis: government schemes and incentives for promotion of entrepreneurship, government policy on small and medium enterprises (SMEs)/SSIs/ MSME sectors, venture capital (VC), contract farming (CF) and joint ventures (JV), public-private partnerships (PPP), overview of agricultural engineering industry, characteristics of Indian farm machinery industry.

Practical

Preparation of business: strengths weaknesses opportunities and threats (SWOT) analysis, analysis of financial statements (balance sheet, profit loss statement); compounding and discounting, break-even analysis; visit to agro-based industries; study of agro-industries development corporation, ratio analysis, application of project appraisal technique– I(undiscounted measures), application of project appraisal technique – II(discounted measures), formulation of project feasibility reports, farm machinery project proposals as entrepreneur – individual and group; presentation of project proposals in the class.

Suggested Readings :

1. Koontz, M. Principles of Management. O'doniel.
2. Chandra, P. Financial Management.
3. Nandan,H. Fundamentals of Entrepreneurship Management.
4. Chandra, P. Project Management.
5. Vasisht, A.K. and Singh, Alka. WTO and New International Trade Regime- Implication for Indian Agriculture.

ENTOMOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
ENT 102	Fundamentals of Entomology	4 (3+1)	II/VI
ENT 301	Pests of Crops and Stored Grain and their Management	3 (2+1)	V/IX
ENT 302	Management of Beneficial Insects	2 (1+1)	VI/X
	Total Credits	**9 (6+3)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 3	Bee Keeping	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

ENT 102	FUNDAMENTALS OF ENTOMOLOGY	4 (3 + 1)	SEM II/VI

Theory

Part - I

History of entomology in India; factors for insect's abundance; major points related to dominance of insecta in animal kingdom; classification of phylum arthropoda upto classes; relationship of class insecta with other classes of arthropoda; morphology: structure and functions of insect cuticle and molting; body segmentation; structure of head, thorax and abdomen; structure and modifications of insect antennae, mouth parts, legs, wing venation, modifications and wing coupling apparatus; structure of male and female genital organ; metamorphosis and diapause in insects; types of larvae and pupae; structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretary (endocrine) and reproductive system, in insects; types of reproduction in insects; major sensory organs like simple and compound eyes, chemoreceptor.

Part-II

Insect ecology: introduction, environment and its components; effect of abiotic factors–temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents; effect of biotic factors–food competition, natural and environmental resistance; concepts of balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem.

Part III

Pest surveillance and pest forecasting; categories of pests; host plant resistance, cultural, mechanical, physical; legislative; biological (parasites, predators & transgenic plant pathogens such as bacteria, fungi and viruses) methods of control; chemical control-importance, hazards and limitations; classification of insecticides, toxicity of insecticides and formulations of insecticides; recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation and genetic control; practices, scope and limitations of IPM; insecticides Act 1968-important provisions; application techniques of spray fluids; phytotoxicity of insecticides; symptoms of poisoning, first aid and antidotes; beneficial insects: parasites and predators used in pest control and their mass multiplication techniques; important groups of microorganisms, bacteria, viruses and fungi used in pest control and their mass multiplication techniques; important species of pollinators, weed killers and scavengers, their importance.

Part – IV

Systematics: taxonomy–importance, history and development and binomial nomenclature;

definitions of biotype, sub-species, species, genus, family and order; classification of class Insecta upto orders, basic groups of present day insects with special emphasis to orders and families of agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papiloinidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturnidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthridinidae, Apidae. Trichogrammatidae, lchneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae,Muscidae, Tephritidae.

Practical

Methods of collection and preservation of insects including immature stages; external features of grasshopper/blister beetle; types of insect antennae, mouthparts and legs; wing venation, types of wings and wing coupling apparatus; types of insect larvae and pupae; dissection of digestive system in insects (Grasshopper); dissection of male and female reproductive systems in insects (Grasshopper); study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance.

Suggested Readings :

1. Borror and DeLong's (2005). Introduction to the Study of Insects. 7th Edition. Norman F. Johnson, Charles A. Triplehorn. Thomson Brooks/cole Publishing Co. Singapore.
2. Chapman, R.F. (1982). The Insects: Structure and Function. Cambridge Univ. Press.
3. David, B.V. and Ananthkrishnan, T.N. (2003). General and Applied Entomology. IInd Edition. Tata McGraw Hill.Bangalore.
4. Evans, J.W. (2004). Outlines of Agricultural Entomology. Asiatic Publ. New Delhi.
5. Larry P Pedigo and Marline, E. (2014). Entomology and Pest Management. Sixth Edition. Rice Waveland Press Inc. London by Larry P Pedigo , Tata McGraw Hill.

ENT 301	PESTS OF CROPS AND STORED GRAIN AND THEIR MANAGEMENT	4 (3 + 1)	SEM V/IX

Theory

General account on nature and type of damage by different arthropods pests; scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, narcotics, spices and condiments; factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain; insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management; storage structure and methods of grain storage and fundamental principles of grain store management.

Practical

Identification of different types of damage; identification and study of life cycle and seasonal history of various insect pests attacking crops and their produce: (a) Field crops; (b) Vegetable crops; (c) Fruit crops; (d) Plantation, gardens, narcotics, spices & condiments; identification of insect pests and mites associated with stored grain; determination of insect infestation by different methods; assessment of

losses due to insects; calculations on the doses of insecticides application technique; fumigation of grain store/godown; identification of rodents and rodent control operations in godowns; identification of birds and bird control operations in godowns; determination of moisture content of grain; methods of grain sampling under storage condition; visit to Indian Storage Management and Research Institute, Hapur and Quality Laboratory, Department of Food, Delhi; visit to nearest FCI godowns.

Suggested Readings :

1. Atwal, A.S. (1976). Agricultural Pests of India and South East Asia. Kalyani Publishers, Ludhiana.
2. Butani, D. K. (1984). Insects and Fruits. Periodical Export Book Agency, New Delhi.
3. Nair, M.R.G.K. (1986). Insects and Mites of crops in India. Indian Council of Agricultural Research New Delhi.
4. Ramakrishna Ayyar, T.V. (1963). Handbook of Economic Entomology for South India. Government Press, Madras.
5. Vasantharaj David, B. (2003). Elements of Economic Entomology. Popular Book Depot, Coimbatore.

ENT 302	MANAGEMENT OF BENEFICIAL INSECTS	2 (1 + 1)	SEM VI/X

Theory

Importance of beneficial Insects, beekeeping, pollinating plant and their cycle, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease; bee pasturage, bee foraging and communication; insect pests and diseases of honey bee; types of silkworm, voltinism and biology of silkworm; mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves; rearing, mounting and harvesting of cocoons; pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection; species of lac insect, morphology, biology, host plant, lac production– seed lac, button lac, shellac, lac- products; identification of major parasitoids and predators commonly being used in biological control; insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques; important species of pollinator, weed killers and scavengers with their importance.

Practical

Honey bee species, castes of bees; beekeeping appliances and seasonal management, bee enemies and disease; bee pasturage, bee foraging and communication; types of silkworm, voltinism and biology of silkworm; mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves; species of lac insect, host plant identification; identification of other important pollinators, weed killers and scavengers; visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies.

Suggested Readings :

1. Abrol, D.P. (2009). Bees and Beekeeping in India, Kalyani Publishers. Head Office: B-1/1292, Rajinder Nagar, Ludhiana-141 008.
2. Ghorai, N. (1995). Lac cultivation in India, Publisher –International Books & Periodicals Supply Service, New Delhi.
3. Krishnaswami, S. (1960). Lac Cultivation in India,Ministry of Agriculture, Directorate of Extension, Farm Information Unit, Farm Bulletin, 59.
4. M. Madan Mohan Rao (1998). A Textbook of Sericulture. B.S. Publications, Sultan Nagar, Hyderabad.
5. Mishra, R.C. (1998). Perspectives in Indian Apiculture –Publisher Agro Botanica, 4E 176 J.N. Vyas Nagar, Bikaner.

Module 3	BEE KEEPING	10 (0+10)	SEM VIII/XII
Weekly activities			
Week	**Activities**		
1	Identification of different honeybees species, life-cycle, colony organization and division of labour in Apis mellifera; study the body structure and appendages of honey bees		
2	Identify the parts of hive and beekeeping equipments, describe the dimensions of various parts of hives and equipments; use of different beekeeping equipments and their maintenance, and skill development for handling beekeeping tools for various systems		
3	Identify the suitable site for apiary, installation of beehive and how to establish apiary and precautions while handling beehives		
4	Maintenance of data and record keeping, identification and selection of strong colonies, colony management during honey flow and dearth period, strategies for maximizing honey production in Apis mellifera colonies, ensuring cleanliness and hygiene of beehive		
5	Management of swarming, absconding, robbing & drifting menaces and curbing drone population		
6	Management of Apis mellifera colonies during spring and summer seasons		
7	Management of Apis mellifera colonies during monsoon, autumn and winter seasons		
8	Colony division and uniting; bee flora, its distribution, importance and utility to honey bees		
9	Learn the pollination process and construct a flowering calendar for various season, management of Apis mellifera colonies for crop pollination		
10	Honey extraction, processing and packaging, pollen, propolis and bee venom collection, and processing of bee wax		
11	Traditional techniques for mass rearing of queen bees, doolittle and other novel technologies of mass queen bee rearing		
12	Queen introduction, clipping and marking; management of queenless and laying worker colonies of Apis mellifera, royal jelly production and collection		
13	Farm visit for flora identification and foraging behavior, bee pollination of crops		
14	Management of bacterial and viral diseases of honey bees		
15	Management of fungal and protozoan diseases of honey bees, protecting honey bees against pesticidal poisoning		
16	Identification and management of parasitic mites, wax moths, ants and wasps and predatory birds		

EXTENSION EDUCATION

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
EXT 102	Fundamentals of Agricultural Extension Education	3 (2+1)	II/VI
EXT 202	Communication Skills and Personality Development	2 (1+1)	IV/VIII
EXT 301	Entrepreneurship Development and Business Communication	2 (1+1)	V/IX
	Total Credits	**7 (4+3)**	
AG ECON 491/ AGRON 491/ EXT 491	Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Agronomy, Agricultural Economics and Extension Education)	20 (0+20)	VII/XI
	Total Credits	**20 (0+20)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 1	Agro-advisory Services (To be taught jointly by Agricultural Meteorology and Extension Education)	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

EXT 102	FUNDAMENTALS OF AGRICULTURAL EXTENSION EDUCATION	3 (2 + 1)	SEM II/VI

Theory

Education: meaning, definition & types; extension education- meaning, definition, scope and process; objectives and principles of extension education; extension programme planning- meaning, process, principles and steps in programme development; extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND,NATP, NAIP, etc.); new trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.; rural development: concept, meaning, definition; various rural development programmes launched by Govt. of India; community development- meaning, definition, concept & principles; physiology of C.D. rural leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions; monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes; transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, media mix strategies; communication: meaning and definition; models and barriers to communication; agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To be acquainted with university extension system; group discussion- exercise; handling and use of audio visual equipments and digital camera and LCD projector; preparation and use of AV aids, preparation of extension literature– leaflet, booklet, folder, pamphlet news stories and success stories; presentation skills exercise; micro teaching exercise; a visit to village to understand the problems being encountered by the villagers/ farmers; study of organization and functioning of DRDA and other development departments at district level; visit to NGO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for

understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

Suggested Readings :

1. Jalihal, K.A. and Veerabhadraiah, V. (2007). Fundamentals of Extension Education and Management in Extension, Concept Publications.
2. Khan, P.M. and Somani, L.L. (2009). Fundamentals of Extension Education, Agrotech Publishing Academy, Udaipur.
3. Mondal, Sagar (2015). Agricultural Extension, Kalyani Publishers.
4. Ray, G.L. (2006). Extension Communication and Management, Kalyani Publishers.
5. Van Den Ban, A.W. and Hawkins, H.S. (1998). Agricultural Extension, 2nd Ed. CBS.

EXT 202	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT	2 (1 + 1)	SEM IV/VIII

Theory

Communication skills: meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; communication barriers, building self-esteem and self-confidence ; know the importance of personality development, dimensions of personality development like attitude, team work, management of conflicts, identity the different personality traits; reading and comprehension of general and technical articles, summarizing, abstracting, individual and group presentations, impromptu presentation, public speaking, group discussion; organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Suggested Readings :

1. Kaur, J. and Sakhuja, R. (2016). Personality Development and Communication Skills, Galgotia Publishing Company.
2. Rao, V. S. P. (2011). Organizational Behaviour, Himalaya Publishing House.
3. Ray, G.L. (2006). Extension Communication and Management, Kalyani Publishers.
4. Sandhu, A.S. (2014). Text Book on Agricultural Communication: Process and Methods, Jain Book Depot.
5. Sharma, P.C. (2013). Communication Skills and Personality Development, Nirali Prakashan.

EXT 301	ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION	2 (1 + 1)	SEM V/IX

Theory

Concept of entrepreneur, entrepreneurship development, characteristics of entrepreneurs; assessment of entrepreneurship skills, SWOT analysis & achievement motivation; entrepreneurial behavior, government policy and programs and institutions for entrepreneurship development; entrepreneurial development process; business leadership skills; communication skills for entrepreneurship development, developing organizational skill; developing managerial skills, problem solving skill, achievement motivation; time management; supply chain management and total quality management, project planning formulation and report preparation; opportunities for entrepreneurship and rural entrepreneurship.

Practical

Assessing entrepreneurial potential; problem solving ability; managerial skills and achievement

motivation; exercise in creativity, time audit, preparation of business plan and proposal writing; visit to entrepreneurship development institute and entrepreneurs.

Suggested Readings :

1. Grover, Indu (2008). Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
2. Gupta C.B. (2001). Management Theory and Practice. Sultan Chand & Sons.
3. Khanka, S.S. (1999). Entrepreneurial Development. S. Chand & Co.
4. Ray, G.L. (2006). Extension Communication and Management. Kalyani Publ.
5. Tripathi, P.C. and Reddy, P.N. (1991). Principles of Management. Tata McGraw Hill. Vasanta.

Module 1	**AGRO-ADVISORY SERVICES (To be taught jointly by Agricultural Meteorology and Extension Education)**	**10 (0+10)**	**SEM VIII/XII**

Weekly activities	
Week	**Activities**
1	Exposure and operation of meteorological instruments/equipments in agromet observatories, automatic weather station – data logger and sensors, measurement of weather variables, computation and interpretation of data
2	Practical knowledge of different methods of weather forecast and their significance for agriculture at short, medium and long range levels
3	Use of satellite imageries and synoptic charts in weather forecasting
4	Methodology of special forecasts for drought, floods, high winds, cold waves, frost and heat waves, hail storms, cyclones and advisory for protection against such extreme events
5	Basic knowledge of agro advisory services of India and their role in development of agriculture, preparation of weather-based agro-advisories using various approaches and synoptic charts
6	Compilation of agromet bulletin, district, state and national level, flow chart of dissemination of agro advisory service, use of ICT in preparation and dissemination of agro-advisories, online and offline agro-advisory services bulletin generation
7	Development of survey proforma and analysis of impact the agro-advisory adopted village to monitor farmers' risk perceptions, attitudes and to assess, mitigation and adaptation strategies to abnormal biotic and abiotic stress through agro-advisory services
8	Analyze the significant, adoption and decision support at farm level through agro-advisory services
9	Evaluation of dissemination, adoption and impact of agro advisory services, preparation of crop weather calendars
10	Computation of agro climatic requirement of different *rabi* and *kharif* crops
11	Preparation of crop contingency advisory plan for different conditions of SW Monsoon, quantification of weather-pests-diseases of different crops, vegetable and fruit crops
12	Organizing PRA techniques in a village to identify the agricultural problems, simulating exercises on communication, fixing the priorities and preparation of project on agricultural problems
13	Organization of group discussion and method of demonstration, planning and writing the scripts of radio and television or audio/visual/print aids and information material for farming community
14	Preparation of district wise crop benefit ration of stockholder due adoption through agro-advisory services (practical report of individual)
15	Visit of KVK/FTC/Radio Station/TV station/NGO/Kisan Mela, etc.,
16	Visit of agromet-advisory division and weather forecasting centre, India Meteorological Department, New Delhi and National Centre of Medium Range Weather Forecasting Centre (NCMRWF) Noida to expand the practical knowledge of students

FORESTRY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
FOR 101	Introduction to Forestry	3 (2+1)	I/V
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3+0)	Agri.: III/VII B.Tech.: II CS : III
	Total Credits	**6 (5+1)**	

FOR 101	INTRODUCTION TO FORESTRY	3 (2 + 1)	SEM I/V

Theory

Introduction– definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian forest policies; forest regeneration, natural regeneration-natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; artificial regeneration– objectives, choice between natural and artificial regeneration, essential preliminary considerations; crown classification; tending operations– weeding, cleaning, thinning– mechanical, ordinary, crown and advance thinning; forest mensuration– objectives, diameter measurement, instruments used in diameter measurement; non instrumental methods of height measurement-shadow and single pole method; instrumental methods of height measurement- geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees; agroforestry– definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens; cultivation practices of two important fast growing tree species of the region.

Practical

Identification of tree-species; diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees; height measurement of standing trees by shadow method, single pole method and hypsometer; volume measurement of logs using various formulae; nursery lay out, seed sowing, vegetative propagation techniques; forest plantations and their management; visits of nearby forest based industries.

Suggested Readings :

1. Chaturvedi, A.N. and Khanna, L.S. (1994). Forest Mensuration. International Book Distributor, Dehradun.
2. Dwivedi, A.P. (1992). Agroforestry- Principles and Practices. Oxford IBH Co. Pvt. Ltd. New Delhi.
3. Dwivedi, A.P. (1993). Forestry in India. Surya Publications, Dehradun.
4. Nair, P.K.R., Rai, M.R. and Buck, L.E. (2004). New Vistas in Agroforestry. Kluwer.
5. Thampan, P.K. (1993). Trees and Tree Farming. Peekay Tree Crops Development Foundation.

FOR 201 AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	**ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]**	**3 (3 + 0)**	**SEM Agri.: III/VII B.Tech.: II CS : III**

Theory

Multidisciplinary nature of environmental studies: definition, scope and importance; natural resources: renewable and non-renewable resources, natural resources and associated problems; forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forest and tribal people, wasteland management through tree plantations; water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies; land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles; ecosystems: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers, energy flow in the ecosystem; ecological succession, food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of the ecosystem: forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries); biodiversity and its conservation: introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India; value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels, India as a mega-diversity nation; hot-sports of biodiversity; threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity; environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards; solid waste management: causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; peaceful uses of chemistry; recycling and reusing the biodegradable and dry waste; social issues and environment: from unsustainable to sustainable development, 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, nuclear accidents and holocaust dies; wasteland reclamation; consumerism and waste products; environment protection act; air (prevention and control of pollution) act; water (prevention and control of pollution) act; wildlife protection act; forest conservation act; issues involved in enforcement of environmental legislation; 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.

Disaster management

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; man made disasters: nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water

pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents; disaster management: effect to migrate natural disaster 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 :

1. Anil, K Gupta and Nair, Sreeja S. (2012). Environmental Extremes: Disaster Risk Management addressing Climate Change, NIDM, New Delhi.
2. Baskar, Sushmitha and Baskar, R. (2007). Environmental Studies for Undergraduate Courses. Unicorn Books, New Delhi.
3. Bharucha Erach (2004). Environmental Science for Undergraduate Courses. University Grants Commission, New Delhi.
4. Dwivedi, A.P. (1992). Agroforestry: Principles and Practices. Oxford & IBH.
5. Singh, Y.K. (2006). Environmental Science. New Age International (p) Limited, New Delhi.

GENETICS AND PLANT BREEDING

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
GP 102	Fundamentals of Genetics	3 (2+1)	II/VI
GP 201	Fundamentals of Plant Breeding	3 (2+1)	III/VII
GP 301	Crop Improvement-I (*Kharif* Crops)	3 (2+1)	V/IX
GP 302	Crop Improvement-II (*Rabi* Crops)	3 (2+1)	VI/X
	Total Credits	**12 (8+4)**	

GP 102	FUNDAMENTALS OF GENETICS	3 (2 + 1)	SEM II/VI

Theory

Pre and post Mendelian concepts of heredity, Mendelian_principles of heredity, cell division – mitosis, meiosis, probability and chi-square; dominance relationships, gene interaction; multiple alleles, pleiotropism and pseudoalleles, sex determination and sex linkage, sex limited and sex influenced traits, blood group genetics, linkage and its estimation, crossing over mechanisms, chromosome mapping; structural changes in chromosome, mutation, classification, methods of inducing mutation & CIB technique, mutagenic agents and induction of mutation; qualitative & quantitative traits, polygenes and continuous variations, multiple factor hypothesis, epistatic interactions with examples; cytoplasmic inheritance; genetic disorders, nature, structure & replication of genetic material; protein synthesis, transcription and translational mechanism of genetic material, gene concept: gene structure, function and regulation, lac and trp operons.

Practical

Study of microscope; study of cell structure; experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, experiments on epistatic interactions including test cross and back cross, practice on mitotic and meiotic cell division, experiments on probability and chi-square test; determination of linkage and cross over analysis (through two point test cross and three point test cross data); study on sex linked inheritance in drosophila; study of models on DNA and RNA structure.

Suggested Readings :

1. Gardner, E.J. and Snustad, D.P. (2010). Principles of Genetics. John Wiley & Sons.
2. Klug, W.S. and Cummings, M.R. (1986). Concepts of Genetics. Peterson Edu.
3. Russell, P.J. (1986). Genetics. The Benzamin/Cummings Publishing Co.
4. Strickberger, M.W. (1968). Genetics. Prentice Hall.
5. Tamarin, R.H. (1981). Principles of Genetics. Wm. C. Brown Publs.

GP 201	FUNDAMENTALS OF PLANT BREEDING	3 (2 + 1)	SEM III/VII

Theory

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; genetics in relation to plant breeding, modes of reproduction and apomixes, self–incompatibility and male sterility- genetic consequences, cultivar options; domestication, acclimatization, introduction; centre of origin/diversity, component of genetic variation; heritability and genetic advance; genetic basis and breeding methods in self- pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population; multiline concept;

concepts of population genetics and Hardy-Weinberg Law, genetic basis and methods of breeding cross pollinated crops, modes of selection; heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; breeding methods in asexually propagated crops, clonal selection and hybridization; wide hybridization and pre-breeding; polyploidy in relation to plant breeding, mutation breeding-methods and uses; breeding for important biotic and abiotic stresses; biotechnological tools- DNA markers and marker assisted selection; participatory plant breeding; intellectual property rights, patenting, plant breeders and & farmer's rights.

Practical

Plant breeder's kit, study of germplasm of various crops; study of floral structure of self-pollinated and cross pollinated crops; emasculation and hybridization techniques in self & cross pollinated crops; consequences of inbreeding on genetic structure of resulting populations; study of male sterility system; handing of segregation populations; methods of calculating mean, range, variance, standard deviation, heritability; designs used in plant breeding experiment, analysis of randomized block design; to work out the mode of pollination in a given crop and extent of natural out crossing; prediction of performance of double cross hybrids.

Suggested Readings :

1. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley & Sons, New York.
2. Chopra, V.L. (2004). Plant Breeding. Oxford & IBH Publishing Co. New Delhi.
3. Gupta, S.K. (2000). Plant Breeding: Theory and Techniques. Agribios Jodhpur.
4. Singh, B.D. (2012). (Ninth Revised Edition). Plant Breeding: Principles and Methods. Kalyani Publishers.
5. Singh, P. (2006). Essentials of Plant Breeding. Kalyani.

GP 301	CROP IMPROVEMENT-I (*KHARIF* CROPS)	3 (2 + 1)	SEM V/IX

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; plant genetic resources, its utilization and conservation; floral biology, study of genetics of qualitative and quantitative characters; important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); seed production technology in self pollinated, cross pollinated and vegetatively propagated crops; hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeonpea, etc. ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species; viz., rice, maize, sorghum, pearl millet, ragi, pigeonpea, urdbean, mungbean, soybean, groundnut, seasame, caster, cotton, cowpea, pearl millet and tobacco; maintenance breeding of different *kharif* crops; handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; study of field techniques for seed production and hybrid seeds production in *kharif* crops; estimation of heterosis, inbreeding depression and heritability; layout of field experiments; study of quality characters, donor parents for different characters; visit to seed production plots; visit to AICRP plots of different field crops.

Suggested Readings :

1. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley & Sons, New York.
2. George Acquaah (2012). Principles of Plant Genetics & Breeding. John Wiley & Sons, Ltd. Publication.
3. Panwar, I.S. and Singh, S. (2010). Theory and application of Biometrical Genetics. CBS Publishers & distributors Pvt. Ltd.
4. Poehlman, J.M. (1987). Breeding field crops. Van Nostrand Reinhold, NY.
5. Singh, S. and Panwar, I.S. (2006). Genetic basis and methods of plant breeding. CBS Publishers & distributors Pvt. Ltd.

GP 302	CROP IMPROVEMENT-II (*RABI* CROPS)	3 (2 + 1)	SEM VI/X

Theory

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; plant genetic resources, its utilization and conservation; floral biology, study of genetics of qualitative and quantitative characters; important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); seed production technology in self pollinated, cross pollinated and vegetatively propagated crops; hybrid seed production technology of *rabi* crops; ideotype concept and climate resilient crop varieties for future.

Practical

Emasculation and hybridization techniques in different crop species namely wheat, oat, barley, chickpea, lentil, field pea, rapeseed mustard, sunflower, potato, berseem; sugarcane, cowpea; handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; study of field techniques for seed production and hybrid seeds production in *rabi* crops; estimation of heterosis, inbreeding depression and heritability; layout of field experiments; study of quality characters, study of donor parents for different characters; visit to seed production plots; visit to AICRP plots of different field crops.

Suggested Readings :

1. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley & Sons, New York.
2. George Acquaah (2012). Principles of Plant Genetics & Breeding. John Wiley & sons, Ltd. Publication.
3. Poehlman, J.M. (1987). Breeding Field Crops. Van Nostrand Reinhold, NY.
4. Singh, B.D. (2012). (Ninth Revised Edition). Plant Breeding: Principles and Methods. Kalyani Publishers.
5. Singh, S. and Panwar, I. S. (2006). Genetic Basis and Methods of Plant Breeding. CBS Publishers & distributors Pvt. Ltd.

HORTICULTURE

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
HORT 201	Fundamentals of Horticulture	2 (1+1)	III/VII
HORT 202	Production Technology for Ornamental Crops, MAP and Landscaping	3 (2+1)	IV/VIII
HORT 203	Principles of Horticultural Crops and Plant Protection (For B.Tech. Agricultural Engineering)	2 (1+1)	III
HORT 204	Production Technology for Fruit and Plantation Crops	2 (1+1)	IV/VIII
HORT 302/ VSC 302	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	VI/X
	Total Credits	**11 (6+5)**	

HORT 201	FUNDAMENTALS OF HORTICULTURE	2 (1 + 1)	SEM III/VII

Theory

Horticulture-its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; plant propagation-methods and propagating structures; principles of orchard establishment; principles and methods of training and pruning, juvenility, physiology of flowering and flower bud differentiation; dormancy; fruit drop; fruit drop, unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; use of plant bio-regulators in horticulture; irrigation & fertilizers application-method and quantity.

Practical

Identification of garden tools; identification of horticultural crops; preparation of seed bed/nursery bed; practice of sexual and asexual methods of propagation; layout and planting of orchard plants; training and pruning of fruit trees; transplanting and care of vegetable seedlings; making of herbaceous and shrubbery borders; preparation of potting mixture, potting and repotting; fertilizer application in different crops; visits to commercial nurseries/orchard.

Suggested Readings :

1. Chadha, K. L. (2001). Handbook of Horticulture, Directorate of Information and Publication of Agriculture, ICAR, New Delhi.
2. Kumar, N. (2016). Introduction to Horticulture, Published by Oxford & IBH Publishing Co. Pvt. Ltd.
3. Singh, A. (2012). Fruit Physiology & Production, Kalyani Publishers, Ludhiana, New Delhi.
4. Singh, J. (2017). Basic Horticulture, Published by Kalyani Publishers, Ludhiana/Lyall BK Depot.
5. Swamy, G.S.K. and Auxcilia, J. (2017). Fundamental of Horticulture, ICAR e-course.

HORT 202	PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MAP AND LANDSCAPING	3 (2 + 1)	SEM IV/VIII

Theory

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping; principles of landscaping; landscape uses of trees, shrubs and climbers; lawn making; production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected

conditions and gladiolus, tuberose, chrysanthemum under open conditions; package of practices for loose flowers like marigold and jasmine under open conditions; production technology of important medicinal plants like asparagus, aloe, costus, cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver; processing and value addition in ornamental crops and MAPs produce.

Practical

Identification of ornamental plants; identification of medicinal and aromatic plants; nursery bed preparation and seed sowing; training and pruning of ornamental plants; planning and layout of garden; bed preparation and planting of MAP; protected structures– care and maintenance; intercultural operations in flowers and MAP; harvesting and post harvest handling of cut and loose flowers; processing of MAP; visit to commercial flower/MAP unit.

Suggested Readings :

1. Arora, J.S. (2012). Introductory Ornamental Horticulture, Kalyani Publishers, Ludhiana.
2. Bhattacharjee, S.K. and De, L.C. (2003). Advanced Commercial Floriculture, Aavishkar Publishers, Jaipur.
3. Chadha, K. L. (2001). Handbook of Horticulture, Directorate of Information and Publication of Agriculture, ICAR, New Delhi.
4. Farooqi, Azhar Ali and Sreeramu, B.S. (2010). Cultivation of Medicinal and Aromatic Plants, University Press, Hyderabad.
5. Joshi, Shankar Gopal (2000). Medicinal Plants, Oxford, New Delhi.

HORT 203	PRINCIPLES OF HORTICULTURAL CROPS AND PLANT PROTECTION (For B.Tech. Agricultural Engineering)	2 (1 + 1)	SEM III

Theory

Scope of horticultural crops; soil and climatic requirements for fruits, vegetables and floriculture crops, improved/commercial varieties/hybrids of sub-tropical region, criteria for site selection, layout and planting methods, nursery raising, sowing and planting times and methods, seed rate and seed treatment for vegetable crops; macro and micro propagation methods, plant growing structures, pruning and training, crop coefficients, water requirements and critical stages, fertilizer application, fertigation, irrigation methods, harvesting, grading and packaging, post harvest practices, garden tools, management of orchard, extraction and storage of vegetables seeds; major pests and diseases and their management in horticulture crops.

Practical

Maturity indices for harvesting of fruits and vegetables; study of seed viability and germination test; identification and description of important fruits, flowers and vegetable crops; study of different garden tools; preparation of nursery bed; practices of pruning and training in some important fruit crops, visit to commercial greenhouse/ polyhouse; cultural operations for vegetable crops (sowing, fertilizer application, mulching, irrigation and weed control); seed extraction techniques; identification of important pests and diseases and their control.

Suggested Readings :

1. Bal, J.S. (2007). Fruit growing (edition 2nd). Kalyani Publisher.
2. Hartman, H.T., Kester, F.T, Davies, R.G. (2011). Plant propagation principles & practices (edition 8th). Prentice Hall India Pvt. Ltd.

3. Arora, J.S. (1992). Introductory ornamental horticulture. (edition 2nd). Kalyani Publishers.
4. Chadha, K.L. (2010). Hand book of Horticulture. (edition 8th). ICAR Publication.
5. Singh, S.P. (1989). Production technology of Veg. crops (edition 1st). ARCC.

HORT 204	PRODUCTION TECHNOLOGY FOR FRUIT AND PLANTATION CROPS	2 (1 + 1)	SEM VI/VIII

Theory

Importance and scope of fruit and plantation crop industry in India; high density planting; use of rootstocks; production technologies for the cultivation of major fruits-mango, banana, ber, aonla, datepalm, sapota, plum, citrus, grape, guava, litchi, papaya, apple, pear, peach and; minor fruits-pineapple, pomegranate, jackfruit, strawberry, nut crops; plantation crops-coconut, areca nut, cashew, tea, coffee & rubber.

Practical

Seed propagation; scarification and stratification of seeds; propagation methods for fruit and plantation crops including micro-propagation; description and identification of fruit and plantation crops; preparation of plant bio regulators and their uses, pests, diseases and physiological disorders of above fruit and plantation crops, visit to commercial orchard.

Suggested Readings :

1. Bal, J.S. (2010). Fruit Growing, Kalyani Publishers, New Delhi.
2. Chadha, K. L. (2001). Handbook of Horticulture, Directorate of Information and Publication of Agriculture, ICAR, New Delhi.
3. Chadha, K.L. and Rethinam, P. (1994). Advances in Horticulture, Vol. 9 & 10, Plantation and Spices Crops, Malhotra Publishing House, New Delhi.
4. Kunte, Y.N.; Kawthalkar, M.P.; Yawalkar, K.S. (2014). Principles of Horticulture and Fruit Growing, Agri. Horticultural Publishing House, Nagpur, India.
5. Singh, A. (2003). Fruit Physiology and Production, 5th Edition, Kalyani Publisher, New Delhi.

HORT 302/ VSC 302	POST-HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES (To be taught jointly by Horticulture and Vegetable Science)	2 (1 + 1)	SEM VI/X

Theory

Importance of fruits and vegetables, extent and possible causes of post-harvest losses; pre-harvest factors affecting post-harvest quality, maturity, and ripening; changes occurring during ripening; respiration and factors affecting respiration rate; role of ethylene; post-harvest diseases and disorders; heat, chilling and freezing injury; harvesting and field handling; storage (ZECC, cold storage, CA, MA and hypobaric); value addition concept; principles and methods of preservation; intermediate moisture foodstuffs- jam, jelly, marmalade, preserve, candy- concepts and standards; fermented and non-fermented beverages (squash and syrup); tomato products- concepts and standards; drying/dehydration of fruits and vegetables- concept and methods, osmotic drying; canning- concepts and standards, and packaging of products.

Practical

Identification of equipments and materials used in post-harvest management; applications of different types of packaging container for shelf life extension; effect of temperature on shelf life and quality of produce; demonstration of chilling and freezing injury in vegetables and fruits; extraction

and preservation of pulps and juices; preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy, preserve and tomato products, chutney, canned products and preservation of fruits and vegetables; quality evaluation of products- physico-chemical and sensory; visit to processing unit/industry.

Suggested Readings :

1. Khader, V. (1999). Preservation of fruits and vegetables. Kalyani Publisher.
2. Lal, G., Siddappa, G.S. and Tandon, G.L. (1998). Preservation of Fruits & Vegetabls by ICAR Publications.
3. Srivastava, R.P. and Kumar, S. (1998). Fruit and Vegetable Preservation – Principles & Practices, Internatioal Book Distributing Co, Lucknow.
4. Wills, R.; Lea, T. and Graham, D. (1989). Post harvest and introduction to physiology and handling of fruits, vegetables and ornamental, CABI International.
5. Wills, R.B.H. (1989). Post harvest and introduction to physiology and handling of fruits and vegetables by AVI Publications.

NEMATOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core course			
NEMA 301	Introductory Nematology	2 (1+1)	V/IX
	Total Credits	**2 (1+1)**	

NEMA 301	INTRODUCTORY NEMATOLOGY	2 (1 + 1)	SEM V/IX

Theory

Introduction, history, kinds and habitats of nematodes; gross morphology of plant parasitic nematodes; biology and ecology of plant parasitic nematodes; nature of damage and general symptomatology; principles and practices of nematode management; hosts, distribution, biology, symptoms and management of important plant parasitic nematodes viz., *Meloidogyne* spp., *Heterodera avenae, Globodera rostochiensis* and *G. pallida*, *Radopholus similis, Hirschmanniella oryzae, Pratylenchus spp., Tylenchulus semipenetrans, Rotylenchulus reniformis, Anguina tritici, Aphelenchoides besseyi, Ditylenchus angustus.*

Practical

Collection of soil and plant samples; extraction of nematodes from soil and plant tissues; counting and estimation of nematode populations; killing, fixing and clearing nematodes; preparation of temporary and permanent mounts; study of major morphological characteristics; identification of important plant parasitic nematodes and symptoms caused by them; methods of nematode management.

Suggested Readings :

1. Bhatti, D.S. and Walia, R.K. (1992). Nematode Pests of Crops.CBS Publishers.
2. Janathan, E.I. (2010). Nematology Fundamentals and Application, New India Publishing Agency.
3. Ravichandra, N. G. (2008). Plant Nematology, IK International Publishing House Pvt. Ltd.
4. Reddy, P. P. (1987). A Treatise on Phytonematology, Agricole Publishing Academy.
5. Walia, R. K. and Bajaj, H.K. (2014). Textbook of Introductory Plant Nematology, ICAR.

PLANT PATHOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
PL PATH 102	Fundamentals of Plant Pathology	4 (3+1)	II/VI
PL PATH 301	Diseases of *Kharif* Field Crops and Horticultural Crops and their Management -I	3 (2+1)	V/IX
PL PATH 302	Diseases of *Rabi* Field crops and Horticultural Crops and their Management-II	3 (2+1)	VI/X
	Total Credits	**10 (7+3)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 4	Mushroom Cultivation	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

PL PATH 102	FUNDAMENTALS OF PLANT PATHOLOGY	4 (3 + 1)	SEM II/VI

Theory

Introduction: importance of plant diseases, scope and objectives of plant pathology; history of plant pathology with special reference to Indian work; terms and concepts in plant pathology; pathogenesis, cause and classification of plant diseases; important plant pathogenic organism, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites with examples of diseases caused by them; diseases and symptoms due to abiotic causes; fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual); nomenclature, binomial system of nomenclature, rules of nomenclature, classification of fungi, key to divisions, sub-divisions, orders and classes; bacteria and mollicutes: general morphological characters, basic methods of classification and reproduction; viruses: nature, architecture, multiplication and transmission; study of phaneorganic plant parasites; principles and methods of plant disease control, integrated disease management, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy, preparation of media, isolation and Koch's postulates; general study of different structures of fungi; study of symptoms of various plant diseases; study of representative fungal genera; staining and identification of plant pathogenic bacteria; transmission of plant viruses; study of phaneroganic plant parasites; study of fungicides and their formulations; methods of pesticide/bio-pesticides application and their safe use; calculation of fungicide sprays concentrations.

Suggested Readings :

1. Agrios, G.N. (2005). Plant Pathology, Acad. Press, New York.
2. Mehrotra, R.S. and Aneja, K.R. (1990). An Introductory Mycology, Wiley Eastern, New Delhi.
3. Singh, R.S. (1982). Plant Pathogens (Fungi and Viruses). Oxford & IBH Publication, New Delhi.
4. Singh, R.S. (1984). Introduction to the Principles of Plant Pathology, (4th edition) Oxford & IBH Publication Co, New Delhi.
5. Verma, J.P. (1992). The Bacteria, IInd Edition, New Delhi, Pub. House.

PL PATH 301	DISEASES OF *KHARIF* FIELD CROPS AND HORTICULTURAL CROPS AND THEIR MANAGEMENT -I	3 (2 + 1)	SEM V/IX

Theory

Symptoms, etiology, disease cycle and management of major diseases of following crops: Field crops- rice : blast, brown spot, bakanae, bacterial blight, bacterial leaf streak, sheath blight, false smut, khaira and tungro; maize : stalk rots, downy mildew, leaf spots; sorghum: smuts, grain mold and anthracnose, bajra: downy mildew, smut and ergot; groundnut: early and late leaf spots (tikka disease), wilt, rust and collar rot, sesamum: root rot and phyllody; clusterbean: alternaria leaf spot and bacterial blight; cotton: anthracnose, vascular wilt, root rot, angular leaf spot, myrothecium leaf spot and CLCuD, soybean: rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; pigeonpea: phytophthora blight, wilt and sterility mosaic, black & green gram; cercospora leaf spot and anthracnose, web blight, yellow mosaic and leaf crinkle; castor: phytophthora blight and alternaria leaf spot; tobacco: black shank, black root rot and mosaic; horticultural crops- guava: wilt and anthracnose; banana: panama wilt, bacterial wilt, sigatoka and bunchy top, ber: powdery mildew, papaya: foot rot leaf curl and mosaic, pomegranate: bacterial blight; cruciferous vegetables: alternaria leaf spot and black rot; brinjal: phomopsis blight and fruit rot and sclerotinia blight, little leaf disease; tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; okra: yellow vein mosaic; beans: anthracnose and bacterial blight: ginger: soft rot; colocasia: phytophthora blight; coconut: wilt and bud rot; tea: blister blight, red rust; coffee: rust.

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory; field visit for the diagnosis of field problems; collection and preservation of plant disease specimens for herbarium.

Note: Students should submit 50 pressed and well-mounted specimens.

Suggested Readings :

1. Rangaswami, G. and Mahadevan, A. (1999). Diseases of Crop plants in India, Prentice Hall of India Pvt. Ltd.
2. Singh, R.S. (1995). Diseases of vegetable crops, Oxford & IBH Publ. Co., New Delhi.
3. Singh, R.S. (1998). Plant Diseases, Oxford & IBH Publ. Co., Delhi.
4. Singh, R.S. (2000). Diseases of fruit crops, Oxford & IBH Publ. Co., New Delhi.
5. Thind, T.S. (2005). NATIC Diseases of Field crops and their management, Daya Publishing New Delhi.

PL PATH 302	DISEASES OF *RABI* FIELD CROPS AND HORTICULTURAL CROPS AND THEIR MANAGEMENT-II	3 (2 + 1)	SEM VI/X

Theory

Symptoms, etiology, disease cycle and management of following diseases:

Field crops- wheat: rusts, loose smut, flag smut, karnal bunt, powdery mildew, alternaria blight and tundu; barley: covered smut, stripe disease, rust and loose smut; sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng; sunflower: sclerotinia stem rot, rhizopus leaf rot and alternaria blight; rapeseed & mustard: alternaria blight, white rust, downy mildew, club root and sclerotinia stem rot; gram: wilt, root rot, grey mould and ascochyta blight; lentil: rust and wilt; pea:

powdery mildew, downy mildew, and rust; berseem: stem rot, powdery mildew and root rot; horticultural crops- mango: anthracnose, malformation, bacterial blight and powdery mildew; citrus: canker and gummosis; grape vine: downy mildew, powdery mildew and anthracnose; apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl; strawberry: leaf spot; potato: early and late blight, black scurf, leaf roll and mosaic, scab and apical leaf curl; cucurbits: downy mildew, powdery mildew and wilt; onion and garlic: purple blotch and stemphylium blight; chillies: anthracnose and fruit rot, wilt and leaf curl; turmeric: leaf spot, coriander: stem gall; marigold: alternaria blight, wilt and bortytis blight; rose: dieback, powdery mildew and black leaf spot.

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory; field visit for the diagnosis of field problems; collection and preservation of plant diseased specimens for herbarium.

Note: Students should submit 50 pressed and well-mounted specimens.

Suggested Readings :

1. Rangaswami, G. and Mahadevan, A. (1999). Diseases of Crop Plants in India, Prentice Hall of India Pvt. Ltd.
2. Singh, R.S. (1995). Diseases of Vegetable Crops, Oxford & IBH Publ. Co., New Delhi.
3. Singh, R.S. (1998). Plant Diseases, Oxford & IBH Publ. Co., Delhi.
4. Singh, R.S. (2000). Diseases of Fruit Crops, Oxford & IBH Publ. Co., New Delhi.
5. Thind, T.S. (2005). NATIC Diseases of Field Crops and their Management, Daya Publishing New Delhi.

Module 4	**MUSHROOM CULTIVATION**	**10 (0+10)**	**SEM VIII/XII**
Weekly activities			
Week	**Activities**		
1	Mushrooms- an agri-business, nutritional and medicinal value of mushrooms and history of mushroom		
2	Preparation of different culture media and pure culture of different mushrooms		
3	Single spore culture and multispore culture		
4	Preparation of mother spawn and preparation of commercial spawn		
5	Cultivation of button mushroom: wetting of substrate, mixing of different ingredients and turnings of compost for button mushroom cultivation, qualities of good compost and its testing, fabrication of low cost mushroom house		
6	Spawning methods; preparation of casing materials for button mushroom cultivation; maintenance of environment in mushroom house		
7	Methods of harvesting and packaging of button mushroom, diseases /mould/insect pests and nematodes of button mushroom and their management		
8	Substrate preparation for oyster mushroom cultivation, diseases /mould/insect pests and nematodes of oyster mushroom and their management; picking methods and drying of mushrooms		

9	Substrate preparation for milky mushroom cultivation, substrate preparation for paddy straw mushroom cultivation
10	Post-harvest handling for value addition including dehydration of mushrooms
11	Cultivation of shiitake mushroom, cultivation of paddy straw mushroom
12	Uses of spent mushroom compost, economics of button mushroom cultivation, economics of oyster mushroom cultivation, economics of milky mushroom cultivation and economics of shiitake mushroom cultivation
13	Visit to different farm houses
14	Poisonous mushrooms, cultivation of speciality mushrooms
15	Visit at Haryana Agro Industries Corporation, Murthal (Sonipat)/visit at NRCM, Chambaghat, Solan (H.P.)
16	Recent advances in mushroom cultivation; machineries, tools, equipments required for mushroom cultivation; information technology and mushroom cultivation as an entrepreneur

SEED SCIENCE AND TECHNOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core course			
SST 202	Principles of Seed Technology	3 (2+1)	IV/VIII
	Total Credits	**3 (2+1)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 5	Seed Production and Technology	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

SST 202	PRINCIPLES OF SEED TECHNOLOGY	3 (2 + 1)	SEM IV/VIII

Theory

Seed and seed technology: introduction, definition and importance; deterioration causes of crop varieties and their control; maintenance of genetic purity during seed production, seed quality; definition, characters of good quality seed, different classes of seed; foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables; seed certification, phases of certification, procedure for seed certification, field inspection; Seed Act and Seed Act enforcement; duty and powers of seed inspector, offences and penalties; seeds control order 1983, varietal identification through grow out test and electrophoresis, molecular and biochemical test; detection of genetically modified crops, transgene contamination in non-GM crops, GM crops and organic seed production; seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing; seed storage; general principles, stages and factors affecting seed longevity during storage; measures for pest and disease control during storage; seed marketing: structure and organization, sales generation activities, promotional media; factors affecting seed marketing, role of WTO and OECD in seed marketing.

Practical

Seed production in major cereals: wheat, rice, maize, sorghum and bajra; seed production in major pulses: urd, mung, pigeonpea, lentil, gram fieldpea; seed production in major oilseeds: soybean, rapeseed and mustard; seed production in vegetable crops; seed sampling and testing: physical purity, germination, viability, etc.; seed and seedling vigour test; genetic purity test: grow out test and electrophoresis; seed certification: procedure, field inspection, preparation of field inspection report; visit to seed production farms, seed testing laboratories and seed processing plant.

Suggested Readings :

1. Agarwal, R.L. (1997). Seed Technology, 2nd Ed. Oxford & IBH.
2. Copeland, L.O. and McDonald, M.B. (2001). Principles of Seed Science and Technology, 4th Ed. Chapman & Hall.
3. Joshi, A.K. and Singh, B.D. (2004). Seed Science and Technology, Kalyani.
4. Nema, N.P. (1986). Principles of Seed Certification and Testing, Allied Publs.
5. Sen, S. and Ghosh, N. (2015). Published by Kalyani Publishers.

Module 5	SEED PRODUCTION AND TECHNOLOGY	10(0+10)	SEM VIII/XII
Weekly activities			
Week	**Activities**		
1	Identification and collection of seeds of field and vegetable crops, preparation of seedarium, identification and collection of labels and tags of various classes of seed		
2	Identification of crop varieties / hybrids on the basis of morphological characters		
3	Selection of suitable area/ locations for high quality seed/ planting material production and inspection to verify the land requirement and isolation distance in field and vegetable crops		
4	Observations on factors affecting deterioration and maintenance of genetic purity of crop varieties		
5-6	Learn seed production techniques of self and cross-pollinated crops		
7	Identification of parental lines, hybrid seed production in field & vegetable crops		
8	Visit to seed production farm and processing unit of public and private seed companies		
9	Identification of seed processing machinery, optimization of parameters of seed processing machinery for specific crop/variety, working adjustment and maintenance of seed processing equipments like: air screen cleaner cum grader, indent cylinder separator, specific gravity separator, etc.		
10	Visit of different types of seed storage structures i.e. traditional and modern, application of fumigants in seed stores and visit of market / seed company to know the seed marketing strategies		
11	Identification and handling of seed testing equipments and structure of different monocots and dicots seeds and seedlings, seed sampling procedure in seed stores and seed testing laboratory		
12	Conduct physical purity analysis and calculation of its components in seed samples, moisture determination by different methods in various field and vegetable crops.		
13	Conduct germination testing of field and vegetable crops by various methods, quick viability testing (Tz test) and seed vigour testing in different crops		
14	Estimation of seed dormancy and its alleviation, varietal identification by laboratory techniques, genetic purity testing by grow-out test and seed invigoration techniques to enhance the planting value of seed		
15	Identification of seed-borne diseases and storage insect pest and their management and detection methods for seed-borne pathogens and storage insects-pests		
16	Visit to seed testing laboratory of various public and private seed companies		

SOIL SCIENCE

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
SOILS 101	Fundamentals of Soil Science	3 (2+1)	I/V
SOILS 103	Principles of Soil Science (For B.Tech. Agricultural Engineering)	3 (2+1)	I
SOILS 201/ FOR 201/ AGM 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3+0)	Agri.: III/VII B.Tech.: II CS : III
SOILS 202	Manure, Fertilizers and Soil Fertility Management	3 (2+1)	IV/VIII
SOILS 204/ AGRON 206/ MICRO 204	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
SOILS 301	Problematic Soils and their Management	2 (2+0)	V/IX
	Total Credits	**16 (12+4)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 6	Soil, Plant, Water and Fertilizer Testing Services	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

SOILS 101	FUNDAMENTALS OF SOIL SCIENCE	3 (2 + 1)	SEM I/V

Theory

Soil as a natural body, pedological and edaphological concepts of soil; soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; soil profile, components of soil; soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; elementary knowledge of soil taxonomy classification and soils of India; soil water retention, movement and availability; soil air, composition, gaseous exchange, problem and plant growth; source, amount and flow of heat in soil; soil temperature and plant growth; soil reaction- pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids- inorganic and organic; silicate clays: constitution and properties, sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; soil organisms: macro and micro organisms, their beneficial and harmful effects.

Practical

Study of soil profile in field; study of soil sampling tools, collection of representative soil sample, its processing and storage; study of soil forming rocks and minerals; determination of soil density, moisture content and porosity; determination of soil texture by feel and Bouyoucos methods; studies of capillary rise phenomenon of water in soil column and water movement in soil; determination of soil pH and electrical conductivity; determination of cation exchange capacity of soil; study of soil map; determination of soil colour; demonstration of heat transfer in soil; estimation of organic matter content of soil.

Suggested Readings :

1. Brady, N.C. and Weil, R.R. (2013). The Nature and Properties of Soils, Thirteen Edition, Printice-Hall of India Private Limited, New Delhi.

2. Goswami, N.N., Rattan, R.K., Dev, G., Narayanasamy, G., Das, D.K., Sanyal, S.K., Pal, D.K. and Rao, D.L.N. (Eds.) (2009). Fundamentals of Soil Science Indian Society of Soil Science, IARI, New Delhi.
3. Lal, R. and Shukla, M.K. (2004). Principles of Soil Physics, Marcel Dekker, Madison Avenue, New York.
4. Saha, A.K. (2006). Text book of Soil Physics, Kalyani Publishers, New Delhi.
5. Sehgal, J. (2008). A Text Book of Pedology- Concepts and Applications, Kalyani Publishers, New Delhi.

SOILS 103	PRINCIPLES OF SOIL SCIENCE (For B.Tech. Agricultural Engineering)	3 (2 + 1)	SEM I

Theory

Nature and origin of soil; soil forming rocks and minerals, their classification and composition; soil forming processes; classification of soils: soil taxonomy orders; important soil physical properties and their importance; soil particle distribution; soil inorganic colloids: their composition, properties and origin of charge; ion exchange in soil and nutrient availability; soil organic matter: its composition and decomposition, effect on soil fertility; soil reaction; problem soils: acidic, saline and sodic soils; quality of irrigation water; essential plants nutrients: their functions and deficiency symptoms in plants; important inorganic fertilizers and their reactions in soils; use of saline and sodic water for crop production, gypsum requirement for reclamation of sodic soils and neutralizing RSC; liquid fertilizers and their solubility and compatibility.

Practical

Identification of rocks and minerals; examination of soil profile in the field; collection of soil sample; determination of bulk density; particle density and porosity of soil; determination of organic carbon of soil; determination of nitrogen, phosphorus and potassium; identification of nutrient deficiency symptoms of crops in the field; determination of water quality parameters.

Suggested Readings :

1. Fundamentals of Soil Science (2009). Indian Society of Soil Science, IARI, New Delhi.
2. Lal, R. and Shukla, M.K. (2004). Principles of Soil Physics, Marcel Dekker, Madison Avenue, New York.
3. Brady, N.C. and Weil, R.R. (2013). The Nature and Properties of Soils, Thirteen Edition, Printice-Hall of India Private Limited, New Delhi.
4. Sehgal, J. (2008). A Text Book of Pedology- Concepts and Applications, Kalyani Publishers, New Delhi.
5. Saha, A.K. (2006). Text book of Soil Physics, Kalyani Publishers, New Delhi.

SOILS 201/ FOR 201/ AGM 201/ AG ECON 203/ CHEM 201	ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3 + 0)	SEM Agri.: III/VII B.Tech.: II CS : III

Theory

Multidisciplinary nature of environmental studies: definition, scope and importance; natural resources: renewable and non-renewable resources, natural resources and associated problems; forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining,

dams and their effects on forest and tribal people, wasteland management through tree plantations; water resources: use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies; land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles; ecosystems: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers, energy flow in the ecosystem; ecological succession, food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of the ecosystem: forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries); biodiversity and its conservation: introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India; value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels, India as a mega-diversity nation; hot-sports of biodiversity; threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity; environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards; solid waste management: causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; peaceful uses of chemistry; recycling and reusing the biodegradable and dry waste; social issues and environment: from unsustainable to sustainable development, 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, nuclear accidents and holocaust dies; wasteland reclamation; consumerism and waste products; environment protection act; air (prevention and control of pollution) act; water (prevention and control of pollution) act; wildlife protection act; forest conservation act; issues involved in enforcement of environmental legislation; 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.

Disaster management

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; man made disasters: nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents; disaster management: effect to migrate natural disaster 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 :

1. Anil, K Gupta and Nair, Sreeja S. (2012). Environmental Extremes: Disaster Risk Management addressing Climate Change, NIDM, New Delhi.
2. Baskar, Sushmitha and Baskar, R. (2007). Environmental Studies for Undergraduate Courses. Unicorn Books, New Delhi.
3. Bharucha Erach (2004). Environmental Science for undergraduate courses. University Grants Commission, New Delhi.
4. Dwivedi, A.P. (1992). Agroforestry: Principles and Practices. Oxford & IBH.
5. Singh, Y.K. (2006). Environmental Science. New Age International (p) Limited, New Delhi.

SOILS 202	MANURE, FERTILIZERS AND SOIL FERTILITY MANAGEMENT	3 (2 + 1)	SEM IV/VIII

Theory

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures; humic substances- nature and properties; green/leaf manuring; integrated nutrient management; chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, mixed and complex fertilizers, nano fertilizers, soil amendments, fertilizer storage, fertilizer control order; history of soil fertility and plant nutrition; criteria of essentiality, role, deficiency and toxicity symptoms of essential plant nutrients, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants; chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients; soil fertility evaluation, soil testing; critical levels of different nutrients in soil; forms of nutrients in soil, plant analysis, rapid plant tissue tests; indicator plants; methods of fertilizer recommendations to crops; factors influencing nutrient use efficiency, methods of application under rainfed and irrigated conditions.

Practical

Introduction of analytical instruments and their principles, calibration and applications, colorimetry and flame photometry, and atomic absorption spectrophotometer; estimation of available N, P, K, Ca, Mg and S in soils; estimation of available Zn, Fe, Cu, and Mn in soils; estimation of N, P, K, S and micronutrients in plants.

Suggested Readings :

1. Brady, N. C. and Weil, R. R. (2002). The Nature and Properties of Soils, 13th Edition. Prentice Hall of India, Pvt. Ltd. New Delhi.
2. Das, D. K. (2002). Introductory Soil Science, Kalyani Publisher, New Delhi.
3. Rattan, R. K., Katyal, J. C., Dwivedi, B. S., Sarkar, A. K., Bhattacharyya, Tapas, Tarafdar, J. C. and Kukal, S. S. (Editors) (2015). Soil Science: An Introduction, Indian Society of Soil Science, New Delhi.
4. Tisdale, S. L., Nelson, W. L., Beaton, J. D. and Havlin, J. L. (2002). Soil Fertility and Fertilizers, Prentice Hall of India, New Delhi.
5. Yawalkar, K. S., Agarwal, J. P. and Bokde, S. (1996). Manures and Fertilizers, 8th Revised Edition, Agri-Horticultural Publishing House, Nagpur.

SOILS 204/ AGRON 206/ MICRO 204	AGRICULTURAL WASTE MANAGEMENT (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1 + 1)	SEM IV/VIII

Theory

Introduction to agricultural waste management; nature and characteristics of agricultural waste and their impact on the environment; kinds of wastes; classification, role of soil and plants in waste management, sources of waste, impact of waste on soil and plant quality; biological processes of waste management, utilization and recycling of agricultural waste, potential of recyclable crop residues and its management, in-situ management of agriculture waste, composting and vermicomposting for bio-conservation of biodegradable waste, biogas technology, agricultural waste and water, air and animal resources, impacts of waste on human, animal health and environment; management of bedding & litter, wasted feed, run-off from feed lots and holding areas and waste water form dairy parlors, agro-waste recycling through farming system, waste management machineries, environmental benefit of waste management.

Practical

Collection and preparation agricultural waste sample; determination of pH, EC, CEC, heavy metals, BOD, COD, TSS, TDS, NH_4, total P, and dissolved reactive P; nutrient status (N, P, K, secondary and micronutrients); analysis of agricultural waste; waste management equipment operation, maintenance and safety hazards, computer software and models; survey of different agri- wastes from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals, preparation of compost, vermicomposting, biogas and analysis of compost.

Suggested Readings :

1. Chongrak, P. (1996). Organic Wastes Reclying, John Wiley and Sons.
2. Kapoor, K. K., Sharma, P. K., Dudeja, S. S. and Kundu, B. S. (2005). Management of Organic Wastes for Crop Production, Proceedings of the National Symposium on Management of Organic Wastes for Crop Production.
3. Raymond, C. L. (2012). Agricultural Waste Management: Problems, Processes and Approaches, Academic Press, New York.
4. Sannigrahi, A.K. (2011). Agriculture And Waste Management For sustainable Future, New India Publishing Agency, Pitam Pura New Delhi.
5. Srivastav, M. L. (2007). Waste Management, Shree Publications and Distributors, New Delhi.

SOILS 301	PROBLEMATIC SOILS AND THEIR MANAGEMENT	2 (2 + 0)	SEM V/IX

Theory

Soil quality and health; soil erosion: types, effects, mechanism and control; distribution of waste land and problem soils in India, their categorization based on properties; origin and basic concepts of problem soils, reclamation and management of saline and sodic soils; acid soils, acid sulphate soils, eroded and compacted soils, flooded soils; soil pollution-behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution; irrigation water– quality and standards, utilization of saline water in agriculture; remote sensing and GIS in diagnosis and management of problem soils; multipurpose tree species (MPTS), bio remediation through MPTs of soils, land capability and classification, land suitability classification; problematic soils under different agro-ecosystems.

Suggested Readings :

1. Abrol, I.P., Yadav, J.S.P and Massound, F.L. (1988). Salt affected Soil and their Management, FAO (UN).
2. Bear, F. E. (1964). Chemistry of the Soil, Oxford & IBH.
3. Jurinak, J.J. (1978). Salt-affected Soils, Department of Soil Science & Biometeorology. Utah State University, US.
4. Rattan, R. K., Katyal, J. C., Dwivedi, B. S., Sarkar, A. K., Bhattacharyya, Tapas, Tarafdar, J. C. and Kukal, S. S. (Editors) (2015). Soil Science: An Introduction, Indian Society of Soil Science, New Delhi.
5. USDA Handbook No. 60. (1954). Diagnosis and Improvement of Saline and Alkali Soils. Oxford & IBH.

Module 6	**SOIL, PLANT, WATER AND FERTILIZER TESTING SERVICES**	**10 (0+10)**	**SEM VIII/XII**
Weekly activities			
Week	**Activities**		
1	Basic concepts of chemical analysis**;** principle of pH meter, EC meter, spectrophotometer, flame photometer and atomic absorption spectrophotometer		
2	Preparation and standardization of solutions and reagents, sampling of soil, procedure and precautions, collection and preparation of soil samples		
3	Determination of soil texture, bulk density, pH, EC and organic carbon		
4	Determination of available NPKS in soil samples		
5	Determination of micro nutrients (Zn, Cu, Mn, Fe); CEC and exchangeable Na in soil, estimation of cations and anions in soil, interpretation of analytical data and nutrient index		
6	Plant sampling and sample preparation for analysis, sampling stages and plant part to be sampled, and digestion of plant material		
7	Determination of NPKS in plant samples		
8	Determination of Zn, Fe, Cu, Mn content in plant samples; rapid time test for determination for NPK; quantitative rating of plant analysis data and interpretation of results, critical nutrient concentration and critical nutrient ranges		
9	Collection of water samples, quality criteria, classification and suitability of irrigation water, and water quality index; determination of pH and EC of irrigation water		
10	Determination of cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+}) and anions (NO_3^{-}, CO_3^{--}, HCO_3^{-}, Cl^{-}, SO_4^{--}) in irrigation water, computation of SAR and RSC of irrigation water		
11	Sampling procedure for fertilizers and manures for chemical analysis; fertilizer control order; storage of fertilizers		
12	Determination of ammonium and nitrate contents of nitrogenous fertilizers, total N content in urea, estimation of water soluble P_2O_5 in DAP and SSP		
13	Determination of water soluble potassium in MOP, estimation of Zn, Fe, Cu and Mn in the fertilizers		
14	Determination of pH, EC, organic carbon, N and P content of different manures		
15	Determination of K, S, Zn, Fe, Cu and Mn contents in organic manures		
16	Adulteration test of fertilizers		

VEGETABLE SCIENCE

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Core courses			
VSC 201	Production Technology for Vegetables and Spices	3 (2+1)	III/VII
VSC 302/ HORT 302	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	VI/X
	Total Credits	**5 (3+2)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 7	Commercial Vegetable Production	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

VSC 201	PRODUCTION TECHNOLOGY FOR VEGETABLES AND SPICES	3 (2 + 1)	SEM III/VII

Theory

Importance of vegetables and spices in human nutrition and national economy, brief about origin, area, production, climate and soil requirement, improved varieties and cultivation practices such as sowing time, sowing, nursery raising, transplanting, fertilizer requirements, irrigation, weed management, harvesting, physiological disorders, insect-pests, diseases of important vegetables- potato, tomato, brinjal, cauliflower, radish, carrot, okra, sweet potato, musk melon, water melon, bottle gourd, bitter gourd and sponge gourd, and spices- hot pepper, onion, garlic, fenugreek and coriander.

Practical

Identification of vegetable & spice crops and their seeds; raising of nursery of vegetables & spices; direct seed sowing and transplanting; study of morphological characters of different vegetables & spices; fertilizers applications; vegetables & spices seed extraction; harvesting & preparation for market; economics of vegetables and spices cultivation.

Suggested Readings :

1. Bose, T.K. and Som, M.G. (1986). Vegetable Crops in India. Naya Prokash.
2. Chauhan, D.V.S. (1986). Vegetable Production in India. Ram Prasad & Sons.
3. Rana, M.K. (2008). Fundamentals of Vegetable Production. New India Publishing Agency, Delhi.
4. Rana, M.K. (2008). Olericulture in India. Kalyani.
5. Tiwari, R.S. and Agarwal, A. (2004). Production Technology of Spices. International Book Distr. Co.

VSC 302/ HORT 302	POST-HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES (To be taught jointly by Horticulture and Vegetable Science)	2 (1 + 1)	SEM VI/X

Theory

Importance of fruits and vegetables, extent and possible causes of post-harvest losses; pre-harvest factors affecting post-harvest quality, maturity, and ripening; changes occurring during ripening; respiration and factors affecting respiration rate; role of ethylene; post-harvest diseases and disorders; heat, chilling and freezing injury; harvesting and field handling; storage (ZECC, cold storage, CA, MA and hypobaric); value addition concept; principles and methods of preservation; intermediate moisture foodstuffs- jam, jelly, marmalade, preserve, candy- concepts and standards; fermented and non-fermented beverages (squash and syrup); tomato products- concepts and

standards; drying/dehydration of fruits and vegetables- concept and methods, osmotic drying; canning- concepts and standards, and packaging of products.

Practical

Identification of equipments and materials used in post-harvest management; applications of different types of packaging container for shelf life extension; effect of temperature on shelf life and quality of produce; demonstration of chilling and freezing injury in vegetables and fruits; extraction and preservation of pulps and juices; preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy, preserve and tomato products, chutney, canned products and preservation of fruits and vegetables; quality evaluation of products- physico-chemical and sensory; visit to processing unit/industry.

Suggested Readings :

1. Khader, V. (1999). Preservation of fruits and vegetables. Kalyani Publisher.
2. Lal, G., Siddappa, G.S. and Tandon, G.L. (1998). Preservation of Fruits & Vegetabls by ICAR Publications.
3. Srivastava, R.P. and Kumar, S. (1998). Fruit and Vegetable Preservation – Principles & Practices, Internatioal Book Distributing Co, Lucknow.
4. Wills, R.; Lea, T. and Graham, D. (1989). Post harvest and introduction to physiology and handling of fruits, vegetables and ornamental, CABI International.
5. Wills, R.B.H. (1989). Post harvest and introduction to physiology and handling of fruits and vegetables by AVI Publications.

Module 7	**COMMERCIAL VEGETABLE PRODUCTION**	**10 (0+10)**	**SEM VIII/XII**
Weekly activites			
Week	**Activites**		
1	Identification of vegetable seeds, plants and varieties		
2	Planning and layout of a model kitchen garden		
3	Preparation of different nursery beds for raising vegetable seedlings in different seasons		
4	Preparation of seedbeds for growing different vegetable crops in different seasons		
5	Seed treatment before sowing, i.e., (i) with fungicides, (ii) for breaking dormancy, (iii) soaking seeds before sowing, (iv) inoculation of vegetable seeds and seedlings		
6	Raising of vegetable seedlings in field and portrays in different seasons		
7	Hardening of seedlings and suitable treatments for the hardening of seedlings before transplanting in field		
8	Transplanting of seedlings, gap filling and aftercare		
9	Identification of critical stages for irrigation in different vegetable crops and different methods of irrigation used in vegetable crops		
10	Preparation of solution of PGRs and its spray in different vegetable crops for increasing their production		
11	Application of different fertilizers, fertigation and use of bio-fertilizers in different vegetable crops		
12	Cultural operations including mulching, earthing up, training, pruning and staking in vegetable crops		
13	Hoeing, weeding, chemical weed control and sprays of insecticides and fungicides in different vegetable crops		
14	Growing of cool and warm season vegetables at vegetable research farm		
15	Growing of vegetables in low tunnels and under protected structures		
16	Harvesting and packinghouse operations of different vegetable crops		

OTHER SUPPORTING COURSE
LIVESTOCK PRODUCTION AND MANAGEMENT

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
LPM 201	Livestock and Poultry Management	4 (3+1)	III/VII
	Total Credits	**4 (3+1)**	

LPM 201	LIVESTOCK AND POULTRY MANAGEMENT	4 (3 + 1)	SEM III/VII

Theory

Present status and future prospects of various livestock in India; importance of livestock in the national economy; taxonomy of common domestic animals (cattle, buffalo, sheep, goat & swine); livestock development programmes in the past and present plan period; breeds and classification of various farm animals (cattle, buffalo, sheep, goat and swine), exotic cattle breeds, their identification and body confirmation; economic traits/characters in livestock; factors affecting reproduction in farm animals; methods and basis of selection of livestock for higher milk production; systems of breeding followed in livestock for increased productivity; importance of feeding green fodder; classification of feed & fodder; importance of feed supplements and feed additives; proximate principles of feed; feed nutrients and their functions; guidelines of feeding ration and preparation of least cost ration for livestock; preservation of green fodder, advantages and disadvantages of silage and hay making, methods of silage and hay making; animal house, different types of animal houses, their advantages and disadvantages; space requirement for different categories of animals, water supply on animal farm; care and management of calves, heifers, dry, milch and bulls; care and management of sheep, goat and swine; milk secretion, milking of animals and factors affecting milk yield and composition; various animal farm records and their importance; common animal diseases; disease control (cattle & buffalo), vaccination and prevention of diseases and animal farm waste management practices.

Importance and scope of poultry in the national economy; present and future prospects of poultry in India; common terms; classification of chicken and other poultry birds; characteristics of important exotic breeds of chicken; poultry housing systems, location, construction, space requirement; cage and litter management; major feed ingredients and non-nutritional feed additives, methods of feeding, feed storage in poultry, Breeding systems and methods of mating, brooding and its methods, incubation and hatching, egg-structure, physical and chemical composition, storage and maintenance of egg quality; vaccination and prevention of diseases in poultry.

Practical

External body parts of cattle, buffalo, sheep, goat, swine and poultry; handling and restraining of livestock; identification methods of farm animals and poultry; visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records; body weight and age determination in different categories of livestock; dipping, spraying and shearing in small ruminants; judging of cattle, buffalo and poultry; culling of livestock and poultry; planning and layout of housing for different types of livestock; computation of rations for livestock; formulation of concentrate mixtures; clean milk production, milking methods; hatchery operations, incubation and hatching equipments; management of chicks, growers and layers; debeaking, dusting and vaccination; cost of milk production and economics of viable units of cattle, buffalo, sheep, goat, swine and poultry production.

Suggested Readings :

1. C.K. Thomas and N.S.R. Shastry. (2007). Dairy Bovine Production. Kalyani Publishers, 4th edition. New Delhi-Ludhiana.
2. G.C. Banerjee. (2013). A Textbook of Animal Husbandry. 8th edition. Oxford and IBH Publishing Co. Pvt, Ltd.
3. Jagdish Prasad. (2015). Poultry Production and Management. Kalyani Publishers, New Delhi.
4. Jagdish Prasad. (2016). Principles and Practice of Dairy Farm Management 8th edition. Kalyani Publishers, New Delhi-Ludhiana.
5. R.A.Singh. (2008). Poultry Production. Kalyani Publishers, New Delhi.

NON-GRADIAL COURSE

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
TUT 101	Human Values and Ethics	1 (1+0)	I/V
	Total Credits	**1 (1+0)**	

TUT 101	HUMAN VALUES AND ETHICS	1 (1+0)	SEM I/V

Theory

Values and ethics: an introduction, goal and mission of life; vision of life, principles and philosophy; self exploration, self awareness, self satisfaction; decision making, motivation, sensitivity, success; selfless service, case study of ethical lives; positive spirit, body, mind and soul; attachment and detachment; spirituality quotient; and examination.

Suggested Readings :

1. Gogate, S.B. (2010). Human Values and Professional Ethics. Vikas GBTU Students Series.
2. Govindarajan, M.; Natarajan, S. and Senthilkumar, V.S. (2013). Professional Ethics and Human Values. PHI Learning Pvt. Ltd.
3. Tripathi, A. N. (2009). Human Values. New Age International.
4. Subramanian, R. (2013). Professional Ethics. OUP India.
5. Slote, Michael A. (2013). Education and Human Values: Reconciling Talent with an Ethics of Care. Routledge.



College of Agricultural Engineering and Technology


TECHNOLOGY



COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

B.Tech. (Agricultural Engineering), 4-Year Programme*

Courses: Semester-wise

Course No.	Course Title	Credits
	Semester I	
CE 101	Surveying and Levelling	3 (1+2)
CE 102	Engineering Mechanics	3 (2+1)
CHEM 101	Engineering Chemistry	3 (2+1)
MATH 104	Engineering Mathematics-I	3 (2+1)
ME 101	Engineering Drawing	2 (0+2)
ME 102	Heat and Mass Transfer	2 (1+1)
PHY 101	Engineering Physics	3 (2+1)
SOILS 103	Principles of Soil Science	3 (2+1)
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (13+12)**
	Semester II	
ABM 102	Entrepreneurship Development and Business Management	3 (2+1)
CE 103	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)
CE 104	Strength of Materials	2 (1+1)
EE 101	Web Designing and Internet Applications	2 (1+1)
FOR 201 AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental studies and disaster management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics & Chemistry)	3 (3+0)
MATH 105	Engineering Mathematics-II	3 (2+1)
ME 103	Workshop Technology and Practices	3 (1+2)
ME 104	Theory of Machines	2 (1+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**23 (14+9)**
	Semester III	
AGRON 203	Principles of Agronomy	3 (2+1)
CE 201	Soil Mechanics	2 (1+1)
CE 202	Design of Structures	2 (1+1)
EE 201	Electrical Machines and Power Utilization	3 (2+1)
ENG 201	Communication Skills and Personality Development	2 (1+1)
HORT 203	Principles of Horticultural Crops and Plant Protection	2 (1+1)
MATH 201	Engineering Mathematics-III	3 (2+1)
ME 201	Machine Design	2 (1+1)
ME 202	Thermodynamics, Refrigeration and Air Conditioning	3 (2+1)
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (14+11)**

***Same course catalogue applicable for students admitted through lateral entry from 2nd year (IIIrd semester) and onwards**

Course No.	Course Title	Credits
Semester IV		
CE 203	Building Construction and Cost Estimation	2 (2+0)
EE 202	Applied Electronics and Instrumentation	3 (2+1)
FMPE 201	Tractor and Automotive Engines	3 (2+1)
ME 203	Auto CAD Applications	2 (0+2)
PFE 201	Engineering Properties of Agricultural Produce	2 (1+1)
RBEE 201	Fundamentals of Renewable Energy Sources	3 (2+1)
SWE 201	Watershed Hydrology	2 (1+1)
SWE 202	Irrigation Engineering	3 (2+1)
SWE 203	Sprinkler and Micro Irrigation Systems	2 (1+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**24 (14+10)**
Semester V		
FMPE 301	Tractor Systems and Controls	3 (2+1)
FMPE 302	Farm Machinery and Equipment-I	3 (2+1)
PFE 301	Agricultural Structures and Environmental Control	3 (2+1)
PFE 302	Post Harvest Engineering of Cereals, Pulses and Oil Seeds	3 (2+1)
RBEE 301	Renewable Power Sources	3 (2+1)
SWE 301	Soil and Water Conservation Engineering	3 (2+1)
SWE 302	Watershed Planning and Management	2 (1+1)
SWE 303	Drainage Engineering	2 (1+1)
FMPE 390/ PFE 390/ RBEE 390/ SWE 390	Skill Development Training-I (Student READY) (Skill Development Training-I (Student READY) during semester break after IV Semester)	5 (0+5)
CCA[@]	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**29 (15+14)**
Semester VI		
EE 301	Computer Programming and Data Structures	3 (1+2)
FMPE 303	Farm Machinery and Equipment-II	3 (2+1)
FMPE 304	Tractor and Farm Machinery Operation and Maintenance	2 (0+2)
PFE 303	Post Harvest Engineering of Horticultural Crops	2 (1+1)
PFE 304	Dairy and Food Engineering	3 (2+1)
SWE 304	Water Harvesting and Soil Conservation Structures	3 (2+1)
SWE 305	Groundwater, Wells and Pumps	3 (2+1)
RBEE 302	Bio-energy Systems: Design and Applications	3 (2+1)
FMPE 391/ PFE 391/ RBEE 391/ SWE 391	Undergraduate Seminar	1 (0+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (13+12)**

Course No.	Course Title	Credits
Semester VII		
Student READY (Rural and Entrepreneurship Awareness Development Yojana)		
FMPE 411/ PFE 411/ RBEE 411/ SWE 411	Industrial Attachment /Internship (Student READY)	10 (0+10)
FMPE 412/ PFE 412/ RBEE 412/ SWE 412	Experiential Learning On campus (Student READY)	10 (0+10)
FMPE 490/ PFE 490/ RBEE 490/ SWE 490	Skill Development Training-II (Student READY) (Skill Development Training-II (Student READY) during semester break after VI Semester)	5 (0+5)
	Total Credits	**25 (0+25)**
Semester VIII		
Student READY (Rural and Entrepreneurship Awareness Development Yojana) A student has to get registered 9 credits opting for one elective from the list of four elective groups.		
	Elective course	3 (2+1)
	Elective course	3 (2+1)
	Elective course	3 (2+1)
FMPE 491/ PFE 491/ RBEE 491/ SWE 491	Project Planning and Report Writing (Student READY) (Students required to register with same department as of elective package)	10 (0+10)
	Total Credits	**19 (6+13)**

[@]NCC/NSS (0+2) for students admitted through lateral entry

B.Tech. (Agricultural Engineering), 4-Year Programme
Core Courses: Department-wise
College of Agricultural Engineering and Technology

Course No.	Course Title	Credits	Semester
FARM MACHINERY AND POWER ENGINEERING			
FMPE 201	Tractor and Automotive Engines	3 (2+1)	IV
FMPE 301	Tractor Systems and Controls	3 (2+1)	V
FMPE 302	Farm Machinery and Equipment-I	3 (2+1)	V
FMPE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
FMPE 303	Farm Machinery and Equipment-II	3 (2+1)	VI
FMPE 304	Tractor and Farm Machinery Operation and Maintenance	2 (0+2)	VI
FMPE 391	Undergraduate Seminar	1 (0+1)	VI
FMPE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
FMPE 412	Experiential Learning On campus(Student READY)	10 (0+10)	VII
FMPE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
FMPE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**55 (8+47)**	
PROCESSING AND FOOD ENGINEERING			
PFE 201	Engineering Properties of Agricultural Produce	2 (1+1)	IV
PFE 301	Agricultural Structures and Environmental Control	3 (2+1)	V
PFE 302	Post Harvest Engineering of Cereals; Pulses and Oil Seeds	3 (2+1)	V
PFE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
PFE 303	Post Harvest Engineering of Horticultural Crops	2 (1+1)	VI
PFE 304	Dairy and Food Engineering	3 (2+1)	VI
PFE 391	Undergraduate Seminar	1 (0+1)	VI
PFE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
PFE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
PFE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
PFE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**54 (8+46)**	
RENEWABLE AND BIO ENERGY ENGINEERING			
RBEE 201	Fundamentals of Renewable Energy Sources	3 (2+1)	IV
RBEE 301	Renewable Power Sources	3 (2+1)	V
RBEE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
RBEE 302	Bio-energy Systems: Design and Applications	3 (2+1)	VI
RBEE 391	Undergraduate Seminar	1 (0+1)	VI
RBEE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
RBEE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
RBEE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
RBEE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**50 (6+44)**	
SOIL AND WATER ENGINEERING			
SWE 201	Watershed Hydrology	2 (1+1)	IV
SWE 202	Irrigation Engineering	3 (2+1)	IV

SWE 203	Sprinkler and Micro Irrigation Systems	2 (1+1)	IV
SWE 301	Soil and Water Conservation Engineering	3 (2+1)	V
SWE 302	Watershed Planning and Management	2 (1+1)	V
SWE 303	Drainage Engineering	2 (1+1)	V
SWE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
SWE 304	Water Harvesting and Soil Conservation Structures	3 (2+1)	VI
SWE 305	Groundwater, Wells and Pumps	3 (2+1)	VI
SWE 391	Undergraduate Seminar	1 (0+1)	VI
SWE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
SWE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
SWE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
SWE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**61 (12+49)**	
BASIC ENGINEERING			
Civil Engineering			
CE 101	Surveying and Levelling	3 (1+2)	I
CE 102	Engineering Mechanics	3 (2+1)	I
CE 103	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)	II
CE 104	Strength of Materials	2 (1+1)	II
CE 201	Soil Mechanics	2 (1+1)	III
CE 202	Design of Structures	2 (1+1)	III
CE 203	Building Construction and Cost Estimation	2 (2+0)	IV
	Total Credits	**17 (10+7)**	
Electrical and Electronics Engineering			
EE 101	Web Designing and Internet Applications	2 (1+1)	II
EE 201	Electrical Machines and Power Utilization	3 (2+1)	III
EE 202	Applied Electronics and Instrumentation	3 (2+1)	IV
EE 301	Computer Programming and Data Structures	3 (1+2)	VI
	Total Credits	**11 (6+5)**	
Mechanical Engineering			
ME 101	Engineering Drawing	2 (0+2)	I
ME 102	Heat and Mass Transfer	2 (1+1)	I
ME 103	Workshop Technology and Practice	3 (1+2)	II
ME 104	Theory of Machines	2 (1+1)	II
ME 201	Machine Design	2 (1+1)	III
ME 202	Thermodynamics; Refrigeration and Air Conditioning	3 (2+1)	III
ME 203	Auto CAD Applications	2 (0+2)	IV
	Total Credits	**16 (6+10)**	

Elective Courses: Package-wise

(A student is required to select any one package out of Packages I to IV and take three courses from the selected package)

Course No.	Course Title	Credits	Semester
Package I: Farm Machinery and Power Engineering			
FMPE 401	Human Engineering and Safety	3 (2+1)	VIII
FMPE 402	Hydraulic Drives and Controls	3 (2+1)	VIII
FMPE 403	Tractor Design and Testing	3 (2+1)	VIII
FMPE 404	Mechanics of Tillage and Traction	3 (2+1)	VIII
FMPE 405	Farm Machinery Design and Production	3 (2+1)	VIII
FMPE 406	Precision Agriculture and System Management	3 (2+1)	VIII
FMPE 407	Artificial Intelligence	3 (2+1)	VIII
FMPE 408	Mechatronics	3 (2+1)	VIII
	Total Credits	**24 (16+8)**	
Package II: Processing and Food Engineering			
PFE 401	Food Quality and Control	3 (2+1)	VIII
PFE 402	Food Plant Design and Management	3 (2+1)	VIII
PFE 403	Food Packaging Technology	3 (2+1)	VIII
PFE 404	Development of Processed Products	3 (2+1)	VIII
PFE 405	Process Equipment Design	3 (2+1)	VIII
	Total Credits	**15 (10+5)**	
Package III: Renewable and Bio-Energy Engineering			
RBEE 401	Photovoltaic Technology and Systems	3 (2+1)	VIII
RBEE 402	Waste and By-products Utilization	3 (2+1)	VIII
RBEE 403	Biogas Technology and Mechanism	3 (2+1)	VIII
RBEE 404	Solar Energy Utilization	3 (2+1)	VIII
RBEE 405	Energy Auditing and Management	3 (2+1)	VIII
	Total Credits	**15 (10+5)**	
Package IV: Soil and Water Engineering			
SWE 401	Management of Canal Irrigation System	3 (2+1)	VIII
SWE 402	Remote Sensing and GIS Applications	3 (2+1)	VIII
SWE 403	Precision Farming Techniques for Protected Cultivation	3 (2+1)	VIII
SWE 404	Landscape Irrigation Design and Management	3 (2+1)	VIII
SWE 405	Water Quality and Management Measures	3 (2+1)	VIII
SWE 406	Plastic Applications in Agriculture	3 (2+1)	VIII
SWE 407	Information Technology for Land and Water Management	3 (2+1)	VIII
SWE 408	Minor Irrigation and Command Area Development	3 (2+1)	VIII
SWE 409	Wasteland Development	3 (2+1)	VIII
SWE 410	Floods and Control Measures	3 (2+1)	VIII
	Total Credits	**30 (20+10)**	

Supporting Courses from College of Agriculture

Course No.	Course Title	Credits	Semester
AGRONOMY			
AGRON 203	Principles of Agronomy	3 (2+1)	III
BUSINESS MANAGEMENT			
ABM 102	Entrepreneurship Development and Business Management	3 (2+1)	II
FORESTRY/AGRICULTURAL METEOROLOGY/SOIL SCIENCE/AGRICULTURAL ECONOMICS			
FOR 201 AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental studies and disaster management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	II
HORTICULTURE			
HORT 203	Principles of Horticultural Crops and Plant Protection	2 (1+1)	III
SOIL SCIENCE			
SOILS 103	Principles of Soil Science	3 (2+1)	I
	Total Credits (Agriculture)	**14 (10+4)**	

Supporting Courses from College of Basic Sciences and Humanities

CHEMISTRY AND BIOCHEMISTRY			
CHEM 101	Engineering Chemistry	3 (2+1)	I
LANGUAGES AND HARYANVI CULTURE			
ENG 201	Communication Skills and Personality Development	2 (1+1)	III
MATHEMATICS, STATISTICS AND PHYSICS			
MATH 104	Engineering Mathematics-I	3 (2+1)	I
MATH 105	Engineering Mathematics-II	3 (2+1)	II
MATH 201	Engineering Mathematics-III	3 (2+1)	III
PHY 101	Engineering Physics	3 (2+1)	I
	Total Credits (Basic Sciences and Humanities)	**17 (11+6)**	

Supporting Courses for B. Sc. (Hons.) Agriculture
Department-wise

Farm Machinery and Power Engineering			
FMPE 202	Farm Machinery and Power	2 (1+1)	III/VII
	Total Credits	**2 (1+1)**	
Processing and Food Engineering			
PFE 305	Protected Cultivation and Secondary Agriculture	2 (1+1)	VI/X
	Total Credits	**2 (1+1)**	
Renewable and Bio- energy Engineering			
RBEE 202	Renewable Energy and Green Technology	2 (1+1)	IV/VIII
	Total Credits	**2 (1+1)**	
Soil and Water Engineering			
SWE 101	Introductory Soil and Water Conservation Engineering	2 (1+1)	II/VI
	Total Credits	**2 (1+1)**	

COURSE CONTENTS: DEPARTMENT-WISE

FARM MACHINERY AND POWER ENGINEERING

Course No.	Course Title	Credits	Semester
Core Courses			
FMPE 201	Tractor and Automotive Engines	3 (2+1)	IV
FMPE 202	Farm Machinery and Power (For B. Sc. (Hons.) Agriculture)	2 (1+1)	III/VII
FMPE 301	Tractor Systems and Controls	3 (2+1)	V
FMPE 302	Farm Machinery and Equipment-I	3 (2+1)	V
FMPE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
FMPE 303	Farm Machinery and Equipment-II	3 (2+1)	VI
FMPE 304	Tractor and Farm Machinery Operation and Maintenance	2 (0+2)	VI
FMPE 391	Undergraduate Seminar	1 (0+1)	VI
FMPE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
FMPE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
FMPE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
FMPE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**57 (9+48)**	
Elective Courses (Any three)			
FMPE 401	Human Engineering and Safety	3 (2+1)	VIII
FMPE 402	Hydraulic Drives and Controls	3 (2+1)	VIII
FMPE 403	Tractor Design and Testing	3 (2+1)	VIII
FMPE 404	Mechanics of Tillage and Traction	3 (2+1)	VIII
FMPE 405	Farm Machinery Design and Production	3 (2+1)	VIII
FMPE 406	Precision Agriculture and System Management	3 (2+1)	VIII
FMPE 407	Artificial Intelligence	3 (2+1)	VIII
FMPE 408	Mechatronics	3 (2+1)	VIII
	Total Credits	**24 (16+8)**	

FMPE 201	TRACTOR AND AUTOMOTIVE ENGINES	3 (2 + 1)	SEM IV

Theory

Study of sources of farm power –conventional & non-conventional energy sources; classification of tractors and IC engines; review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle; general energy equation and heat balance sheet; study of mechanical, thermal and volumetric efficiencies; study of engine components their construction; operating principles and functions; study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines; study of engine valve systems, valve mechanism, valve timing diagram and valve clearance adjustment; study of cam profile; valve lift and valve opening area; study of importance of air cleaning system; study of types of air cleaners and performance characteristics of various air cleaners; study of fuel supply system; study of fuels; properties of fuels; calculation of air-fuel ratio; study of tests on fuel for SI and CI engines; study of detonation and knocking in IC engines; study of carburetion system; carburetors and their main functional components; study of fuel injection system – Injection pump, their types, working principles, fuel injector nozzles – their types and working principle; engine governing – need of governors, governor types and governor characteristics; study of lubrication system – need, types, functional components; study of lubricants – physical properties,

additives and their application; engine cooling system – need, cooling methods and main functional components; study of need and type of thermostat valves; additives in the coolant; study of radiator efficiency; study of ignition system of SI engines; study of electrical system including battery, starting motor, battery charging, cut-out etc; comparison of dynamo and alternator; familiarization with the basics of engine testing.

Practical

Introduction to different systems of CI engines; engine parts and functions; working principles etc.; valve system – study, construction and adjustments; oil & fuel – determination of physical properties; air cleaning system; fuel supply system of SI engine; diesel injection system & timing; cooling system and fan performance; thermostat and radiator performance evaluation; part load efficiencies & governing; lubricating system & adjustments; starting and electrical system; ignition system; tractor engine heat balance and engine performance curves; visit to engine manufacturer/ assembler/ spare parts agency.

Suggested Readings:

1. Jain, S.C. and Rai, C.R. (2012). Farm Tractor Maintenance and Repair. Standard Publishers Distributors, New Delhi.
2. Lal, Radhey. (2005). Agricultural Engineering Through Worked Examples. Saroj Prakashan, Allahabad.
3. Michal, A. M. and Ojha, T. P. (2016). Principle of Agricultural Engineering, Vol. 1. Jain Brothers, New Delhi.
4. Kumar, Sanjay. (2008). Textbook of Tractor at a Glance: A Unique Book of Farm Power International Book Distributing Company, Lucknow.
5. Sahay, Jagdishwar. (2015). Elements of Agricultural Engineering. Standard Publishers Distributors, New Delhi.

FMPE 202	FARM MACHINERY AND POWER For B. Sc. (Hons.) Agriculture	2 (1 + 1)	SEM III/VII

Theory

Status of farm power in India; sources of farm power; IC engines: working principles of IC engines; comparison of two stroke and four stroke cycle engines; study of different components of IC engine; IC engine terminology and solved problems; familiarization with different systems of IC engines: air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor; familiarization with power transmission system : clutch, gear box, differential and final drive of a tractor; tractor types; cost analysis of tractor power and attached implement; familiarization with primary and secondary tillage implement; implement for hill agriculture; implement for intercultural operations; familiarization with sowing and planting equipment; calibration of a seed drill and solved examples; familiarization with plant protection equipment; familiarization with harvesting and threshing equipment.

Practical

Study of different components of IC engine; to study air cleaning and cooling system of engine; familiarization with clutch, transmission; differential and final drive of a tractor; familiarization with lubrication and fuel supply system of engine; familiarization with brake, steering, hydraulic control system of engine; learning of tractor driving; familiarization with operation of power tiller, implements for hill agriculture; familiarization with different types of primary and secondary tillage

implements: mould plough, disc plough and disc harrow; familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration; planters and transplanter; familiarization with different types of sprayers and dusters; familiarization with different inter-cultivation equipment; familiarization with harvesting and threshing machinery.

Suggested Readings:

1. Sahay, Jagdishwar. (2015). Elements of Agricultural Engineering. Standard Publishers Distributors, New Delhi.
2. Lal, Radhey. (2005). Agricultural Engineering through Worked Examples. Saroj Prakashan, Allahabad.
3. Jain, S.C. and Rai, C.R. (2012). Farm Tractor Maintenance and Repair. Standard Publishers Distributors, New Delhi.
4. Kumar, Sanjay. (2008). Textbook of Tractor at a Glance: A Unique Book of Farm Power International Book Distributing Company, Lucknow.
5. Nakra, C. P. (2016). Farm Machines and Equipments. Dhanpat Rai Publishing Company, New Delhi.

FMPE 301	TRACTOR SYSTEMS AND CONTROLS	3 (2+1)	SEM V

Theory

Study of need for transmission system in a tractor; transmission system – types, major functional systems; study of clutch – need, types, functional requirements, construction and principle of operation; familiarization with single plate, multi-plate, centrifugal and dual clutch systems; study of gear box – gearing theory, principle of operation, gear box types, functional requirements and calculation for speed ratio; study of differential system – need, functional components, construction, calculation for speed reduction; study of need for a final drive; study of brake system – types, principle of operation, construction, calculation for braking torque; study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius; familiarization with ackerman steering, steering systems in track type tractors; study of hydraulic system in a tractor – principle of operation, types, main functional components, functional requirements; familiarization with the hydraulic system adjustments and ADDC; study of tractor power outlets –PTO standards, types and functional requirements; introduction to traction, traction terminology, theoretical calculation of shear force and rolling resistance on traction device; study of wheels and tyres – solid tyres and pneumatic tyres; tyre construction and tyre specifications; study of traction aids; study of tractor mechanics – forces acting on the tractor; determination of CG of a tractor; determination and importance of moment of inertia of a tractor; study of tractor static equilibrium; tractor stability especially at turns; determination of maximum drawbar pull; familiarization with tractor as a spring-mass system; ergonomic considerations and operational safety; introduction to tractor testing; deciphering the engine test codes.

Practical

Introduction to transmission systems and components; study of clutch functioning, parts and design problem on clutch system; study of different types of gear box; calculation of speed ratios; design problems on gear box; study on differential and final drive and planetary gears; study of brake systems and some design problems; steering geometry and adjustments; study of hydraulic systems in a tractor; hydraulic trainer and some design problems; appraisal of various controls in different makes tractors in relation to anthropometric measurements; determination of location of CG of a tractor, moment of inertia of a tractor; traction performance of a traction wheel.

Suggested Readings:

1. Kumar, Sanjay. (2008). Textbook of Tractor at a Glance. A unique book of farm Power. International Book Distributing Company, Lucknow.
2. Nakra, C. P. (2016). Farm Machines and Equipments. Dhanpat Rai Publishing Company, New Delhi.
3. Jain, S.C. and Rai, C.R. (2012). Farm Tractor Maintenance and Repair. Standard Publishers Distributors, New Delhi.
4. Lal, Radhey. (2005). Agricultural Engineering through Worked Examples. Saroj Prakashan, Allahabad.
5. Liljedahl, John B., Turnquist, Paul K., Smith, David W., Makoto, Hoki. (2004). Tractors and their Power Units. Van Nostrand Reinhold, New York.

FMPE 302	FARM MACHINERY AND EQUIPMENT-I	3 (2+1)	SEM V

Theory

Introduction to farm mechanization; classification of farm machines; unit operations in crop production; identification and selection of machines for various operations on the farm; hitching systems and controls of farm machinery; calculation of field capacities and field efficiency; calculations for economics of machinery usage; comparison of ownership with hiring of machines; introduction to seed-bed preparation and its classification; familiarization with land reclamation and earth moving equipment; introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage; measurement of draft of tillage tools and calculations for power requirement for the tillage machines; introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators; identification of major functional components; attachments with tillage machinery; introduction to sowing, planting & transplanting equipment; introduction to seed drills, no-till drills and strip-till drills; introduction to planters, bed-planters and other planting equipment; study of types of furrow openers and metering systems in drills and planters; calibration of seed-drills/ planters; adjustments during operation; introduction to materials used in construction of farm machines; heat treatment processes and their requirement in farm machines; properties of materials used for critical and functional components of agricultural machines; introduction to steels and alloys for agricultural application; identification of heat treatment processes specially for the agricultural machinery components.

Practical

Familiarization with different farm implements and tools; study of hitching systems; problems on machinery management; study of primary and secondary tillage machinery – construction, operation, adjustments and calculations of power and draft requirements; study of sowing and planting equipment – construction, types, calculation for calibration and adjustments; study of transplanters – paddy, vegetable etc; identification of materials of construction in agricultural machinery and study of material properties; study of heat treatment processes subjected to critical components of agricultural machinery.

Suggested Readings:

1. Lal, Radhey. (2005). Agricultural Engineering through Worked Examples. Saroj Prakashan, Allahabad.
2. Nakra, C. P. (2016). Farm Machines and Equipments. Dhanpat Rai Publishing Company, New Delhi.

3. Kepner, R.A., Bainer, Roy and Barger, E.L. (2005). Principles of Farm Machinery. John Wiley & Sons, New York.
4. Singh, T.P. (2017). Farm Machinery. PHI Learning Privet Limited, New Delhi.
5. Handbook of Agricultural Engineering (2013). ICAR, Bio-Green Books, New Delhi.

FMPE 303	FARM MACHINERY AND EQUIPMENT-II	3 (2+1)	SEM VI

Theory

Introduction to plant protection equipment – sprayers and dusters; classification of sprayers and sprays; types of nozzles; calculations for calibration of sprayers and chemical application rates; introduction to interculture equipment; use of weeders – manual and powered; study of functional requirements of weeders and main components; familiarization of fertilizer application equipment; study of harvesting operation–harvesting methods; harvesting terminology; study of mowers – types, constructional details, working and adjustments; study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology and cutting pattern; study of reapers, binders and windrowers – principle of operation and constructional details; importance of hay conditioning; methods of hay conditioning and calculation of moisture content of hay; introduction to threshing systems – manual and mechanical systems; types of threshing drums and their applications; types of threshers-tangential and axial, their constructional details and cleaning systems; study of factors affecting thresher performance; study of grain combines, combine terminology, classification of grain combines; study of material flow in combines; computation of combine losses; study of combine troubles and troubleshooting; study of chaff cutters and capacity calculations; study of straw combines–working principle and constructional details; study of root crop diggers–principle of operation, blade adjustment and approach angle and calculation of material handled; study of potato and groundnut diggers; study of cotton harvesting – cotton harvesting mechanisms; study of cotton pickers and strippers; functional components; study of maize harvesting combines; introduction to vegetables and fruit harvesting equipment and tools.

Practical

Familiarization with plant protection and interculture equipment; study of sprayers: types, functional components; study of dusters: types and functional components; calculations for chemical application rates; study of nozzle types and spread pattern using patternator; familiarization with manual and powered weeding equipment and identification of functional components; study of fertilizer application equipment including manure spreaders and fertilizer broadcasters; study of various types of mowers, reaper, reaper binder; study of functional components of mowers and reapers; familiarization with threshing systems; cleaning systems in threshers; calculations of losses in threshers; familiarization with functional units of grain combines and their types; calculations for grain losses in a combine; study of root crop diggers and familiarization with the functional units and attachments; familiarization with the working of cotton and maize harvesters; familiarization with vegetable and fruit harvesters.

Suggested Readings:

1. Nakra, C. P. (2016). Farm Machines and Equipments. Dhanpat Rai Publishing Company, New Delhi.
2. Kepner, R.A., Bainer, Roy and Barger, E.L. (2005). Principles of Farm Machinery. John Wiley & Sons, New York.
3. Singh, T.P. (2017). Farm Machinery. PHI Learning Privet Limited, New Delhi.
4. Smith, D. W., Sims, B. G. and O'Neill, D. H. (1994). Testing and Evaluation of Agricultural Machinery and Equipment. Food & Agriculture Organization, Rome.
5. Mehta, M.L., Verma, S.R., Misra S.K. and Sharma, V.K. (2005). Testing and Evaluation of Agricultural Machinery. Daya Publishing House, New Delhi.

FMPE 304	TRACTOR AND FARM MACHINERY OPERATION AND MAINTENANCE	2 (0+2)	SEM VI

Practical

Familiarization with different makes and models of agricultural tractors; identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems; study of maintenance points to be checked before starting a tractor; familiarization with controls on a tractor; safety rules and precautions to be observed while driving a tractor; driving practice of tractor; practice of operating a tillage tool (mould-board plough/ disc plough) and their adjustment in the field; study of field patterns while operating a tillage implement; hitching & de-hitching of mounted and trail type implement to the tractor; driving practice with a trail type trolley – forward and in reverse direction; introduction to tractor maintenance – precautionary and break-down maintenance; tractor starting with low battery charge; introduction to trouble shooting in tractors; familiarization with tools for general and special maintenance; introduction to scheduled maintenance after 10, 100, 300, 60, 900 and 1200 hours of operation; safety hints; top end overhauling; fuel saving tips; preparing the tractor for storage; care and maintenance procedure of agricultural machinery during operation and off-season; repair and maintenance of implements – adjustment of functional parameters in tillage implements; replacement of broken components in tillage implements; replacement of furrow openers and change of blades of rotavators; maintenance of cutter bar in a reaper; adjustments in a thresher for different crops; replacement of v-belts on implements; setting of agricultural machinery workshop.

Suggested Readings:

1. Jain, S.C. and Rai, C.R. (2012). Farm Tractor Maintenance and Repair. Standard Publishers Distributors, New Delhi.
2. Liljedahl, J. B., Casleton, W. M., Turnquist, P. K. and Smith, D.W. (2004). Tractors and their Power Units. Van Nostrand Reinhold, New York.
3. Mehta, M. L., Verma, S. R., Misra S. K. and Sharma, V. K. (2005). Testing and Evaluation of Agricultural Machinery. Daya Publishing House, New Delhi.
4. Hunt, D. and Wilson, D. (2015). Farm Power and Machinery Management. Waveland Press Inc Long Grove, Illinois, USA.
5. Gupta, R. B. and Gupta, B. K. (1987). Tractor Mechanic, Theory, Maintenance and Repair. Sathya Prakashan and Tech India Publication, New Delhi.

FMPE 390/ PFE 390/ RBEE 390/ SWE 390	SKILL DEVELOPMENT TRAINING-I (Student READY)	5 (0+5)	SEM V

Exposure to industrial and institutional applications in selected fields of interest (Farm Machinery and Power Engineering; Processing & Food Engineering; Renewable & Bio-energy Engineering; Soil & Water Engineering; Information Technology etc.); training report preparation and presentation (students will be required to undergo training of about 4 weeks during semester break after IVth semester).

FMPE 391/ PFE 391/ RBEE 391/ SWE 391	UNDERGRADUATE SEMINAR	1 (0+1)	SEM VI

Topic selection; material collection; slide preparation; presentation and interaction.

FMPE 411/ PFE 411/ RBEE 411/ SWE 411	**INDUSTRIAL ATTACHMENT/ INTERNSHIP (Student READY)**	**10 (0+10)**	**SEM VII**

Attachment with selected industries/organizations dealing with tractors, agril machinery, precision agriculture, irrigation systems, pumps, soil conservation, watershed management, processing, value addition, renewable and bio-energy and other aspects related to agricultural engineering; to enrich desired skills and practical knowledge of the students.

FMPE 412/ PFE 412/ RBEE 412/ SWE 412	**EXPERIENTIAL LEARNING ON CAMPUS (Student READY)**	**10 (0+10)**	**SEM VII**

FMPE: Exposure to production technology; testing and evaluation of agricultural machinery as per standards; interpretation and preparation of test reports.

PFE: Agro-processing; food product development; setting up of model plants for food processing and value addition; processing and packaging of selected grains; fruits and vegetables.

RBEE: Design; development; installation and maintenance of renewable energy appliances/ equipments and use of related softwares.

SWE: Farm planning and development of irrigation and drainage projects; watershed project formulation; design of water harvesting and recycling systems; maintenance and operation of wells and pumps; irrigation and drainage systems; installation of weirs and flumes for water measurement.

FMPE 490/ PFE 490/ RBEE 490/ SWE 490	**SKILL DEVELOPMENT TRAINING-II (Student READY)**	**5 (0+5)**	**SEM VII**

Exposure to an environment in which students are expected to be associated in their future career; preparation of training report technical aspects of the training and presentation (students will be required to undergo training of about 4 weeks during semester break after VIth semester).

FMPE 491/ PFE 491/ RBEE 491/ SWE 491	**PROJECT PLANNING AND REPORT WRITING (Student READY)**	**10 (0+10)**	**SEM VIII**

Field/lab studies; project report writing and presentation.

Elective Courses

(A student can opt need based elective courses equivalent to 9 Credit Hours)

FMPE 401	**HUMAN ENGINEERING AND SAFETY**	**3 (2+1)**	**SEM VIII**

Theory

Human factors in system development – concept of systems, basic processes in system development, performance reliability, human performance, information input process, visual displays, major types and use of displays; auditory and factual displays; speech communications; biomechanics of motion; types of movements; range of movements; strength and endurance; speed and accuracy; human control of systems; human motor activities, controls, tools and related devices; anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance; air pollution; dangerous machine (regulation) act; rehabilitation and compensation to

accident victims; safety gadgets for spraying; threshing; chaff cutting and tractor & trailer operation etc.

Practical

Calibration of the subject in the laboratory using bi-cycle ergo-meter; study and calibration of the subject in the laboratory using mechanical treadmill; use of respiration gas meter from human energy point of view; use of heart rate monitor; study of general fatigue of the subject using blink ratio method; familiarization with electro-myograph equipment; anthropometric measurements of a selected subjects; optimum work space layout and locations of controls for different tractors; familiarization with the noise and vibration equipment; familiarization with safety gadgets for various farm machines.

Suggested Readings:

1. Bridger, Robert. (2008). Introduction to Ergonomics (3rd Edition), CRC Press.
2. Singh, Pal Lakhwinder. (2016). Work Study and Ergonomics. Cambridge University Press.
3. Chauhan, Kaur Manjit. (2016). Ergonomics-Practical Manual for Beginners. Authors press.
4. Khan, M. I. (2010). Industrial Ergonomics. Prentice Hall India Learning Pvt. Ltd.
5. Stephanidis, Constantine. (2009). The Universal Access Handbook (Human Factors and Ergonomics). CRC Press.

FMPE 402	HYDRAULIC DRIVES AND CONTROLS	3 (2+1)	SEM VIII

Theory

Hydraulic basics: Pascal's law, flow, energy, work and power; hydraulic systems: color coding, reservoirs, strainers and filters; filtering material and elements; accumulators, pressure gauges and volume meters; hydraulic circuit; fittings and connectors: pumps, pump classifications, operation, performance, displacement, design of gear pumps, vane pumps, piston pumps, hydraulic actuators, cylinders, construction and applications; maintenance: hydraulic motors, valves, pressure-control valves, directional-control valves, flow-control valves; valve: installation; valve failures and remedies; valve assembly; troubleshooting of valves hydraulic circuit diagrams and troubleshooting; United States of American Standards Institute USASI graphical symbols tractor hydraulics; nudging system; ADDC; pneumatics; air services; logic units; fail safe and safety systems robotics: application of hydraulics and pneumatics drives in agricultural systems; Programmable Logic Controls (PLCs).

Practical

Introduction to hydraulic systems; study of hydraulic pumps; hydraulic actuators; study of hydraulic motors; hydraulic valves; colour codes and circuits; building simple hydraulic circuits; hydraulics in tractors; introduction to pneumatics; pneumatics devices; pneumatics in agriculture; use of hydraulics and pneumatics for robotics.

Suggested Readings:

1. Liljedahl, J. B., Casleton, W. M., Turnquist, P. K. and Smith, D. W. (2004). Tractors and Their Power Units. Van Nostrand Reinhold, New York.
2. Hunt, D. and Wilson, D. (2015). Farm Power and Machinery Management. Waveland Press Inc Long Grove, Illinois, USA.
3. Walters, R.B. (1991). Hydraulic and Electro-Hydraulic Control Systems. Elsevier Science Publishers LTD, New York, USA.
4. Majumdar, S. R. (2002). Oil hydraulic Systems: Principles and Maintenance. London, UK.
5. Parr, Andrew. (2011). Hydraulics and Pneumatics: Technicians and Engineer's Guide. Elsevier Ltd., Kidlington, UK.

FMPE 403	TRACTOR DESIGN AND TESTING	3 (2+1)	SEM VIII

Theory

Procedure for design and development of agricultural tractor; study of parameters for balanced design of tractor for stability & weight distribution; traction theory; hydraulic lift and hitch system design; design of mechanical power transmission in agricultural tractors: single disc; multi disc and cone clutches; rolling friction and anti-friction bearings; design of ackerman steering and tractor hydraulic steering; study of special design features of tractor engines and their selection viz. cylinder, piston, piston pin, crankshaft etc; design of seat and controls of an agricultural tractor; tractor testing.

Practical

Design problem of tractor clutch – (single/ multiple disc clutch); design of gear box (synchromesh/ constant mesh); variable speed constant mesh drive; selection of tractor tires – problem solving; problem on design of governor; design and selection of hydraulic pump; engine testing as per BIS code; drawbar performance in the lab; PTO test and measure the tractor power in the lab/field; determining the turning space; turning radius and brake test; hydraulic pump performance test and air cleaner and noise measurement test; visit to tractor testing centre/industry.

Suggested Readings:

1. Sharma, D. N. and Mukesh, S. (2016). Design of Agricultural Tractor (3rd Edition). Publisher: Jain Brothers, New Delhi.
2. Londhe, Dattatraya, Atkari, Vinod and Kamble, Yatiraj (2013). Testing of Tractor. LAP Lambert Academic Publishers.
3. Londhe, Dattatraya, Atkari, vinod and Kamble, Yatiraj. (2013). Testing of Tractor: Based on IS Codes. LAP Lambert Academic Publishers.
4. Alcock, Ralph. (2012). Tractor - Implement Systems. Springer.
5. Butterworth, Bill (1984). Farm tractors: The Case Guide to Tractor Selection, Operation, Economics and Servicing. Publisher: Springer.

FMPE 404	MECHANICS OF TILLAGE AND TRACTION	3 (2+1)	SEM VIII

Theory

Introduction to mechanics of tillage tools; engineering properties of soil; principles and concepts; stress strain relationship; design of tillage tools principles of soil cutting; design equation; force analysis; application of dimensional analysis in soil dynamics and traction prediction equation; introduction to traction and mechanics; off road traction and mobility; traction model; traction improvement; tyre size; tyre lug geometry and their effects; tyre testing; soil compaction and plant growth; variability and application of GIS in soil dynamics.

Practical

Measurement of static and dynamic soil parameters related to tillage; soil parameters related to puddling and floatation; draft for passive rotary and oscillating tools; slip and sinkage under dry and wet soil conditions and load and fuel consumption for different farm operations; weight transfer and tractor loading including placement and traction aids; studies on tyres; tracks and treads under different conditions and soil compaction and number of operations.

Suggested Readings:

1. Gill, William R. and Berg, Glen E. Vanden (1967). Soil Dynamics in Tillage and Traction. Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C.

2. Punmia, B. C. and Jain, Ashok Kumar. (2005). Soil Mechanics and Foundations. Laxmi Publications (P) Ltd, New Delhi.
3. Sineokov, G. N. Design of soil tilling machines.
4. Terzaghi, Karl Peck, Ralph, B., Mesri, Gholamreza. Soil Mechanics in Engineering Practice.
5. Punmia, B.C. and Jain, A. K. Soil Mechanics and Foundations.

FMPE 405	FARM MACHINERY DESIGN AND PRODUCTION	3 (2+1)	SEM VIII

Theory

Introduction to design parameters of agricultural machines & design procedure; characteristics of farm machinery design; research and development aspects of farm machinery; design of standard power transmission components used in agricultural machines: mechanical & hydraulic units; introduction to safety in power transmission; application of design principles to the systems of selected farm machines; critical appraisal in production of agricultural machinery; advances in material used for agricultural machinery; cutting tools including CNC tools and finishing tools; advanced manufacturing techniques including powder metallurgy; EDM (Electro-Discharge Machining); heat treatment of steels including pack carburizing; shot pining process etc.; limits; fits & tolerances; jigs & fixtures; industrial lay-out planning; quality production management; reliability; economics of process selection; familiarization with project report.

Practical

Familiarization with different design aspects of farm machinery and selected components; solving design problems on farm machines & equipment visit to agricultural machinery manufacturing industry; tractor manufacturing industry jigs and fixtures – study in relation to agricultural machinery; fits; tolerances and limits; layout planning of a small scale industry; problems on economics of process selection; preparation of a project report; case study for manufacturing of simple agricultural machinery.

Suggested Readings:

1. Sharma, D. N. and Mukesh, S. (2013). Farm Machinery Design (3rd Edition). Jain Brothers, New Delhi.
2. Krutz, Gary Thompson, Lester and Claar, Paul. (1984). Design of Agricultural Machinery. Publisher: New York: Wiley.
3. Bosoi, E. S. and Verniaev, O. V. (1990). Theory, Construction and Calculations of Agricultural Machines. Oxonian Press, New Delhi.
4. Varshney, A. C. (2004). Data Book for Agricultural Machinery Design. Central Institute of Agricultural Engineering, Bhopal.
5. Rajput, R. K. (2016). A Textbook of Manufacturing Technology (Manufacturing Processes). Laxmi Publications, New Delhi.

FMPE 406	PRECISION AGRICULTURE AND SYSTEM MANAGEMENT	3 (2+1)	SEM VIII

Theory

Precision agriculture – need and functional requirements; familiarization with issues relating to natural resources; familiarization with equipment for precision agriculture including sowing and planting machines; power sprayers; land clearing machines; laser guided land levellers; straw-chopper; straw-balers; grain combines; etc.; introduction to GIS based precision agriculture and its applications; introduction to sensors and application of sensors for data generation; database management; system concept; system approach in farm machinery management; problems on

machinery selection; maintenance and scheduling of operations; application to PERT and CPM for machinery system management.

Practical

Familiarization with precision agriculture problems and issues; familiarization with various machines for resource conservation; solving problems related to various capacities; pattern efficiency; system limitation; etc.; problems related to cost analysis and inflation and problems related to selection of equipment; replacement; break-even analysis; time value of money etc.

Suggested Readings:

1. Handbook of Agricultural Engineering (2013). ICAR, Bio-Green Books, New Delhi.
2. Srinivasan, Ancha. (2006). Handbook of Precision Agriculture: Principles and Applications. Food Products Press, New York.
3. Heege, Hermann J. (2013). Precision in Crop Farming: Site Specific Concepts and Sensing Methods: Applications and Results. New York, USA.
4. Shenoy, G. V., Srivastava, U. K. and Sharma, S. C. (1991). Operations Research for Management. New Age international (P) limited, New Delhi.
5. Hunt, D. and Wilson, D. (2015). Farm Power and Machinery Management. Waveland Press Inc Long Grove, Illinois, USA.

FMPE 407	ARTIFICIAL INTELLIGENCE	3 (2+1)	SEM VIII

Theory

Foundation and history of artificial intelligent; problems and techniques – AI programming languages; introduction to LISP and PROLOG- problem spaces and searches; blind search strategies; Breadth first- Depth first- heuristic search techniques Hill climbing: best first-A* algorithm AO* algorithm- game tree; min max algorithms; game playing- alpha beta pruning; knowledge representation issues; predicate logic- logic programming; semantic nets- frames and inheritance; constraint propagation; representing knowledge using rules; rules based deduction systems. reasoning under uncertainty; review of probability; Baye's probabilistic interferences and Dempster shafer theory; Heuristic methods; symbolic reasoning under uncertainty; statistical reasoning; fuzzy reasoning; temporal reasoning; non monotonic reasoning. planning and planning in situational calculus; representation for planning; partial order planning algorithm; learning from examples; discovery as learning; learning by analogy; explanation based learning; neural nets; genetic algorithms. principles of natural language processing; rule based systems architecture; expert systems; knowledge acquisition concepts; AI application to robotics; and current trends in intelligent systems.

Practical:

Developing AI applications using LISP and PROLOG; development of prototype expert system of agricultural systems with LISP/POLOG.

Suggested Readings:

1. Panigrahi, S. and Ting, K. C. (2012).Artificial Intelligence for Biology and Agriculture. Springer Science & Business Media, Berlin, Germany.
2. Bakti, Z. A. K. (1993). The Role of Information Technology and Artificial Intelligence in Mechanized Agriculture Malaysian Agricultural Research and Development Institute. Institute of Agriculture, Malaysia.
3. Más, Francisco Rovira, Zhang, Qin, and Hansen, Alan C. (2010). Mechatronics and Intelligent Systems for off-road Vehicles. Springer London Dordrecht Heidelberg, New York.

4. Li, D. and Chen, Y. (2012). Computer and Computing Technologies in Agriculture. Springer Heidelberg Dordrecht, London, UK.

5. Kubota, N., Kiguichi, K., Liu, H. and Obo, T. (2016). Intelligent Robotics and Applications. Springer International Publishing Switzerland.

FMPE 408	MECHATRONICS	3 (2+1)	SEM VIII

Theory

Definition of mechatronics; measurement system; control systems; microprocessor based controllers; mechatronics approach; sensors and transducers; performance terminology; displacement; position & proximity sensors; photo-electric transducers; flow transducers; optical sensors and transducers; actuators; mechanical actuation systems; hydraulic & pneumatic actuation systems; electrical actuation systems; A.C. Motor, D.C. Motor; stepper motor; signal conditioning process; filtering digital signal; multiplexers; data acquisition; digital signal processing; measurement system; pulse modulation; data presentation systems; system modelling & control; mathematical models; engineering systems; electro-mechanical & hydraulic-mechanical systems; modelling dynamic systems; transfer functions; control modes; PID controller; micro-processor & computer; computer and interfacing; micro-computer structure; micro-controllers; application of microcontrollers; PLC; robotics; robot components; robot classification and specification; work envelopes; other basic parameters of robots; robot applications; robot applications in manufacturing; material transfer and machine loading/unloading; processing operations like welding & painting; assembly operations; inspection automation; future applications.

Practical

Selection of sensor for a particular application from catalogue/internet; design a mechatronics product/system and incorporate application of mechatronics for enhancing product values; to study the hardware and software of mechatronics kit; to move a table in X-direction within the range of proximity sensors using control-X software; to run a motor with PLC; to run a conveyor with computer; to study the movement of actuating cylinders and sensors.

Suggested Readings:

1. Zhang, Dan and Wei, Bin. (2017). Robotics and Mechatronics for Agriculture. CRC Press, Taylor & Francis Group, Boca Raton, Florida.

2. Más, Francisco Rovira, Zhang, Qin and Hansen, Alan C. (2010). Mechatronics and Intelligent Systems for Off-road Vehicles. Springer London Dordrecht Heidelberg, New York.

3. Husain, Ashfaq. (2012). Electric Machines. Dhanpat Rai & Company, New Delhi.

4. Zhang, Q. and Pierce, F. J. (2013). Agricultural automation: fundamentals and practices, CRC Press, Taylor & Francis Group, Boca Raton, Florida.

5. G. C. Onwubolu. (2005). Mechatronics: principles and applications. Elsevier Butterworth-Heinemann, Burlington, Massachusetts, USA.

PROCESSING AND FOOD ENGINEERING

Course No.	Course Title	Credits	Semester
Core Courses			
PFE 201	Engineering Properties of Agricultural Produce	2 (1+1)	IV
PFE 301	Agricultural Structures and Environmental Control	3 (2+1)	V
PFE 302	Post Harvest Engineering of Cereals; Pulses and Oil Seeds	3 (2+1)	V
PFE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
PFE 303	Post Harvest Engineering of Horticultural Crops	2 (1+1)	VI
PFE 304	Dairy and Food Engineering	3 (2+1)	VI
PFE 305	Protected Cultivation and Secondary Agriculture (For B. Sc. (Hons.) Agriculture)	2 (1+1)	VI/X
PFE 391	Undergraduate Seminar	1 (0+1)	VI
PFE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
PFE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
PFE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
PFE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**56 (9+47)**	
Elective Courses (Any three)			
PFE 401	Food Quality and Control	3 (2+1)	VIII
PFE 402	Food Plant Design and Management	3 (2+1)	VIII
PFE 403	Food Packaging Technology	3 (2+1)	VIII
PFE 404	Development of Processed Products	3 (2+1)	VIII
PFE 405	Process Equipment Design	3 (2+1)	VIII
	Total Credits	**15 (10+5)**	

PFE 201	ENGINEERING PROPERTIES OF AGRICULTURAL PRODUCE	2 (1+1)	SEM IV

Theory

Classification and importance of engineering properties of agricultural produce: shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables; thermal properties; heat capacity; specific heat; thermal conductivity; thermal diffusivity; heat of respiration; co-efficient of thermal expansion; friction in agricultural materials; static friction; kinetic friction; rolling resistance; angle of internal friction; angle of repose; flow of bulk granular materials; aero dynamics of agricultural products; drag coefficients; terminal velocity; rheological properties; force; deformation; stress; strain; elastic; plastic and viscous behaviour; Newtonian and Non-Newtonian liquid; visco-elasticity; Newtonian and Non-Newtonian fluid; pseudo-plastic; dilatant; thixotropic; rheopectic and bingham plastic foods; flow curves. electrical properties; dielectric loss factor; loss tangent; A.C. conductivity and dielectric constant; method of determination. Application of engineering properties in handling processing machines and storage structures.

Practical

Determination of the shape and size of grains; fruits and vegetables; determination of bulk density and angle of repose of grains; determination of the particle density/true density and porosity of solid

grains; finding the co-efficient of external and internal friction of different crops; finding out the terminal velocity of grain sample and study the separating behaviour in a vertical wind tunnel; finding the thermal conductivity of different grains; determination of specific heat of some food grains; determination of hardness of food material and determination of viscosity of liquid foods.

Suggested Readings:

1. Mohsenin, Nuri N. (1980). Physical Properties of Plant and Animal Materials: Structure, Physical Characteristics and Mechanical Properties. Gordon and Breach Science Publishers, New York, London.
2. Singhal, O. P. and Samuel, D. V. K. (2003). Engineering Properties of Biological Material. Saroj Prakashan.
3. Rao, M.A., Rizvi, S.H., Syed, Datta, K. Ashim and Ahmed, Jasim. (2015). Engineering Properties Foods. Fourth Edition. Morkel Dekker, Inc. New York, Based.
4. Kachru, R. P., Gupta, R. K. and Anwar, Alam (1994). Physico-Chemical Constituent & Engineering- Properties of Food Crops. Scientific Publisher, Jodhpur.
5. Sahay, K. M. and Singh, K. K. (2005) Unit operation of Agricultural Processing. Vikash Publication House Pvt. Ltd. New Delhi.

PFE 301	AGRICULTURAL STRUCTURES AND ENVIRONMENTAL CONTROL	3 (2+1)	SEM V

Theory

Planning and layout of farmstead; scope; importance and need for environmental control; physiological reaction of livestock environmental factors; environmental control systems and their design; control of temperature; humidity and other air constituents by ventilation and other methods; livestock production facilities; BIS standards for dairy; piggery; poultry and other farm structures; design, construction and cost estimation of farm structures, animal shelters, compost pit, fodder silo, fencing and implement sheds; barn for cows, buffalo, poultry etc.; storage of grains; causes of spoilage; water activity for low and high moisture food and its limits for storage; moisture and temperature changes in grain bins; traditional storage structures and their improvements; improved storage structures (CAP; hermetic storage; Pusa bin; RCC ring bins); design consideration for grain storage godowns; bag storage structures; shallow and deep bin; calculation of pressure in bins; storage of seeds; rural living and development; rural roads; their construction cost and repair and maintenance; sources of water supply; norms of water supply for human being and animals; drinking water standards and water treatment suitable to rural community; site and orientation of building in regard to sanitation; community sanitation system; sewage system and its design; cost and maintenance; design of septic tank for small family; estimation of domestic power requirement; source of power supply and electrification of rural housing.

Practical

Measurements for environmental parameters and cooling load of a farm building; design and layout of a dairy farm; design and layout of a poultry house; design and layout of a goat house/sheep house; design of a farm fencing system; design of a feed/fodder storage structures; design of grain storage structures; design and layout of commercial bag and bulk storage facilities; study and performance evaluation of different domestic storage structure; estimation of a farm building.

Suggested Readings:

1. Dixon, John E. and Esmay, Merle L. (1986). Environmental Control for Agricultural Buildings. Westport, Conn. : AVI Pub. Co.

2. Barre, H. (2012). Environmental and Functional Engineering of Agricultural Buildings. Springer Science & Business Media.

3. Pandey, P. H. (2014). Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers.

4. Ojha and Micheal (2005). Principles of Agricultural Engineering Vol 1. Jain Brothers.

5. Lindley, J. A. and Whitaker, J. H. (1996). Agricultural buildings and structures. American Society of Agricultural Engineers (ASAE).

PFE 302	POST HARVEST ENGINEERING OF CEREALS; PULSES AND OIL SEEDS	3 (2+1)	SEM V

Theory

Cleaning and grading, aspiration, scalping, size separators, screens, sieve analysis, capacity and effectiveness of screens; various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters, cyclone shape graders; size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing; impact; cutting and shearing); size reduction machinery: jaw crusher, hammer mill, plate mill, ball mill: material handling equipment: types of conveyors: belt, roller, chain and screw; elevators: bucket, cranes & hoists; trucks (refrigerated/ unrefrigerated); pneumatic conveying; drying: moisture content and water activity; free; bound and equilibrium moisture content; isotherm; hysteresis effect; EMC determination; psychrometric chart and its use in drying; drying principles and theory; thin layer and deep bed drying analysis; falling rate and constant rate drying periods; maximum and decreasing drying rate period; drying equations; mass and energy balance; Shedd's equation; dryer performance; different methods of drying; batch-continuous; mixing-non-mixing; sun-mechanical; conduction; convection; radiation; superheated steam; tempering during drying; different types of grain dryers: bin, flat bed, LSU, columnar,; RPEC, fluidized, rotary and tray; mixing: theory of mixing of solids and pastes, mixing index, types of mixers for solids, liquid foods and pastes; milling of rice: conditioning and parboiling; advantages and disadvantages; traditional methods; CFTRI and Jadavpur methods; pressure parboiling method; types of rice mills; modern rice milling; different unit operations and equipment; milling of wheat; unit operations and equipment; milling of pulses: traditional milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods; pulse milling machines; milling of corn and its products; dry and wet milling; milling of oilseeds: mechanical expression, screw press, hydraulic press, solvent extraction methods, preconditioning of oilseeds, refining of oil, stabilization of rice bran; extrusion cooking: principle, factors affecting, single and twin screw extruders; by-products utilization.

Practical

Performance evaluation of different types of cleaners and separators; determination of separation efficiency; study of different size reduction machines and performance evaluation; determination of fineness modulus and uniformity index; study of different types of conveying and elevating equipments; study of different types of mixers; measurement of moisture content: dry basis and wet basis; study on drying characteristics of grains and determination of drying constant; determination of EMC (Static and dynamic method); study of various types of dryers; study of different equipments in rice mills and their performance evaluation; study of different equipments in pulse mills and their performance evaluation; study of different equipments in oil mills and their performance evaluation; type of process flow charts with examples relating to processing of cereals pulses and oil seeds; visit to grain processing industries.

Suggested Readings:

1. Chakraverty, Amalendu (1988). Post Harvest Technology of Cereals: Pulses and Oilseeds. Oxford & IBH Publishing Company.
2. Sahay, K. M. and Singh, K. K. (2005). Unit operation of Agricultural Processing. Vikash Publication House Pvt Ltd. New Delhi.
3. Pandey, P. H. (2007). Principles & Practices of Post Harvest Technology. Kalyani Publishers.
4. Chakraverty, Amalendu, Singh, R. Paul (2016). Postharvest Technology and Food Process Engineering. CRC Press.
5. Chakraverty, Amalendu, Mujumdar, Arun S., Ramaswamy, Hosahalli S. (2003) Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press.

PFE 303	POST HARVEST ENGINEERING OF HORTICULTURAL CROPS	2 (1+1)	SEM VI

Theory

Importance of processing of fruits and vegetables, spices, condiments and flowers; characteristics and properties of horticultural crops important for processing; peeling: different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling and thermal peeling); slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction etc.; blanching: importance and objectives, blanching methods, effects on food (nutrition, colour, pigment, texture); chilling and freezing: application of refrigeration in different perishable food products; thermophilic; mesophilic & psychrophilic micro-organisms; chilling requirements of different fruits and vegetables; freezing of food: freezing time calculations, slow and fast freezing, equipment for chilling and freezing (mechanical & cryogenic), effect on food during chilling and freezing, cold storage heat load calculations and cold storage design; refrigerated vehicle and cold chain system; dryers for fruits and vegetables; osmo-dehydration; packaging of horticultural commodities; packaging requirements (in terms of light transmittance, heat, moisture and gas proof micro organisms, mechanical strength); different types of packaging materials commonly used for raw and processed fruits and vegetables products; bulk and retail packages and packaging machines; handling and transportation of fruits and vegetables; pack house technology; minimal processing; common methods of storage; low temperature storage; evaporative cooled storage; controlled atmospheric storage; modified atmospheric packaging; preservation technology; general methods of preservation of fruits and vegetables; brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation; flowcharts for preparation of different finished products; important parameters and equipment used for different unit operations; post harvest management and equipment for spices and flowers; quality control in fruit and vegetable processing industry, food supply chain.

Practical

Performance evaluation of peeler and slicer; performance evaluation of juicer and pulper; performance evaluation of blanching equipment; testing adequacy of blanching; study of cold storage and its design; study of CAP and MAP storage; minimal processing of vegetables; preparation of value added products; visit to fruit and vegetable processing industry; visit to spice processing plant.

Suggested Readings:

1. Sudheer, K. P. and Indira, V.(2007). Post Harvest Technology of Horticultural Crops. New India Publishing.

2. Pandey, P. H. (1997). Post Harvest Technology of Fruits and Vegetables (principles and Practices). Saroj Prakashan.
3. Verma, L. R. (2000). Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation, and Waste Management. Indus Publishing.
4. Jacob, John P. (2008). A Hand Book on Post Harvest Management of Fruits & Vegetables. Daya Publishing House, Delhi.
5. Kader, Adel A. (2002). Postharvest Technology of Horticultural Crops. (3rd Edition). University of California Agriculture and Natural Resources.

PFE 304	DAIRY AND FOOD ENGINEERING	3 (2+1)	SEM VI

Theory

Deterioration in food products and their controls; physical; chemical and biological methods of food preservation; nanotechnology: history, fundamental concepts, tools and techniques nanomaterials; applications in food packaging and products; implications; environmental impact of nanomaterials and their potential effects on global economics; regulation of nanotechnology, dairy development in India; engineering; thermal and chemical properties of milk and milk products; process flow charts for product manufacture; unit operation of various dairy and food processing systems; principles and equipment related to receiving of milk, pasteurization, sterilization, homogenization, centrifugation and cream separation; preparation methods and equipment for manufacture of cheese, *paneer*, butter and ice cream; filling and packaging of milk and milk products; dairy plant design and layout; plant utilities; principles of operation and equipment for thermal processing, canning, aseptic processing; evaporation of food products: principle, types of evaporators, steam economy, multiple effect evaporation, vapour recompression, drying of liquid and perishable foods: principles of drying, spray drying, drum drying, freeze drying, filtration: principle, types of filters, membrane separation; RO: nano-filtration, ultra filtration and macro-filtration; equipment and applications; non-thermal and other alternate thermal processing in food processing.

Practical

Study of pasteurizers; study of sterilizers; study of homogenizers; study of separators; study of butter churns; study of evaporators; study of milk dryers; study of freezers; study of filtration; design of food processing plants & preparation of layout; visit to multi-product dairy plant; estimation of steam requirements; estimation of refrigeration requirements in dairy & food plant; visit to food industry.

Suggested Readings:

1. Singh, R. P. and Heldman, D. R. (2001). Introduction to food engineering. Gulf Professional Publishing.
2. Fellows, P. J. (2009). Food processing technology: principles and practice. Elsevier.
3. Earle, R. L. (2013). Unit operations in food processing. Elsevier.
4. Tufail, Ahmad. (2004). Dairy Plant Engineering and Management. Kitab Mahal Agencies.
5. Arthur, William Farrall. (1963). Engineering for dairy and food products. Wiley.

PFE 305	PROTECTED CULTIVATION AND SECONDARY AGRICULTURE (For B. Sc. (Hons.) Agriculture)	2 (1+1)	SEM VI/X

Theory

Green house technology: introduction, types of green houses, plant response to green house environment, planning and design of greenhouses; design criteria of green house for cooling and heating purposes,

green house equipments; materials of construction for traditional and low cost green houses, irrigation systems used in greenhouses; typical applications; passive solar green house; hot air green house heating systems; green house drying, cost estimation and economic analysis.

Important engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed; their application in PHT equipment design and operation. Drying and dehydration; moisture measurement; EMC; drying theory; various drying method; commercial grain dryer (deep bed dryer; flat bed dryer; tray dryer; fluidized bed dryer, recirculatory dryer and solar dryer). material handling equipment; conveyer and elevators; their principle, working and selection.

Practical

Study of different type of green houses based on shape; determine the rate of air exchange in an active summer winter cooling system; determination of drying rate of agricultural products inside green house; study of green house equipments; visit to various post harvest laboratories; determination of moisture content of various grains by oven drying & infrared moisture methods; determination of engineering properties (shape and size, bulk density and porosity of biomaterials); determination of moisture content of various grains by moisture meter; field visit to seed processing plant.

Suggested Readings:

1. Taft, L. R. (2013). Green House Management: Forcing of Flowers Vegetables and Fruits, Daya Publishing House.
2. Manohar, K. Radha and Igathinathane, C. (2007). Greenhouse: Technology and Management, 2nd Edition, BSP BS Publications, Hyderabad.
3. Tiwari, G. N. (2003). Greenhouse Technology for Controlled Environment, Alpha Science.
4. Chandra, Pitam and More, T.A. (2013). Greenhouse Prodyogiki (In Hindi), ICAR, Govt. of India (Indian Council of Agricultural Research).
5. Ojha, T.P. and Michael, A.M. (2005). Principles of Agricultural Engineering, Jain Brothers, New Delhi.

FMPE 390/ PFE 390/ RBEE 390/ SWE 390	**SKILL DEVELOPMENT TRAINING-I (Student READY)**	**5 (0+5)**	**SEM V**

Exposure to industrial and institutional applications in selected fields of interest (Farm Machinery and Power Engineering; Processing & Food Engineering; Renewable & Bio-energy Engineering; Soil & Water Engineering; Information Technology etc.); training report preparation and presentation (students will be required to undergo training of about 4 weeks during semester break after IVth semester).

FMPE 391/ PFE 391/ RBEE 391/ SWE 391	**UNDERGRADUATE SEMINAR**	**1 (0+1)**	**SEM VI**

Topic selection; material collection; slide preparation; presentation and interaction.

FMPE 411/ PFE 411/ RBEE 411/ SWE 411	**INDUSTRIAL ATTACHMENT/ INTERNSHIP (Student READY)**	**10 (0+10)**	**SEM VII**

Attachment with selected industries/organizations dealing with tractors, agril machinery, precision agriculture, irrigation systems, pumps, soil conservation, watershed management, processing, value

addition, renewable and bio-energy and other aspects related to agricultural engineering; to enrich desired skills and practical knowledge of the students

FMPE 412/ PFE 412/ RBEE 412/ SWE 412	**EXPERIENTIAL LEARNING ON CAMPUS (Student READY)**	**10 (0+10)**	**SEM VII**

FMPE: Exposure to production technology; testing and evaluation of agricultural machinery as per standards; interpretation and preparation of test reports.

PFE: Agro-processing; food product development; setting up of model plants for food processing and value addition; processing and packaging of selected grains; fruits and vegetables.

RBEE: Design; development; installation and maintenance of renewable energy appliances/ equipments and use of related softwares.

SWE: Farm planning and development of irrigation and drainage projects; watershed project formulation; design of water harvesting and recycling systems; maintenance and operation of wells and pumps; irrigation and drainage systems; installation of weirs and flumes for water measurement.

FMPE 490/ PFE 490/ RBEE 490/ SWE 490	**SKILL DEVELOPMENT TRAINING-II (Student READY)**	**5 (0+5)**	**SEM VII**

Exposure to an environment in which students are expected to be associated in their future career; preparation of training report technical aspects of the training and presentation (students will be required to undergo training of about 4 weeks during semester break after VIth semester).

FMPE 491/ PFE 491/ RBEE 491/ SWE 491	**PROJECT PLANNING AND REPORT WRITING (Student READY)**	**10 (0+10)**	**SEM VIII**

Field/lab studies; project report writing and presentation.

Elective Courses

(A student can opt need based elective courses equivalent to 9 Credit Hours)

PFE 401	**FOOD QUALITY AND CONTROL**	**3 (2+1)**	**SEM VIII**

Theory

Basics of food science and food analysis; concept; objectives and need of food quality; measurement of colour, flavor, consistency, viscosity, texture and their relationship with food quality and composition; sampling, purpose, sampling techniques, sampling procedures for liquid; powdered and granular materials; quality control, quality control tools, statistical quality control, sensory evaluation methods; panel selection methods; interpretation of sensory results, instrumental method for testing quality, food adulteration and food safety, TQM and TQC; consumer preferences and acceptance; Food Safety Management Systems GAP; GHP; GMP; Hazards and HACCP (Hazard analysis and critical control point); Sanitation in food industry (SSOP); Food Laws and Regulations in India; FSSAI; Food grades and standards BIS; AGMARK; PFA; FPO; ISO 9000; 22000 Series. CAC (Codex Alimantarious Commission); Traceability and Quality Assurance system in a process plant; Bio safety and Bioterrorism.

Practical

Examination of cereals & pulses from one of go-downs and market shops in relation to FPO and BIS specifications; detection of adulteration and examination of ghee for various standards of AGMARK & BIS standards; detection of adulteration and examination of spices for AGMARK and BIS standards; detection of adulteration and examination of milk and milk products for BIS standards; detection of adulteration and examination of fruit products such as jams, jellys, marmalades for FPO specification; visit to quality control laboratory; case study of statistical process control in food processing industry; study of registration process and licensing procedure under FSSAI; study of sampling techniques from food processing establishments; visit to food processing laboratory and study of records and reports maintained by food processing laboratory.

Suggested Readings:

1. Alli, I. (2016). Food Quality Assurance: Principles and Practices. CRC Press.
2. Ranganna, S. (1986). Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw-Hill Education.
3. Lima, G. P. and Vianello, F. (Eds.). (2013). Food Quality, Safety and Technology. Springer.
4. Jha, S. N. (Ed.). (2010). Nondestructive Evaluation of Food Quality: Theory and Practice. Springer Science & Business Media.
5. Fortin, N. D. (2016). Food Regulation: Law, Science, Policy and Practice. John Wiley & Sons.

PFE 402	FOOD PLANT DESIGN AND MANAGEMENT	3 (2+1)	SEM VIII

Theory

Food plant location, selection criteria, selection of processes, plant capacity, requirements of plant building and its components; project design, flow diagrams, selection of equipment, process and controls; objectives and principles of food plant layout, salient features of processing plants for cereals, pulses, oilseeds, horticultural and vegetable crops; poultry, fish and meat products; milk and milk products. introduction to finance; food product marketing; food business analysis and strategic planning; introduction to marketing; food marketing management; supply chain management for retail food products; entrepreneurship development in food industry; SWOT analysis, generation, incubation and commercialization of ideas and innovations; new product development process, government schemes and incentive for promotion of entrepreneurship; Govt. policy on small and medium scale food processing enterprise; export and import policies relevant to food processing sector; procedure of obtaining license and registration under FSSAI; cost analysis and preparation of feasibility report.

Practical

Preparation of project report; preparation of feasibility report; salient features and layout of pre processing house; salient features and layout of milk and milk product plants; evaluation of given layout; salient features; design and layout of modern rice mill; salient features; design and layout of bakery and related product plant; study of different types of records relating to production of a food plant; study of different types of records relating to finance of a food plant; study of different types of records relating to marketing of a food business; brain storming and SWOT analysis to start a food processing business.

Suggested Readings:

1. Slade, F. H. (1967). Food Processing Plant. Vol. I. Leonard Hill Books.

2. Moran, S. (2015). An Applied Guide to Process and Plant Design. Butterworth-Heinemann.
3. Johnson, A. J. (1986). Process Control Instrumentation Technology. 2nd Ed. Wiley International & ELBS.
4. Backhurst, J. R. and Harker, J. H. (2013). Process Plant Design: Heinemann Chemical Engineering Series. Butterworth-Heinemann.
5. McFarlane, I. (2012). Automatic Control of Food Manufacturing Processes. Springer Science & Business Media.

PFE 403	FOOD PACKAGING TECHNOLOGY	3 (2+1)	SEM VIII

Theory

Factors affecting shelf life of food material during storage; interactions of spoilage agents with environmental factors as water, oxygen, light, pH etc. and general principles of control of the spoilage agents; difference between food infection; food intoxication and allergy; packaging of foods, requirement, importance and scope; frame work of packaging strategy; environmental considerations; packaging systems: types, flexible and rigid, retail and bulk, levels of packaging, special solutions and packaging machines; technical packaging systems and data management packaging systems; different types of packaging materials: their key properties and applications; metal cans; manufacture of two piece and three piece cans; plastic packaging; different types of polymers used in food packaging and their barrier properties; manufacture of plastic packaging materials; profile extrusion; blown film/ sheet extrusion; blow molding; extrusion blow molding; injection blow molding; stretch blow molding; injection molding. glass containers; types of glass used in food packaging; manufacture of glass and glass containers; closures for glass containers; paper and paper board packaging; paper and paper board manufacture process; modification of barrier properties and characteristics of paper/ boards; relative advantages and disadvantages of different packaging materials; effect of these materials on packed commodities; nutritional labelling on packages; CAS and MAP; shrink and cling packaging; vacuum and gas packaging; active packaging; smart packaging; packaging requirement for raw and processed foods; and their selection of packaging materials; factors affecting the choice of packaging materials; disposal and recycle of packaging waste; printing and labelling; lamination; package testing: testing methods for flexible materials; rigid materials and semi rigid materials; tests for paper (thickness. bursting strength. breaking length. Stiffness. tear resistance. folding endurance. ply bond test. surface oil absorption test etc.); plastic film and laminates (thickness. tensile strength. Gloss. Haze. burning test to identify polymer etc.); aluminium foil (thickness. pin holes etc.); glass containers (visual defects. Colour. Dimensions. impact strength etc.); metal containers (pressure test. product compatibility etc.).

Practical

Identification of different types of packaging materials; determination of tensile/ compressive strength of given material/package; to perform different destructive and non-destructive tests for glass containers; vacuum packaging of agricultural produces; determination of tearing strength of paper board; measurement of thickness of packaging materials; to perform grease-resistance test in plastic pouches; determination of bursting strength of packaging material; determination of water-vapour transmission rate; shrink wrapping of various horticultural produce; testing of chemical resistance of packaging materials; determination of drop test of food package and visit to relevant industries.

Suggested Readings:

1. Robertson, G. L. (2016). Food Packaging: Principles and Practice. CRC press.

2. Lee, D. S., Yam, K. L., and Piergiovanni, L. (2008). Food Packaging Science and Technology. CRC press.
3. Yam, K. L., and Lee, D. S. (Eds.). (2012). Emerging Food Packaging Technologies: Principles and Practice. Elsevier.
4. Paine, F. A. and Paine, H. Y. (2012). A Handbook of Food Packaging. Springer Science & Business Media.
5. Natarajan, S., Govindarajan, M. and Kumar, B. (2014). Fundamentals of Packaging Technology. PHI Learning Pvt. Ltd.

PFE 404	DEVELOPMENT OF PROCESSED PRODUCTS	3 (2+1)	SEM VIII

Theory

Process design; process flow chart with mass and energy balance; unit operations and equipments for processing; new product development; technology for value added products from cereal, pulses and oil seeds; milling; puffing; flaking; roasting; bakery products; snack food; extruded products; oil extraction and refining; technology for value added products from fruits, vegetables and spices; canned foods, frozen foods, dried and fried foods; fruit juices, sauce, sugar based confection, candy, fermented food product, spice extracts; technology for animal produce processing , meat, poultry, fish, egg products, health food, nutra-ceuticals and functional food; organic food.

Practical

Process design and process flow chart preparation; preparation of different value added products; visit to roller wheat flour milling; rice milling; spice grinding mill; milk plant; dal and oil mill; fruit/vegetable processing plants & study of operations and machinery; process flow diagram and study of various models of the machines used in a sugar mill.

Suggested Readings:

1. Catherine, Side (2002). Food Product Development: Based on Experience. Iowa State Press.
2. Ulrich, K. T. (2003). Product Design and Development. Tata McGraw-Hill Education.
3. Earle and Earle. (2001). Creating New Foods. Chadwick House Group.
4. Earle, R., Earle, R. and Anderson, A. (2001). Food Product Development. Woodhead Publ.
5. Fuller (2004). New Food Product Development - from Concept to Market Place.

PFE 405	PROCESS EQUIPMENT DESIGN	3 (2+1)	SEM VIII

Theory

Introduction on process equipment design; application of design engineering for processing equipments; design parameters and general design procedure; material specification; types of material for process equipments; design codes; pressure vessel design; design of cleaners. design of tubular heat exchanger; shell and tube heat exchanger and plate heat exchanger; design of belt conveyer; screw conveyer and bucket elevator; design of dryers; design of milling equipments; optimization of design with respect to process efficiency; energy and cost; Computer Aided Design.

Practical

Design of pressure vessel; cleaners; milling equipments; tubular heat exchanger; shell and tube type heat exchanger; plate heat exchanger; dryer; belt conveyor; bucket elevator; screw conveyor.

Suggested Readings:

1. Phirke, P. S. (2004). Processing and Conveying Equipment Design. Jain Bros.

2. Saravacos, G. D. and Kostaropoulos, A. E. (2002). Handbook of Food Processing Equipment. Springer Science & Business Media.
3. Forsythe, S. J. and Hayes, P. R. (1998). Design of Food Processing Equipment. In Food Hygiene, Microbiology and HACCP. Springer US.
4. Joshi, M. V. and Mahajani, V. V. (1996). Process Equipment Design. Macmillan India.
5. Towler, G. and Sinnott, R. K. (2012). Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design. Elsevier.

RENEWABLE AND BIO-ENERGY ENGINEERING

Course No.	Course Title	Credits	Semester
Core Courses			
RBEE 201	Fundamentals of Renewable Energy Sources	3 (2+1)	IV
RBEE 202	Renewable Energy and Green Technology (For B. Sc. (Hons.) Agriculture)	2 (1+1)	IV/VIII
RBEE 301	Renewable Power Sources	3 (2+1)	V
RBEE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
RBEE 302	Bio-energy Systems: Design and Applications	3 (2+1)	VI
RBEE 391	Undergraduate Seminar	1 (0+1)	VI
RBEE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
RBEE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
RBEE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
RBEE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**52 (7+45)**	
Elective Courses (Any three)			
RBEE 401	Photovoltaic Technology and Systems	3 (2+1)	VIII
RBEE 402	Waste and By-products Utilization	3 (2+1)	VIII
RBEE 403	Biogas Technology and Mechanism	3 (2+1)	VIII
RBEE 404	Solar Energy Utilization	3 (2+1)	VIII
RBEE 405	Energy Auditing and Management	3 (2+1)	VIII
	Total Credits	**15 (10+5)**	

RBEE 201	FUNDAMENTALS OF RENEWABLE ENERGY SOURCES	3 (2+1)	SEM IV

Theory

Renewable Energy Sources (RES): definition, concept and limitation, potential and classification of RES. Solar, wind, biomass, geothermal,; ocean energy sources; comparison of renewable energy sources with non-renewable sources; solar energy: energy available, solar radiation, solar energy conversion into heat through flat plate and concentrating collectors; different solar thermal devices; principle of natural and forced convection drying system and green house; solar photovoltaic: p-n junctions, solar cells, spv systems; stand alone and grid connected solar power station; wind energy: energy available, general formula, lift and drag, coefficient of performance (COP), basis of wind energy conversion; effect of density, frequency variances, angle of attack, wind speed and types of wind mill rotors; bio-energy: characteristics of biomass, pyrolysis of biomass to produce solid, liquid and gaseous fuels; biomass gasification and gasifiers and biomass cook-stoves; biogas: fundamentals, biochemistry, factors affecting biogas generation; types of biogas plants: design considerations of domestic biogas plants, uses of biogas and handling of bio-digested slurry.

Practical

Study of solar devices: solar cookers; water heating system; natural and forced convection dryers; desalination unit; green house for agriculture and photovoltaic systems; study of biomass improved cook-stoves and biomass gasifiers; study and performance evaluation of different biogas plants; estimation of calorific value of biomass; biogas and producer gas.

Suggested Readings:

1. Rai, G. D. (1998). Non-Conventional Sources of Energy. Khanna Publ.
2. Twindal, J. W. & Anthony, D. Wier. (1986). Renewable Energy Sources. E&F.N. Spon Ltd.
3. Mital, K. M. (1996). Non-Conventional Energy Systems. Wheeler Publishing, New Delhi.
4. Tiwari G. N. and Ghosal M. K. (2005). Renewable Energy Resources, Narosa Publishing House, New Delhi.
5. Rathore, N. S., Kurchania, A. K.and Panwar, N. L. (2007). Non-conventional Energy Sources. Himanshu Publications

RBEE 202	RENEWABLE ENERGY AND GREEN TECHNOLOGY (For B. Sc. (Hons.) Agriculture)	2 (1+1)	SEM V/VIII

Theory

Classification of energy sources; renewable energy sources and its contribution in agricultural sector; familiarization with biomass utilization for bio-fuel production and their applications; familiarization with different types of biogas plants and gasifiers; biomass briquetting; bio-alcohol; biodiesel and bio-oil production and their utilization; introduction of solar energy; collection and application; familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy, solar drying, solar pond, solar distillation and solar photovoltaic system; introduction of wind energy and its application.

Practical

Familiarization with renewable energy gadgets; study of biogas plants, gasifiers; production process of bio-fuels; study of biomass cook-stoves and briquetting machine; study of solar photovoltaic system: solar light, solar pumping, solar fencing and solar rooftop; study of solar cookers, solar water heating systems, solar distillation, solar pond and solar drying system.

Suggested Readings:

1. Rai, G. D. (1998). Non-conventional Sources of Energy. Khanna Publ.
2. Twindal, J. W. and Anthony, D. Wier. (1986). Renewable Energy Sources. E&F.N. Spon Ltd.
3. Mital, K. M. (1996). Non-conventional Energy Systems. Wheeler Publishing, New Delhi.
4. Tiwari, G.N. and Ghosal, M.K. (2005). Renewable Energy Resources. Narosa Publishing House, New Delhi.
5. Sukhatame, S.P. (1996). Solar Energy. Tata McGraw-Hill Education, New Delhi.

RBEE 301	RENEWABLE POWER SOURCES	3 (2+1)	SEM V

Theory

Energy resources and consumption pattern in India; renewable energy options for power generation; their potential and utilization; design of different commercial size biogas plants; purification and bottling of biogas; power generation from biogas; generation of power from urban, municipal and industrial waste; power generation from biomass (gasification & dendro thermal); shaft power generation and thermal application; solar thermal and photovoltaic systems for power generation, central receiver and distributed type solar power plants; ocean thermal energy conversion (OTEC) and magneto hydrodynamic generator (MHD); hydrogen and fuel cell technology; fuel cells and its associated parameters, power generation from wind: wind power generators, working principle of wind power plants, wind farms; mini, micro and small hydel power plants; cost economics of power generation.

Practical

Performance evaluation of a fixed dome and floating drum type biogas plant; estimation of calorific value of biogas and producer gas; diesel engine operation using dual fuel (diesel and biogas) and gas alone. performance evaluation of biomass gasifier engine system; performance evaluation of solar cooker, solar water heater and solar air heater/dryer; performance evaluation of solar photovoltaic system and its characteristics; visit to commercial/ institutional power generation solar and biogas plants.

Suggested Readings:

1. Rai, G. D. (1998). Non-conventional Sources of Energy. Khanna Publ.
2. Twindal, J. W. & Anthony, D. Wier. (1986). Renewable Energy Sources. E&F.N. Spun Ltd.
3. Sukhatame, S. P. (1996). Solar Energy. Tata McGraw-Hill Education, New Delhi.
4. Garg, H. P. (1990). Advances in Solar Energy Technology. D. Publishing Company, Tokyo.
5. Rathore, N. S., Kurchania, A. K. and Panwar, N. L. (2007). Non Conventional Energy Sources. Himanshu Publications.

RBEE 302	BIO-ENERGY SYSTEMS: DESIGN AND APPLICATIONS	3 (2+1)	SEM VI

Theory

Assessment of available biomass and its potential for bio-energy production; biomass preparation techniques (size reduction, densification and drying); fermentation processes and its general requirements; an overview of aerobic and anaerobic fermentation processes and their industrial application; heat transfer processes in anaerobic digestion systems; land fill gas technology and potential; biomass production: wastelands; classification and their use through energy plantation; selection of species; methods of field preparation and transplanting; harvesting of biomass and coppicing characteristics; thermo-chemical degradation of biomass; principles of combustion; concept of excess air; chemistry of gasification; gasifier fuels; properties; preparation and conditioning of producer gas; trans-esterification for biodiesel production; bio-hydrogen production routes; environmental aspect of bio-energy; assessment of greenhouse gas mitigation potential and economics of bio-energy systems.

Practical

Study of anaerobic fermentation system for industrial application; gasification for industrial process heat; biodiesel production system; biomass densification technique (briquetting, pelletization and cubing); integral bio-energy system for industrial application and bio-energy efficiency in industry and commercial buildings; study and demonstration of energy efficiency in building; measuring efficiency of different insulation technique; study of Brayton, Striling and Rankine cycles.

Suggested Readings:

1. Rathore, N. S., Kurchania, A. K. and Panwar, N. L. (2007). Non Conventional Energy Sources. Himanshu Publications.
2. Mathur, A. N. and Rathore, N. S. (1992). Biogas Production Management and Utilization. Himanshu Publications, Udaipur.
3. Khandelwal, K. C. and Mahdi, S. S. (1990). Biogas Technology.
4. British, Bio Gen. (1997). Anaerobic Digestion of Farm and Food Processing Practices- Good Practice Guidelines, London. Available on www.britishbiogen.co.UK.
5. Centre for Biomass Energy. (1998). Straw for energy production, Technology- Environment-Ecology. Available:www.ens.dk.

FMPE 390/ PFE 390/ RBEE 390/ SWE 390	**SKILL DEVELOPMENT TRAINING-I (Student READY)**	**5 (0+5)**	**SEM V**

Exposure to industrial and institutional applications in selected fields of interest (Farm Machinery and Power Engineering; Processing & Food Engineering; Renewable & Bio-energy Engineering; Soil & Water Engineering; Information Technology etc.); training report preparation and presentation (students will be required to undergo training of about 4 weeks during semester break after IVth semester).

FMPE 391/ PFE 391/ RBEE 391/ SWE 391	**UNDERGRADUATE SEMINAR**	**1 (0+1)**	**SEM VI**

Topic selection; material collection; slide preparation; presentation and interaction.

FMPE 411/ PFE 411/ RBEE 411/ SWE 411	**INDUSTRIAL ATTACHMENT/ INTERNSHIP (Student READY)**	**10 (0+10)**	**SEM VII**

Attachment with selected industries/organizations dealing with tractors, agril machinery, precision agriculture, irrigation systems, pumps, soil conservation, watershed management, processing, value addition, renewable and bio-energy and other aspects related to agricultural engineering; to enrich desired skills and practical knowledge of the students

FMPE 412/ PFE 412/ RBEE 412/ SWE 412	**EXPERIENTIAL LEARNING ON CAMPUS (Student READY)**	**10 (0+10)**	**SEM VII**

FMPE: Exposure to production technology; testing and evaluation of agricultural machinery as per standards; interpretation and preparation of test reports.

PFE: Agro-processing; food product development; setting up of model plants for food processing and value addition; processing and packaging of selected grains; fruits and vegetables.

RBEE: Design; development; installation and maintenance of renewable energy appliances/ equipments and use of related softwares.

SWE: Farm planning and development of irrigation and drainage projects; watershed project formulation; design of water harvesting and recycling systems; maintenance and operation of wells and pumps; irrigation and drainage systems; installation of weirs and flumes for water measurement.

FMPE 490/ PFE 490/ RBEE 490/ SWE 490	**SKILL DEVELOPMENT TRAINING-II (Student READY)**	**5 (0+5)**	**SEM VII**

Exposure to an environment in which students are expected to be associated in their future career; preparation of training report technical aspects of the training and presentation (students will be required to undergo training of about 4 weeks during semester break after VIth semester).

FMPE 491/ PFE 491/ RBEE 491/ SWE 491	**PROJECT PLANNING AND REPORT WRITING (Student READY)**	**10 (0+10)**	**SEM VIII**

Field/lab studies; project report writing and presentation.

Elective Courses

(A student can opt need based elective courses equivalent to 9 Credit Hours)

RBEE 401	**PHOTOVOLTAIC TECHNOLOGY AND SYSTEMS**	**3 (2+1)**	**SEM VIII**

Theory

Solar PV technology: advantages, limitations, current status of PV technology, SWOT analysis of PV technology; types of solar cell; wafer based Silicon cell; Thin film amorphous silicon cell; Thin Cadmium Telluride (CdTe) Cell; Copper Indium Gallium Selenide (CiGS) Cell; thin film crystalline silicon solar cell; solar photo voltaic module: solar cell, solar module, solar array, series & parallel connections of cell; mismatch in cell; fill factor, effect of solar radiation and temperature on power output of module; I-V and power curve of module; balance of solar PV system: introduction to batteries, battery classification, lead acid battery, Nickel Cadmium battery, comparison of batteries, battery parameters; charge controller: types of charge controller, function of charge controller, PWM type, MPPT type charge controller; converters: DC to DC converter and DC to AC type converter, application of solar PV system. solar home lighting system; solar lantern; solar fencing; solar street light; solar water pumping system; roof top solar photovoltaic power plant and smart grid.

Practical

Study of V-I characteristics of solar PV system; smart grid technology and application; manufacturing technique of solar array; different DC to DC and DC to AC converter; domestic solar lighting system; various solar module technologies; safe measurement of PV modules electrical characteristics and commissioning of complete solar PV system.

Suggested Readings:

1. Rai, G. D. (1998). Non-conventional Sources of Energy. Khanna Pub.
2. Rathore, N. S., Kurchania, A. K. and Panwar, N. L. (2006). Renewable Energy. Theory & Practice, Himanshu Publications.
3. Solanki, C. S. (2011). Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI Learning Private Ltd.
4. Meinel and Meinel. (1976). Applied Solar Energy. Addison- Warley Educational Publishers Inc
5. Derrick, Francis and Bokalders. (1989). Solar Photo-voltaic Products. ITDG Publishing,

RBEE 402	**WASTE AND BY-PRODUCTS UTILIZATION**	**3 (2+1)**	**SEM VIII**

Theory

Types and formation of by-products and waste; magnitude of waste generation in different food processing industries; uses of different agricultural by-products from rice mill, sugarcane industry, oil mill etc.; concept, scope and maintenance of waste management and effluent treatment, temperature, pH, oxygen demands (BOD, COD), fat, oil and grease content; metal content; forms of phosphorous and sulphur in waste waters; microbiology of waste; other ingredients like insecticide, pesticides and fungicides residues; waste utilization in various industries, furnaces and boilers run on

agricultural wastes and byproducts; briquetting of biomass as fuel; production of charcoal briquette; generation of electricity using surplus biomass; producer gas generation and utilization; waste treatment and disposal, design, construction; operation and management of institutional community and family size biogas plants; concept of vermin-composting; pre-treatment of waste: sedimentation; coagulation; flocculation and floatation; secondary treatments: biological and chemical oxygen demand for different food plant waste– trickling filters; oxidation ditches; activated sludge process; rotating biological contractors; lagoons; tertiary treatments: advanced waste water treatment process-sand; coal and activated carbon filters ; phosphorous, sulphur, nitrogen and heavy metals removal; assessment, treatment and disposal of solid waste; and biogas generation; effluent treatment plants; environmental performance of food industry to comply with ISO-14001 standards.

Practical

Determination of temperature, pH, turbidity solids content, BOD and COD of waste water; determination of ash content of agricultural wastes and determination of un-burnt carbon in ash; study about briquetting of agricultural residues; estimation of excess air for better combustion of briquettes; study of extraction of oil from rice bran; study on bioconversion of agricultural wastes; recovery of germ and germ oil from by-products of cereals; visit to various industries using waste and food by-products.

Suggested Readings:

1. Markel, I. A. (1981). Managing Livestock Waste, AVI Publishing Co.
2. Joshi, V. K. and Sharma, S. K. (2011) Food Processing Waste Management: Treatment & Utilization. New India Publishing Agency.
3. Prashar, Anupama and Bansal, Pratibha. (2007-08). Industrial Safety and Environment. S.K. Kataria and sons, New Delhi.
4. Garg, S. K. (1998). Environmental Engineering (Vol. II) – Sewage Disposal and Air Pollution Engineering. Khanna Publishers, New Delhi.
5. Bhatia, S. C. (2001). Environmental Pollution and Control in Chemical Process Industries. Khanna Publishers, New Delhi.

RBEE 403	BIOGAS TECHNOLOGY AND MECHANISM	3 (2+1)	SEM VIII

Theory

Biogas technology: introduction and potential of biogas in relation to environment, ecology, agriculture, health and sanitation; digestion process; factors enhancing/inhibiting biogas production; bio-chemical and microbial aspects: biogas mechanism; enhancement of biogas production by different additives (chemicals, organic substances, enzymes) pretreatment process etc. ;scrubbing process; bottling; need for bottling of biogas; liquefaction of biogas; various uses of biogas and its merits and demerits; biogas plant: systems, types of biogas plants, classification, design of a biogas plant (cow dung and organic waste) and structural strength; selection of site and size; construction technique; material requirement; recent advances in high rate bio-methanation reactors; design and material; night soil linked biogas plant; cold condition biogas plant design concept; cost and financial viability; biogas distribution and utilization: properties of biogas; different uses; design of biogas distribution system; pressure and flow measuring devices; safety devices; biogas fittings; principles of dual fuel biogas engines; its limitations; biogas appliances including thermal and cooking efficiency test; effluent: handling of effluent of biogas plant (cow dung based; sanitary latrine attached and agro industrial wastes); effluent treatment and management effect of slurry on crop and fish production; integrated recycling of organic wastes; alternate feed material: study of biogas plant

for distillery and sugar mills effluent; willow dust; agro-wastes; agro and processing industry wastes; repair and maintenance of biogas plants.

Practical

Study of different equipments in lab; study of different models of biogas plants; determination of N; P and K contents of the fresh and digested slurry by chemical analysis; analysis of biogas to determine its constituents (gas chromatography; Orsate gas Analyzer); study on constructional details of different designs of biogas plants; testing of biogas burner for heat transfer; thermal and cooking efficiency; testing of biogas lamp; determination of BOD/COD; determination of calorific value of biogas; visit to industrial biogas plants; BIS code for efficiency testing of biogas appliances.

Suggested Readings:

1. Markel, I. A. (1981). Managing Livestock Waste, AVI Publishing Co.
2. Khoiyangbam, R. S., Navindu, Gupta and Kumar, Sushil. (2011). Biogas Technology: Towards sustainable development. TERI Press, New Delhi.
3. Nijaguna, B.T. (2006). Biogas Technology. New Age International, New Delhi.
4. Mathur, A.N. and Rathore, N.S. (1992). Biogas Production Management & Utilization. Himanshu Publications, Udaipur.
5. Khandelwal, K.C. and Mahdi, S.S.. (1990). Biogas Technology.

RBEE 404	SOLAR ENERGY UTILIZATION	3 (2+1)	SEM VIII

Theory

Solar radiation : sun and its characteristics; structure of the sun; extraterrestrial solar radiation; the solar constant; solar radiation on earth's surface; beam and scattered radiation; variation in extraterrestrial radiations; diffuse radiation; attenuation of beam and diffused radiation at the ground; basic earth sun angles; solar time and equation of time; day length; solar radiation measurements and estimation: solar energy measuring instruments, estimation of average solar radiation; solar collectors : flat plate collector, material for flat plate collector and their properties; thermal analysis of flat-plate collectors; collector efficiency factor and heat removal factor; focussing collectors; types and applications of focussing collectors; solar energy applications: introduction and principle of operation of solar cookers; solar air heaters; solar water heaters; solar distillation; solar pond; solar refrigeration and air-conditioning; solar thermal power generation; green house etc.; solar thermal storage: types of energy storage, thermal storage, material characteristics for thermal storage.

Practical

Measurement of solar radiation; solar energy measuring instruments; study of flat plate collector; performance testing of solar cooker; solar water heater; natural and forced convection solar dryer; solar tunnel dryer; solar green house; solar cooling systems; solar pond and visit to various sites of solar energy applications and solar power plants.

Suggested Readings:

1. Rai, G. D. (1998). Non-conventional Sources of Energy. Khanna Publ.
2. Twindal, J. W. and Anthony, D. Wier. (1986). Renewable Energy Sources. E&F.N. Spon Ltd.
3. Sukhatame, S. P. (1996). Solar Energy, Tata McGraw-Hill Education. New Delhi.
4. Garg, H. P. (1990). Advances in Solar Energy Technology, D. Publishing Company, Tokyo.
5. Yucu, H., Paykoc, E. and Yener, Y. (1978). Solar Energy Utilization. ISBN: 978-94-010-8124-5 (Print) 978-94-009-3631-7 (Online).

RBEE 405	ENERGY AUDITING AND MANAGEMENT	3 (2+1)	SEM VIII

Theory

Energy forms and units : conventional and non-conventional forms of energy; pattern of energy consumption; sources of energy; norms and scenario in agriculture and agro-based industries; energy accounting methods and measurement; second law of thermodynamics and efficiency analysis of system; energy audit : energy auditing, type of energy auditing, energy accounting, energy analysis techniques and methods; energy balance; output and input ratio; resource utilization; data collection and conservation of energy sources; energy auditing of different sectors viz. industrial; agriculture and electrical auditing. energy conservation: energy conservation planning and practices; energy forecasting; energy economics; energy pricing and factors affecting energy economics; energy conservation and management in agriculture; agro-processing industries and domestic sector; co-generation: cogeneration with alternative energy system, waste heat recovery and scope of renewable energy in industries.

Practical

Study of different energy audit techniques; study of instruments required for energy audit; energy audit of selected industries; study of energy use pattern and management strategies for various agro-industries; scope of renewable energy techniques in industries and visit to related agro-industries.

Suggested Readings:

1. Patrick, D. R. and Fardo, S. W. (1982) Energy Management and Conservation, Prentice Hall, Inc., Englewood Cliffs, NJ07632.
2. Abbi, Y. P. (2014). Handbook on Energy Audit and Environment Management. TERI Press, New Delhi.
3. Kreith, Frank, Goswami, D. and Yogi. (2007). Energy Management and Conservation Handbook, CRC Press.
4. Thumann, Albert, Niehus, Terry, Younger and William J. (2017). Handbook of Energy Audits. Pie mental Press.
5. Haimes, Yacov Y. (1980). Energy Auditing and Conservation: Methods, Measurements, Management, and Case Studies. Taylor & Francis Inc. U.K.

SOIL AND WATER ENGINEERING

Course No.	Course Title	Credits	Semester
Core Courses			
SWE 101	Introductory Soil and Water Conservation Engineering (For B. Sc. (Hons.) Agriculture)	2 (1+1)	II/VI
SWE 201	Watershed Hydrology	2 (1+1)	IV
SWE 202	Irrigation Engineering	3 (2+1)	IV
SWE 203	Sprinkler and Micro Irrigation Systems	2 (1+1)	IV
SWE 301	Soil and Water Conservation Engineering	3 (2+1)	V
SWE 302	Watershed Planning and Management	2 (1+1)	V
SWE 303	Drainage Engineering	2 (1+1)	V
SWE 390	Skill Development Training-I (Student READY)	5 (0+5)	V
SWE 304	Water Harvesting and Soil Conservation Structures	3 (2+1)	VI
SWE 305	Groundwater; Wells and Pumps	3 (2+1)	VI
SWE 391	Undergraduate Seminar	1 (0+1)	VI
SWE 411	Industrial Attachment/ Internship (Student READY)	10 (0+10)	VII
SWE 412	Experiential Learning On campus (Student READY)	10 (0+10)	VII
SWE 490	Skill Development Training-II (Student READY)	5 (0+5)	VII
SWE 491	Project Planning and Report Writing (Student READY)	10 (0+10)	VIII
	Total Credits	**61 (12+49)**	
Elective Courses (Any three)			
SWE 401	Management of Canal Irrigation System	3 (2+1)	VIII
SWE 402	Remote Sensing and GIS Applications	3 (2+1)	VIII
SWE 403	Precision Farming Techniques for Protected Cultivation	3 (2+1)	VIII
SWE 404	Landscape Irrigation Design and Management	3 (2+1)	VIII
SWE 405	Water Quality and Management Measures	3 (2+1)	VIII
SWE 406	Plastic Applications in Agriculture	3 (2+1)	VIII
SWE 407	Information Technology for Land and Water Management	3 (2+1)	VIII
SWE 408	Minor Irrigation and Command Area Development	3 (2+1)	VIII
SWE 409	Wasteland Development	3 (2+1)	VIII
SWE 410	Floods and Control Measures	3 (2+1)	VIII
	Total Credits	**30 (20+10)**	

SWE 101	INTRODUCTORY SOIL AND WATER CONSERVATION ENGINEERING (For B. Sc. (Hons.) Agriculture)	2 (1+1)	SEM II/VI

Theory

Introduction to soil and water conservation; causes, types and agents of soil erosion; water erosion: its type, mechanics and factors affecting it; gully erosion: process of gully development, its classification and control measures; soil loss estimation by Universal Loss Soil Equation; erosion control measures: agronomical measures, contour farming, strip cropping and mulching; introduction to contour and graded bund; bench terracing and area lost in bench terrace; grassed water ways and their design; wind erosion: mechanics of wind erosion, types of soil movement, factors affecting it and its control measures; water harvesting and its techniques.

Practical

General status of soil conservation in India; calculation of erosion index; numericals on soil loss estimation; design of shelter belt; design of grassed water ways; design of contour bunds; design of graded bunds; design of bench terracing system; problem on wind erosion.

Suggested Readings:

1. Suresh, R. (2012). Soil and Water Conservation Engineering. Standard Publishers Distributors, New Delhi-11006.
2. Michael, A.M. and Ojha, T.P. (2013). Principles of Agricultural Engineering (Volume-II). Jain Brothers, New Delhi-110005.
3. Murty, V. V. N. and Jha, Madan K. (2015). Land and Water Management Engineering. Kalyani Publishers, Ludhiana-141008.
4. Chandra, Mal Bimal. (2005). Introduction to Soil and Water Conservation Engineering. Kalyani Publishers, Ludhiana-141008.
5. Ghanshyam, Das. (2000). Hydrology and Soil Conservation Engineering. Prentice Hall of India, New Delhi-110001.

SWE 201	WATERSHED HYDROLOGY	2 (1+1)	SEM IV

Theory

Hydrologic cycle; precipitation and its forms; rainfall measurement and estimation of mean rainfall; frequency analysis of point rainfall, mass curve, hyetograph, depth-area-duration curves and intensity-duration-frequency relationship; hydrologic processes-interception, infiltration -factors influencing, measurement and indices; rainfall probability analysis; evaporation - estimation and measurement; runoff - factors affecting; measurement; stage - discharge rating curve; estimation of peak runoff rate and volume; Rational method; Cook's method and SCS curve number method; Hydrograph - Components; base flow separation; unit hydrograph theory; S-curve; synthetic hydrograph; applications and limitations; stream gauging - discharge rating curves; flood peak; design flood; flood routing – channel and reservoir routing; drought – classification; causes and impacts; drought management strategy.

Practical

Visit to meteorological observatory and study of different instruments; design of rain gauge network; exercise on intensity - frequency - duration curves; exercise on depth - area - duration and double mass curves; analysis of rainfall data and estimation of mean rainfall by different methods; exercise on frequency analysis of hydrologic data and estimation of missing data; test for consistency of rainfall records; exercise on computation of infiltration indices; computation of peak runoff and runoff volume by Cook's method and rational formula; computation of runoff volume by SCS curve number method; study of stream gauging instruments - current meter and stage level recorder; exercise on runoff hydrograph; exercise on unit hydrograph ; exercise on synthetic hydrograph ; exercise on flood routing.

Suggested Readings:

1. Subramanya, K. (2016). Engineering Hydrology. Tata McGraw-Hill Publishing Co., New Delhi.
2. Suresh, R. (2005). Watershed Hydrology. Standard Publishers Distributors, Delhi.
3. Varshney, R. S. (1986). Engineering Hydrology. Nem Chand and Brothers, Roorkee, U.P.

4. Jaya, Rami and Reddy, P. (2011). A Text Book of Hydrology. University Science Press, New Delhi.

5. Chow, V. T., Maidment, D. R. and Mays, L.W. (2010). Applied Hydrology, McGraw Hill Publishing Co., New York.

SWE 202	IRRIGATION ENGINEERING	3 (2+1)	SEM IV

Theory

Major and medium irrigation schemes of India; purpose of irrigation; environmental impact of irrigation projects; source of irrigation water; present status of development and utilization of different water resources of the country; measurement of irrigation water: weir, flumes and orifices and other methods; open channel water conveyance system : design and lining of irrigation field channels; on farm structures for water conveyance; control & distribution; underground pipe conveyance system: components and design; land grading: criteria for land levelling; land levelling design methods; estimation of earth work; soil water plant relationship: soil properties influencing irrigation management; soil water movement; infiltration; soil water potential; soil moisture characteristics; soil moisture constants; measurement of soil moisture; moisture stress and plant response; water requirement of crops: concept of evapotranspiration (ET); measurement and estimation of ET; water and irrigation requirement of crops; depth of irrigation; frequency of irrigation; irrigation efficiencies; surface methods of water application: border; check basin and furrow irrigation- adaptability; specification and design considerations.

Practical

Measurement of soil moisture by different soil moisture measuring instruments; measurement of irrigation water; measurement of infiltration characteristics; determination of bulk density; field capacity and wilting point; estimation of evapotranspiration; land grading methods; design of underground pipeline system; estimation of irrigation efficiency; study of advance; recession and computation of infiltration opportunity time; infiltration by inflow-outflow method; evaluation of border irrigation method; evaluation of furrow irrigation method; evaluation of check basin irrigation method.

Suggested Readings:

1. Michael, A. M. (2012). Irrigation: Theory and Practice. Vikas Publishing House New Delhi.

2. Majumdar, D. K. (2013). Irrigation Water Management Principles. PHI Learning Private Limited New Delhi 2nd Edition.

3. Allen, R. G., Pereira, L. S., Raes, D., Smith, M. (1998). Crop Evapotranspiration Guidelines for Computing Crop Water Requirement. Irrigation and drainage Paper 56, FAO of United Nations, Rome.

4. Murthy, V.V.N. (2013). Land and Water Management Engineering. Kalyani Publishers, New Delhi.

5. Israelsen, O. W., Hansen, V. E. and Stringham, G. E. (1980). Irrigation Principles and Practice, John Wiley & Sons, Inc. USA.

SWE 203	SPRINKLER AND MICRO IRRIGATION SYSTEMS	2 (1+1)	SEM IV

Theory

Sprinkler irrigation, adaptability, problems and prospects; types of sprinkler irrigation systems; design of sprinkler irrigation system: layout selection, hydraulic design of lateral, sub-main and main

pipe line; design steps; selection of pump and power unit for sprinkler irrigation system; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency;

Micro irrigation systems: types-drip, spray & bubbler systems, merits and demerits, different components; design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection; hydraulics of drip irrigation system: design steps, necessary steps for proper operation of a drip irrigation system, maintenance of micro irrigation system; clogging problems: filter cleaning, flushing and chemical treatment; fertigation: advantages and limitations of fertigation, fertigation frequency, duration and injection rate; methods of fertigation.

Practical

Study of different components of sprinkler irrigation system; design and installation of sprinkler irrigation system; determination of precipitation pattern; discharge and uniformity coefficient; cost economics of sprinkler irrigation system; study of different components of drip irrigation; design and installation of drip irrigation system; determination of pressure discharge relationship and emission uniformity for given emitter; study of different types of filters and determination of filtration efficiency; determination of rate of injection and calibration for chemigation/fertigation; design of irrigation and fertigation schedule for crops; field visit to micro irrigation system and evaluation of drip system; cost economics of drip irrigation system.

Suggested Readings:

1. Keller, Jack and Bliesner, Ron D. (2001). Sprinkle and Trickle Irrigation. Springer Science business Media, New York.
2. Mane, M. S. and Ayare, B. L. (2007). Principles of Sprinkler Irrigation systems, Jain Brothers, New Delhi.
3. Mane, M. S. and Ayare, B. L. and Magar, S. S. (2006). Principles of Drip Irrigation systems, Jain Brothers, New Delhi.
4. Michael, A. M., Shrimohan and Swaminathan, K. R. (1972) Design and evaluation of irrigation methods, (IARI Monograph No.1). Water Technology Centre, IARI New Delhi.
5. Michael, A.M. (2012). Irrigation: Theory and Practice. Vikas Publishing House, New Delhi.

SWE 301	SOIL AND WATER CONSERVATION ENGINEERING	3 (2+1)	SEM V

Theory

Soil erosion: introduction, causes and types - geological and accelerated erosion; agents; factors affecting and effects of erosion; water erosion: mechanics and forms – splash, sheet, rill, gully, ravine and stream bank erosion; Gullies: classification, stages of development; soil loss estimation: universal soil loss equation (USLE) and modified USLE; rainfall erosivity; estimation by KE>25 and EI_{30} methods; soil erodibility: topography, crop management and conservation practice factors; measurement of soil erosion: runoff plots, soil samplers; water erosion control measures: agronomical measures- contour farming, strip cropping, conservation tillage and mulching; engineering measures- bunds and terraces; bunds: contour and graded bunds- design and surplussing arrangements; terraces: level and graded broad base terraces; bench terraces – planning, design and layout procedure; contour stonewall and trenching; gully and ravine reclamation - principles of gully control - vegetative measures; temporary structures and diversion drains. grassed waterways- design; wind erosion- factors affecting; mechanics; soil loss estimation and control measures - vegetative; mechanical measures; wind breaks and shelter belts and stabilization of sand dunes; land capability classification; rate of sedimentation; silt monitoring and storage loss in tanks.

Practical

Study of different types and forms of water erosion; exercises on computation of rainfall erosivity index; computation of soil erodibility index in soil loss estimation; determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE; exercises on soil loss estimation/measuring techniques; estimation of sediment rate using coshocton wheel sampler and multi-slot devisor; determination of sediment concentration through oven dry method; design and layout of contour bunds; design and layout of graded bunds; design of broad base terraces; design and layout of bench terraces; design of vegetative waterways; exercises on rate of sedimentation and storage loss in tanks; design of shelterbelts and wind breaks for wind erosion control; visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures.

Suggested Readings:

1. Singh, Gurmel, Venkataraman, C., Sastry, G. and Joshi, B. P. (1996). Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ghanshyam, Das. (2008). Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
3. Michael, A.M. and Ojha, T.P. (2003). Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
4. Murthy, V.V.N. (2002). Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
5. Suresh, R. (2014). Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

SWE 302	WATERSHED PLANNING AND MANAGEMENT	2 (1+1)	SEM V

Theory

Watershed - introduction and characteristics; watershed development - problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors; watershed management – concept, objectives, factors affecting watershed planning based on land capability classes; hydrologic data for watershed planning; watershed codification, delineation and prioritization of watersheds – sediment yield index; water budgeting in a watershed; management measures - rainwater conservation technologies - *in-situ* and *ex-situ* storage; water harvesting and recycling; effect of cropping systems land management and cultural practices on watershed hydrology; watershed programme – execution, follow-up practices, maintenance, monitoring and evaluation; participatory watershed management - role of watershed associations; user groups and self-help groups; planning and formulation of project proposal for watershed management programme including cost-benefit analysis.

Practical

Exercises on delineation of watersheds using toposheets; surveying and preparation of watershed map; quantitative analysis of watershed characteristics and parameters; watershed investigations for planning and development; analysis of hydrologic data for planning watershed management; water budgeting of watersheds; prioritization of watersheds based on sediment yield index; study of watershed management technologies; practice on softwares for analysis of hydrologic parameters of watershed; study of role of various functionaries in watershed development programmes; techno-economic viability analysis of watershed projects; visit to watershed development project areas.

Suggested Readings:

1. Das, Ghanshyam. (2008). Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
2. Katyal, J. C., Singh, R. P., Sharma, Shriniwas, Das, S. K., Padmanabhan, M. V. and Mishra, P. K. (1995). Field Manual on Watershed Management. CRIDA, Hyderabad.
3. Mahnot, S. C. (2014). Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.
4. Sharda, V. N., Sikka, A.K. and Juyal, G.P. (2006). Participatory Integrated Watershed Management: A Field Manual. Central Soil and Water Conservation Research and Training Institute,Dehradun.
5. Singh, G. D. and Poonia, T. C. (2003). Fundamentals of Watershed Management Technology. Yash Publishing House, Bikaner.

SWE 303	DRAINAGE ENGINEERING	2 (1+1)	SEM V

Theory

Water logging- causes and impacts; drainage; objectives of drainage; familiarization with the drainage problems of the state; surface drainage coefficient; types of surface drainage; design of surface drains; sub-surface drainage: purpose and benefits; investigations of design parameters-hydraulic conductivity; drainable porosity; water table; derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; drainage materials; drainage pipes; drain envelope; layout; construction and installation of drains; drainage structures; vertical drainage; bio-drainage; mole drains; salt balance; reclamation of saline and alkaline soils; leaching requirements; conjunctive use of fresh and saline water.

Practical

In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; estimation of drainage coefficients; installation of piezometer and observation wells; preparation of iso-bath and isobar maps; determination of drainable porosity; design of surface drainage systems; design of gravel envelop; design of subsurface drainage systems; determination of chemical properties of soil and water; study of drainage tiles and pipes; installation of sub-surface drainage system.

Suggested Readings:

1. Bhattacharya, A. K. and Michael, A. M. (2013). Land Drainage, Principles, Methods and Applications. Vikas Publishing House, New Delhi, Noida (UP).
2. Ritzema, H. P. (1994) Drainage Principles and Applications, ILRI Publication 16, Second Edition.
3. Michael, A. M. and Ojha, T. P. (2014). Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.
4. Kadam U. S., Thokal R. T., Gorantiwar S. D. and Powar A. G. (2007). Agricultural Drainage-Principles and Practices, Westville Publishing House.
5. FAO Irrigation and Drainage Paper No. 6, 9, 15, 16, 28 and 38. Rome, Italy.

SWE 304	WATER HARVESTING AND SOIL CONSERVATION STRUCTURES	3 (2+1)	SEM VI

Theory

Water harvesting –principles, importance and issues; water harvesting techniques - classification based on source, storage and use; runoff harvesting – short-term and long-term techniques; short-term harvesting techniques - terracing and bunding; long-term harvesting techniques – purpose, structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes; farm pond – components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways; percolation pond - site selection, design and construction details; permanent structures for soil conservation and gully control - check dams, drop, chute and drop inlet spillways - design requirements, planning for design; design procedures – hydrologic, hydraulic and structural design and stability analysis; energy –depth relationship for rectangular, triangular and trapezoidal channels; hydraulic jump and its application; drop spillway - applicability; types - straight drop; box-type inlet spillways – description, functional use, advantages and disadvantages; straight apron and stilling basin outlet; structural components and functions; loads on head wall; variables affecting equivalent fluid pressure; triangular load diagram for various flow conditions; creep line theory; uplift pressure estimation; safety against sliding; overturning; crushing and tension; chute spillway – description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations; drop inlet spillway – description, functional use and design criteria.

Practical

Study of different types of farm ponds; computation of storage capacity of embankment type of farm ponds; design of dugout farm ponds; design of percolation pond and *nala* bunds; exercise on energy-depth relationship; exercise on hydraulic jump; exercise on energy dissipation in water flow; hydrologic; hydraulic and structural design of drop spillway and stability analysis; design of SAF stilling basins in chute spillway; hydrologic; hydraulic and structural design of drop inlet spillway; design of small earthen embankment structures; practice on softwares for design of soil and water conservation structures; field visit to watershed project areas treated with soil and water conservation measures / structures.

Suggested Readings:

1. Singh, Gurmel, Venkataraman, C., Sastry, G. and Joshi, B. P. (1996). Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Michael, A. M. and Ojha, T. P. (2003). Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
3. Murthy, V.V.N. (2002). Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
4. Schwab, G. O., Fangmeier,D.D., Elliot,W.J., Frevert, R.K. (1993). Soil and Water Conservation Engineering.4th Edition, John Wiley and Sons Inc. New York.
5. Suresh, R. (2014). Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

SWE 305	GROUNDWATER, WELLS AND PUMPS	3 (2+1)	SEM VI

Theory

Occurrence and movement of ground water; aquifer and its types; classification of wells; fully penetrating tubewells and open wells; familiarization of various types of bore wells; design of open wells; groundwater exploration techniques; methods of drilling of wells, percussion, rotary, reverse rotary, design of tubewell and gravel pack; installation of well screen; completion and development of well; governing equations of groundwater flow in confined and unconfined aquifers; steady flow in confined and unconfined aquifers; groundwater hydraulics-determination of aquifer parameters by different method such as Theis; Jacob and Chow's; Theis recovery method; well interference; multiple well systems; estimation of ground water potential; quality of ground water; artificial groundwater recharge techniques; pumping systems: water lifting devices; different types of pumps;

classification of pumps; component parts of centrifugal pumps; priming; pump selection; installation and trouble shooting; performance curves; effect of speed on capacity; head and power; effect of change of impeller dimensions on performance characteristics; hydraulic ram; propeller pumps; mixed flow pumps and their performance characteristics; deep well turbine pump and submersible pump.

Practical

Verification of Darcy's Law; study of different drilling equipments; sieve analysis for gravel and well screens design; exercise on specific yield and specific retention; estimation of aquifer parameters by Theis method; Coopers-Jacob method; Chow method; Theis recovery method; well design under confined and unconfined conditions; well losses and well efficiency; estimating ground water balance; study of artificial ground water recharge structures; study of radial flow and mixed flow centrifugal pumps; multistage centrifugal pumps; turbine; propeller and other pumps; installation of centrifugal pump; testing of centrifugal pump and study of cavitations; study of hydraulic ram; study and testing of submersible pump.

Suggested Readings:

1. Michael, A. M., Khepar, S. D. and Sondhi, S. K. (2008). Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill, New Delhi.
2. Todd, David Keith and Larry, W. Mays. (2004). Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow).
3. Michael, A. M. and Ojha, T. P. (2014). Principles of Agricultural Engineering Vol-II, 5th Edition. Jain Brothers Publication, New Delhi.
4. Murthy, V.V.N. (2002). Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
5. Michael, A. M. (2012). Irrigation: Theory and Practice. Vikas Publishing House New Delhi.

FMPE 390/ PFE 390/ RBEE 390/ SWE 390	**SKILL DEVELOPMENT TRAINING-I (Student READY)**	**5 (0+5)**	**SEM V**

Exposure to industrial and institutional applications in selected fields of interest (Farm Machinery and Power Engineering; Processing & Food Engineering; Renewable & Bio-energy Engineering; Soil & Water Engineering; Information Technology etc.); training report preparation and presentation (students will be required to undergo training of about 4 weeks during semester break after IVth semester).

FMPE 391/ PFE 391/ RBEE 391/ SWE 391	**UNDERGRADUATE SEMINAR**	**1 (0+1)**	**SEM VI**

Topic selection; material collection; slide preparation; presentation and interaction.

FMPE 411/ PFE 411/ RBEE 411/ SWE 411	**INDUSTRIAL ATTACHMENT/ INTERNSHIP (Student READY)**	**10 (0+10)**	**SEM VII**

Attachment with selected industries/organizations dealing with tractors, agril machinery, precision agriculture, irrigation systems, pumps, soil conservation, watershed management, processing, value addition, renewable and bio-energy and other aspects related to agricultural engineering; to enrich desired skills and practical knowledge of the students.

FMPE 412/ PFE 412/ RBEE 412/ SWE 412	**EXPERIENTIAL LEARNING ON CAMPUS (Student READY)**	**10 (0+10)**	**SEM VII**

FMPE: Exposure to production technology; testing and evaluation of agricultural machinery as per standards; interpretation and preparation of test reports.

PFE: Agro-processing; food product development; setting up of model plants for food processing and value addition; processing and packaging of selected grains; fruits and vegetables.

RBEE: Design; development; installation and maintenance of renewable energy appliances/ equipments and use of related softwares.

SWE: Farm planning and development of irrigation and drainage projects; watershed project formulation; design of water harvesting and recycling systems; maintenance and operation of wells and pumps; irrigation and drainage systems; installation of weirs and flumes for water measurement.

FMPE 490/ PFE 490/ RBEE 490/ SWE 490	**SKILL DEVELOPMENT TRAINING-II (Student READY)**	**5 (0+5)**	**SEM VII**

Exposure to an environment in which students are expected to be associated in their future career; preparation of training report technical aspects of the training and presentation (students will be required to undergo training of about 4 weeks during semester break after VIth semester).

FMPE 491/ PFE 491/ RBEE 491/ SWE 491	**PROJECT PLANNING AND REPORT WRITING (Student READY)**	**10 (0+10)**	**SEM VIII**

Field/lab studies; project report writing and presentation.

Elective Courses

(A student can opt need based elective courses equivalent to 9 Credit Hours)

SWE 401	**MANAGEMENT OF CANAL IRRIGATION SYSTEM**	**3 (2+1)**	**SEM VIII**

Theory

Purpose, benefits and ill effects of irrigation; typical network of canal irrigation system and its physical components; canal classification based on source of water, financial output, purpose, discharge and alignment; canal alignment: general considerations for alignment, performance indicators for canal irrigation system evaluation, estimation of water requirements for canal command areas and determination of canal capacity; water duty and delta; relationship between duty; base period and delta; factors affecting duty and method of improving duty; Silt theory: Kennedy's theory; design of channels by Kennedy's theory; Lacey's regime theory and basic regime equations; design of channels by Lacey's theory; maintenance of unlined irrigation canals; measurement of discharge in canals; rostering (canal running schedule) and warabandhi; necessity of canal lining: advantages and disadvantages, types of canal lining and desirable characteristics for the suitability of lining materials, design of lined canals, functions of distributary head and cross regulators; canal falls: their necessity and factors affecting canal fall; sources of surplus water in canals and types of canal escapes; requirements of a good canal outlet and types of outlet.

Practical

Estimation of water requirement of canal commands; determination of canal capacity; layout of canal alignments on topographic maps; drawing of canal sections in cutting; full banking and partial cutting and partial banking; determination of longitudinal section of canals; design of irrigation canals based on silt

theories; design of lined canals; formulation of warabandhi; study of canal outlets; regulators; escapes and canal falls.

Suggested Readings:

1. Arora, K. R. (2001). Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg, S. K. (2014). Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.
3. Sahasrabudhe, S.R. (2011). Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.
4. Murthy, V.V.N. (2013). Land and Water Management Engineering. Kalyani Publishers New Delhi.
5. Das, Ghanshyam. (2008). Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi.

SWE 402	REMOTE SENSING AND GIS APPLICATIONS	3 (2+1)	SEM VIII

Theory

Basic component of remote sensing (RS); advantages and limitations of RS; possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum; energy interactions in the atmosphere and with the earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation; soil and water; spectral signatures; different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs; scale of aerial photographs; planning aerial photography- end lap and side lap; stereoscopic vision; requirements of stereoscopic photographs; air-photo interpretation- interpretation elements; photogrammetry- measurements on a single vertical aerial photograph; measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing; multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction; image classification; unsupervised classification; supervised classification; important consideration in the identification of training areas; vegetation indices; microwave remote sensing; GIS and basic components; different sources of spatial data; basic spatial entities; major components of spatial data; basic classes of map projections; methods of data input into GIS; data editing; spatial data models and structures; attribute data management; integrating data (map overlay) in GIS; application of remote sensing and GIS for the management of land and water resources.

Practical

Familiarization with remote sensing and GIS hardware; use of software for image interpretation; interpretation of aerial photographs and satellite imagery; basic GIS operations such as image display; study of various features of GIS software package; scanning; digitization of maps and data editing; data base query and map algebra. GIS supported case studies in water resources management.

Suggested Readings:

1. Reddy, Anji M. (2006). Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
2. Elangovan, K. (2006). GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. George, Joseph. (2005). Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.

4. Sahu, K. C. (2008). Text Book of Remote Sensing and Geographic Information Systems. Atlantic Publishers and Distributors (P) Ltd., New Delhi.

5. Shultz, G. A. and Engman, E. T. (2000). Remote Sensing in Hydrology and Water Management. Springer, New York.

SWE 403	PRECISION FARMING TECHNIQUES FOR PROTECTED CULTIVATION	3 (2+1)	SEM VIII

Theory

Protected cultivation: introduction, history, origin, development, national and international scenario; components of green house; perspective, types of green houses; polyhouses /shed nets; cladding materials; plant environment interactions – principles of limiting factors; solar radiation and transpiration; greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment, design and construction of green houses – site selection: orientation, design, construction, design for ventilation requirement using exhaust fan system; selection of equipment; greenhouse cooling system – necessity; methods – ventilation with roof and side ventilators; evaporative cooling; different shading material fogging; combined fogging and fan-pad cooling system; design of cooling system; maintenance of cooling and ventilation systems; pad care etc. greenhouse heating – necessity, components,methods, irrigation in greenhouse and net house – water quality, types of irrigation system, components, design, installation and material requirement; fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement; maintenance of irrigation and fogging systems; fertigation scheduling; rate of application of fertilizers; methods; automated fertilizer application; greenhouse climate measurement; control and management; major crops in greenhouse – irrigation and fertilizer requirements.

Practical

Visit to greenhouses; estimation of material requirement for construction of greenhouse; determination of irrigation and fertilization schedule and rate of application for various crops; design and installation of irrigation system; design and installation of fogging system ; greenhouse heating; study of different greenhouse environment control instruments; study of operation maintenance and fault detection in irrigation system; study of operation maintenance and fault detection in fogging system; economic analysis of greenhouses and net houses.

Suggested Readings:

1. Singh, Brahma and Singh, Balraj. (2014). Advances in protected cultivation, New India Publishing Company.

2. Sharma, P. (2007). Precision Farming. Daya Publishing House New Delhi.

3. Qin, Zhang (2016) Precision Agriculture Technology for Crop Farming. CNC Press.

4. Sharma, Premjit (2017). Precision Farming . Gene Tech Books, New Delhi.

5. Dan, Ess and Mark, Morgan, (2010). The Precision Farming Guide for Agriculturists. Deere & Co.

SWE 404	LANDSCAPE IRRIGATION DESIGN AND MANAGEMENT	3 (2+1)	SEM VIII

Theory

Conventional method of landscape irrigation- hose irrigation system; quick release coupling system and portable sprinkler with hose pipes; modern methods of landscape irrigation- pop-up sprinklers; spray pop-up sprinkler; drip irrigation and bubblers; merits and demerits of conventional and modern

irrigation systems; types of landscapes and suitability of different irrigation methods; water requirement for different landscapes; segments of landscape irrigation systems; main components of modern landscape irrigation systems and their selection criteria; types of pipes; pressure ratings; sizing and selection criteria; automation system for landscape irrigation- main components, types of controllers and their application; design of modern landscape irrigation systems, operation and maintenance of landscape irrigation systems.

Practical

Study of irrigation equipments for landscapes; design and installation of irrigation system for landscape; determination of water requirement; determination of power requirement; pump selection; irrigation scheduling of landscapes; study of irrigation controllers and other equipments; use of AUTOCAD in irrigation design: blocks & symbols; head layout; zoning and valves layout; pipe sizing; pressure calculations etc.; visit to landscape irrigation system and its evaluation.

Suggested Readings:

1. Singh, N.P. (2010). Landscape Irrigation and Floriculture Terminology, Bangalore.
2. Smith, S.W. (1996). Landscape Irrigation : Design Management. Wiley, USA.
3. Murthy, V.V.N. (2013). Land and Water Management Engineering. Kalyani Publishers, New Delhi.
4. Michael, A.M. (2012). Irrigation: Theory and Practice. Vikas Publishing House New Delhi.
5. Singh, Gurmel, Venkataraman, C., Sastry, G. and Joshi, B.P. Manual of Soil and Water Conservation Practices.

SWE 405	WATER QUALITY AND MANAGEMENT MEASURES	3 (2+1)	SEM VIII

Theory

Natural factors affecting quality of surface water and groundwater; water quality objectives in relation to domestic; industrial and agricultural activities; drinking water quality standards; irrigation water quality classification as per USSL and All Indian Coordinated Research Project (AICRP) criteria; point and non-point water pollution sources; water contamination due to inorganic and organic compounds; water contamination related to agricultural chemicals; food industry; hydrocarbon and synthetic organic compounds; Arsenic and fluoride contamination in groundwater and remedial measures; water decontamination technologies; cultural and management practices for using poor quality water for irrigation.

Practical

Water quality analysis and classification according to USSL and AICRP criteria; soil chemical analysis and estimation of lime and gypsum requirements; study of salinity development under shallow and deep water table conditions; study of contamination movement and transport in soil profile; study of different water decontamination techniques; study of different cultural and management practices for using poor quality water for irrigation; field visit to industrial effluent disposal sites.

Suggested Readings:

1. Gray, N. F. Water Technology. Raj Kamal Electric Press, Kundli, Haryana.
2. Hussain, S. K. (1986). Text Book of Water Supply and Sanitary Engineering. Oxford & IBH Publishing Co. New Delhi.
3. McGauhey, P. H. (1968). Engineering Management of water quality. McGraw Hill Book Company, New York.

4. Minhas, P. S. and Tyagi, N. K. (1998). Guidelines for irrigation with saline and alkali waters. Bull. No, 1/98, CSSRI, Karnal, P. :36.

5. Punmia, B. C. and Lal, P.B.B. (1981). Irrigation and water power engineering. Standard Publishers Distributors, Delhi.

SWE 406	PLASTIC APPLICATIONS IN AGRICULTURE	3 (2+1)	SEM VIII

Theory

Introduction of plasticulture - types and quality of plastics used in soil and water conservation; production agriculture and post harvest management; quality control measures; present status and future prospective of plasticulture in India; water management - use of plastics in in-situ moisture conservation and rain water harvesting; plastic film lining in canal, pond and reservoir; plastic pipes for irrigation water management, bore-well casing and subsurface drainage; drip and sprinkler irrigation systems; use of polymers in control of percolation losses in fields; soil conditioning - soil solarisation; effects of different colour plastic mulching in surface covered cultivation; controlled environmental cultivation - plastics as cladding material; green / poly / shade net houses, wind breaks, poly tunnels and crop covers; plastic nets for crop protection - anti insect nets, bird protection nets, plastic fencing, plastics in drying, preservation, handling and storage of agricultural produce; innovative plastic packaging solutions for processed food products; plastic cap covers for storage of food grains in open; use of plastics as alternate material for manufacturing farm equipment and machinery; plastics for aquacultural engineering and animal husbandry - animal shelters; vermi-beds and inland fisheries; silage film technique for fodder preservation; agencies involved in the promotion of plasticulture in agriculture at national and state level; human resource development in plasticutlure applications.

Practical

Design, estimation and laying of plastic films in lining of canal; reservoir and water harvesting ponds; study of plastic components of drip and sprinkler irrigation systems; laying and flushing of laterals; study of components of subsurface drainage system; study of different colour plastic mulch laying; design; estimation and installation of green; poly and shade net houses; low tunnels etc; study on cap covers for food grain storage; innovative packaging solutions - leno bags, crates, bins, boxes, vacuum packing, unit packaging; CAS and MAP and estimation; study on use of plastics in nursery; plant protection; inland fisheries; animal shelters; preparation of vermi-bed and silage film for fodder preservation; study of plastic parts in making farm machinery; visits to nearby manufacturing units/dealers of PVC pipes; drip and sprinkler irrigation systems; greenhouse/ polyhouse/ shadehouse/ nethouse etc; visits to farmers' fields with these installations.

Suggested Readings:

1. Singh, Brahma, Singh, Balraj, Sabir, Naved and Hasan, Murtaza. (2014). Advances in Protected Cultivation. New India Publishing Agency, New Delhi.

2. Central Pollution Control Board. (2012). Material on Plastic Waste Management. Parivesh Bhawan, East Arjun Nagar, Delhi-110032.

3. Pandey, P. H. (2014). Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana, India.

4. Charles A. Harper. (2006). Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.

5. Ojha,T. P. and Michael, A. M., (2012), Principles of Agricultural Engineering-I. Jain Brothers, Karol Bagh, New Delhi.

SWE 407	INFORMATION TECHNOLOGY FOR LAND AND WATER MANAGEMENT	3 (2+1)	SEM VIII

Theory

Concept of Information Technology (IT) and its application potential; role of IT in natural resources management; existing system of information generation and organizations involved in the field of land and water management; application and production of multimedia; internet application tools and web technology; networking system of information; problems and prospects of new information and communication technology; development of database concept for effective natural resources management; application of remote sensing; geographic information system (GIS) and GPS; rational data base management system; object oriented approaches; information system; decision support systems and expert systems; agricultural information management systems - use of mathematical models and programmes; application of decision support systems; multi sensor data loggers and overview of software packages in natural resource management; video-conferencing of scientific information.

Practical

Multimedia production; Internet applications: E-mail, voice mail, web tools and technologies; handling and maintenance of new information technologies and exploiting their potentials; exercises on database management using database and spreadsheet programmes; usage of remote sensing; GIS and GPS survey in information generation and processing; exercises on running computer software packages dealing with water balance; crop production; land development; land and water allocation; watershed analysis etc; exercises on simple decision support and expert systems for management of natural resources; multimedia production using different softwares; exercises on development of information system on selected theme(s); video-conferencing of scientific information.

Suggested Readings:

1. Climate-Smart Agriculture – Source Book. (2013). Food and Agriculture Organization, Rome.
2. Daniel, P. Loucks and Eelco, van Beek. (2005). Water Resources Systems Planning and Management - An Introduction to Methods, Models and Applications. UNESCO, Paris.
3. Dipak, De and Basavaprabhu, Jirli (Eds.). (2010). Communication Support for Sustainable Development. Ganga Kaveri Publishing House, Varanasi – 221001.
4. FAO (1998). Land and Water Resources Information Systems. FAO Land and Water Bulletin 7, Rome.
5. Soam, S. K., Sreekanth, P.D. and Rao, N.H. (Eds.). (2013). Geospatial Technologies for Natural Resources Management. New India Publishing Agency, Delhi.

SWE 408	MINOR IRRIGATION AND COMMAND AREA DEVELOPMENT	3 (2+1)	SEM VIII

Theory

Factors affecting performance of irrigation projects; types of minor irrigation systems in India; lift irrigation systems: feasibility, type of pumping stations and their site selection; design of lift irrigation systems; tank irrigation: grouping of tanks, storage capacity, supply works and sluices; command area development (CAD) programme- components, need, scope and development approaches; historical perspective, command area development authorities-functions and responsibilities; on farm development works; reclamation works; use of remote sensing techniques for CAD works; water productivity: concepts and measures for enhancing water productivity; farmers' participation in command area development.

Practical

Preparation of command area development layout plan; irrigation water requirement of crops; preparation of irrigation schedules; planning and layout of water conveyance system; design of surplus weir of tanks; determination of storage capacity of tanks; design of intake pipe and pump house.

Suggested Readings:

1. Arora, K. R. (2001). Irrigation, Water Power and Water Resources Engineering. Standard Publishers Distributors, Delhi.
2. Garg, S. K. (2014). Irrigation Engineering and Hydraulic Structures, Khanna Publishers New Delhi.
3. Michael, A. M. (2012). Irrigation: Theory and Practice. Vikas Publishing Vikas Publishing House, New Delhi.
4. Sahasrabudhe, S. R. (2011). Irrigation Engineering and Hydraulic structures. SK Kataria & Sons Reprint 2015.
5. Ojha,T. P. and Michael, A. M., (2012), Principles of Agricultural Engineering - I. Jain Brothers, Karol Bagh, New Delhi.

SWE 409	WASTELAND DEVELOPMENT	3 (2+1)	SEM VIII

Theory

Land degradation – concept, classification – arid, semiarid, humid and sub-humid regions; denuded range land and marginal lands; wastelands-factors causing, classification and mapping of wastelands; planning of wastelands development–constraints, agro-climatic conditions, development options, contingency plans, conservation structures-gully stabilization, ravine rehabilitation, sand dune stabilization, water harvesting and recycling methods; afforestation - agro-horti-forestry-silvipasture methods; forage and fuel crops-socioeconomic constraints, shifting cultivation, optimal land use options; wasteland development–hills, semi-arid, coastal areas, water scarce areas, reclamation of waterlogged and salt-affected lands; mine spoils- impact, land degradation and reclamation and rehabilitation; slope stabilization and mine environment management; micro-irrigation in wastelands development; sustainable wasteland development - drought situations, socio-economic perspectives, government policies, participatory approach, preparation of proposal for wasteland development and benefit-cost analysis.

Practical

Mapping and classification of wastelands; identification of factors causing wastelands; estimation of vegetation density and classification; planning and design of engineering measures for reclamation of wastelands; design and estimation of different soil and water conservation structures under arid; semiarid and humid conditions; planning and design of micro-irrigation in wasteland development; cost estimation of the above measures / structures; visit to wasteland development project sites.

Suggested Readings:

1. Abrol, I. P., and Dhruvanarayana, V.V. (1998). Technologies for Wasteland Development. ICAR, New Delhi.
2. Ambast, S. K., Gupta, S. K. and Singh, Gurcharan (Eds.) (2007). Agricultural Land Drainage -Reclamation of Waterlogged Saline Lands. Central Soil Salinity Research Institute, Karnal,Haryana.
3. Yadav, Hridai Ram. (2013). Management of Wastelands. Concept Publishing Company. New Delhi.
4. Karthikeyan, C., Thangaraja, K., Fernandez, C. Cinthia and Chandrakandon, K. (2009).

Dryland Agriculture and Wasteland Management. Atlantic Publishers and Distributors Pvt. Ltd., New Delhi.

5. Lal, Rattan and Stewart, B.A. (Ed.). (2015). Soil Management of Smallholder Agriculture. Volume 21 of Advances in Soil Science. CRC Press, Taylor and Francis Group, Florida, USA.

SWE 410	FLOODS AND CONTROL MEASURES	3 (2+1)	SEM VIII

Theory

Floods - causes of occurrence; flood classification - probable maximum flood, standard project flood, design flood; flood estimation - methods of estimation; estimation of flood peak - rational method, empirical methods, unit hydrograph method, statistics in hydrology, flood frequency methods - log normal; Gumbel's extreme value; log-Pearson type-III distribution; depth-area-duration analysis; flood forecasting; flood routing - channel routing; Muskingum method; reservoir routing; modified Pul's method; flood control - history of flood control; structural and non-structural measures of flood control; storage and detention reservoirs; levees; channel improvement; gully erosion and its control structures - design and implementation; ravine control measures; river training works; planning of flood control projects and their economics; earthen embankments - functions; classification - hydraulic fill and rolled fill dams-homogeneous; zoned and diaphragm type; foundation requirements; grouting; seepage through dams; flow net and its properties; seepage pressure; seepage line in composite earth embankments; drainage filters; piping and its causes; design and construction of earthen dam; stability of earthen embankments against failure by tension; overturning; sliding etc;; stability of slopes - analysis of failure by different methods; subsurface dams - site selection and constructional features; check dam - small earthen embankments-types and design criteria; subsurface dams-site selection and constructional features.

Practical

Determination of flood stage-discharge relationship in a watershed; determination of flood peak-area relationships; determination of frequency distribution functions for extreme flood values using Gumbel's method; determination of confidence limits of the flood peak estimates for Gumbel's extreme value distribution; determination of frequency distribution functions for extreme flood values using log-Pearson Type-III distribution; determination of probable maximum flood; standard project flood and spillway design flood; design of levees for flood control; design of jetties; study of vegetative and structural measures for gully stabilization; design of gully/ravine control structures and cost estimation; designing; planning and cost- benefit analysis of a flood control project; study of different types; materials and design considerations of earthen dams; determination of the position of phreatic line in earth dams for various conditions; stability analysis of earthen dams against head water pressure; foundation shear; sudden draw down condition etc; stability of slopes of earth dams by friction circle and other methods; construction of flow net for isotropic and anisotropic media; computation of seepage by different methods; determination of settlement of earth dam; input-output-storage relationships by reservoir routing; visit to sites of earthen dam and water harvesting structures.

Suggested Readings:

1. Michael, A.M. and Ojha, T.P. (2003). Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2. Murthy, V.V.N. (2002). Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
3. Suresh, R. (2014). Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.
4. Mutreja, K.N. (1990). Applied Hydrology. Tata McGraw-Hill Publishing Co., New York, Delhi.
5. Subramanya, K. (2016). Engineering Hydrology. Tata McGraw-Hill Publishing Co.,New Delhi.

BASIC ENGINEERING

Course No.	Course Title	Credits	Semester
	Civil Engineering		
CE 101	Surveying and Levelling	3 (1+2)	I
CE 102	Engineering Mechanics	3 (2+1)	I
CE 103	Fluid Mechanics and Open Channel Hydraulics	3 (2+1)	II
CE 104	Strength of Materials	2 (1+1)	II
CE 201	Soil Mechanics	2 (1+1)	III
CE 202	Design of Structures	2 (1+1)	III
CE 203	Building Construction and Cost Estimation	2 (2+0)	IV
	Total Credits	**17 (10+7)**	
	Electrical and Electronics Engineering		
EE 101	Web Designing and Internet Applications	2 (1+1)	II
EE 201	Electrical Machines and Power Utilization	3 (2+1)	III
EE 202	Applied Electronics and Instrumentation	3 (2+1)	IV
EE 301	Computer Programming and Data Structures	3 (1+2)	VI
	Total Credits	**11 (6+5)**	
	Mechanical Engineering		
ME 101	Engineering Drawing	2 (0+2)	I
ME 102	Heat and Mass Transfer	2 (1+1)	I
ME 103	Workshop Technology and Practice	3 (1+2)	II
ME 104	Theory of Machines	2 (1+1)	II
ME 201	Machine Design	2 (1+1)	III
ME 202	Thermodynamics; Refrigeration and Air Conditioning	3 (2+1)	III
ME 203	Auto CAD Applications	2 (0+2)	IV
	Total Credits	**16 (6+10)**	

CIVIL ENGINEERING

CE 101	SURVEYING AND LEVELLING	3 (1+2)	SEM I

Theory

Surveying: introduction, classification and basic principles; linear measurements; chain surveying; cross staff survey; compass survey; planimeter; errors in measurements; their elimination and correction; plane table surveying; levelling; leveling difficulties and error in leveling; contouring; computation of area and volume; theodolite traversing; introduction to setting of curves; total station; electronic theodolite; introduction to GPS survey.

Practical

Chain survey of an area and preparation of map; compass survey of an area and plotting of compass survey; plane table surveying; levelling; L section and X sections and its plotting; contour survey of an area and preparation of contour map; introduction of software in drawing contour; theodolite surveying; ranging by theodolite; height of object by using theodolite; setting out curves by theodolite; minor instruments; use of total station.

Suggested Readings:

1. Kochher, C. L. (2012). A test Book of Surveying. Dhanpat Rai Publishing Company.

2. De, Alak. Plane Surveying. S. Chand & Co.
3. Bannister, Arthur & others. Surveying. Darling Kindersley (India) Pvt. Ltd.
4. Kanetkar, T.P. and Kulkarni S.V. Surveying and Levelling. Vidhyarathi Griha Parkashan
5. Pumia, P.C. Surveying and Levelling.

CE 102	ENGINEERING MECHANICS	3 (2+1)	SEM I

Theory

Basic concepts of engineering mechanics; force systems; centroid; moment of inertia; free body diagram and equilibrium of forces; frictional forces analysis of simple framed structures using methods of joints; methods of sections and graphical method; simple stresses; shear force and bending moment diagrams; stresses in beams; torsion; analysis of plane and complex stresses.

Practical

Problems on composition and resolution of forces; moments of a force; couples; transmission of a couple; resolution of a force into a force & a couple; problems relating to resultant of; co-planer force system; collinear force system; concurrent force system; co-planer concurrent force system; co-planer non-concurrent force system; non-coplaner concurrent force system; non-coplaner non-concurrent force system; system of couples in space; problems relating to centroids of composite areas; problems on moment of inertia; polar moment of inertia; radius of gyration; polar radius of gyration of composite areas; equilibrium of concurrent – co-planer and non concurrent – co-planer force systems; problems involving frictional forces; analysis of simple trusses by method of joints and method of sections; analysis of simple trusses by graphical method; problems relating to simple stresses and strains; problems on shear force and bending moment diagrams; problems relating to stresses in beams; problems on torsion of shafts; analysis of plane and complex stresses.

Suggested Readings:

1. Kiran, S. Rajase, Shnkara subramanian, G., 1st (1999). Engineering Mechanics. Vikash ublishing House Pvt. Ltd.
2. Hassan, Ali & Khan, R.A. (2010) Fundamentals of Engineering Mechanics, Acme Learning Pvt. Ltd.
3. Bansal, R.K. Text of Engg. Mech. Luxmi Publication.
4. Velamurli. Engineering Mechanics. Oxford Publication.
5. Timoshenkoo, S. Engineering Mechanics. McGraw Hill.

CE 103	FLUID MECHANICS AND OPEN CHANNEL HYDRAULICS	3 (2+1)	SEM II

Theory

Properties of fluids: ideal and real fluid; pressure and its measurement; Pascal's law; pressure forces on plane and curved surfaces; centre of pressure; buoyancy; meta centre and meta centric height; condition of floatation and stability of submerged and floating bodies; kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion; continuity equation; path lines; streak lines and stream lines; stream function; velocity potential and flow net; types of fluid flow; translation; rotation; circulation and vorticity; vortex motion; dynamics of fluid flow; Bernoulli's theorem; venturimeter; orifice meter and nozzle; siphon; laminar flow: stress strain relationships; flow between infinite parallel plates both plates fixed; one plate moving; discharge; average velocity; laminar and turbulent flow in pipes; general equation for head loss Darcy; equation; Moody's diagram; minor and major hydraulic losses through pipes and fittings; flow through network of pipes;

hydraulic gradient and energy gradient; flow through orifices (measurement of discharge; measurement of time); flow through mouthpieces; flow over notches ; flow over weirs; Chezy's formula for loss of head in pipes; flow through simple and compound pipes; open channel design and hydraulics: Chezy's formula; Bazin's formula; Kutter's Manning's formula; velocity and pressure profiles in open channels; dimensional analysis and similitude: Rayleigh's method and Buckingham's `Pi' theorem; types of similarities; dimensional analysis; dimensionless numbers; introduction to fluid machinery.

Practical

Study of manometers and pressure gauges; verification of Bernoulli's theorem; determination of coefficient of discharge of venturi-meter and orifice meter; determination of coefficient of friction in pipeline; determination of coefficient of discharge for rectangular and triangular notch; determination of coefficient of discharge; coefficient of velocity and coefficient of contraction for flow through orifice; determination of coefficient of discharge for mouth piece; measurement of force exerted by water jets on flat and hemispherical vanes; determination of meta-centric height; determination of efficiency of hydraulic ram; performance evaluation of Pelton and Francis turbine; study of current meter; velocity distribution in open channels and determination of Manning's coefficient of rugosity.

Suggested Readings:

1. Kothandaraman, C. P. and Rudramoorthy, R. (2011). Fluid Mechanics and Machinery. Newage International Publisher.
2. Gupta, Vijay and Gupta, S. K. Fluid Mechanics and its applications. Newage International Publisher.
3. Modi, P.N. and Seth. Hydraulic and Fluid Mechanics. Standard Book House.
4. Bansal, R.K. A text of Fluid Mechanics. Luxmi Publication.
5. Monthy, A.K. Fluid Mechanics. PHI Learning Pvt. Ltd.

CE 104	STRENGTH OF MATERIALS	2 (1+1)	SEM II

Theory

Slope and deflection of beams using integration techniques; moment area theorems and conjugate beam method; columns and struts; stability of masonry dams; analysis of statically intermediate beams; propped beams; fixed and continuous beam analysis using superposition; three moment equation and moment distribution methods.

Practical

To perform the tension test on metal specimen (M.S., C.I.); to observe the behaviour of materials under load; to calculate the value of E; ultimate stress; permissible stress; percentage elongation etc.; and to study its fracture; to perform the compression test on; concrete cylinders &cubes; M.S., C.I. & Wood specimens and to determine various physical and mechanical properties; to perform the bending test on the specimens; M.S. Girder; wooden beam; plain concrete beams & R.C.C. beam; and to determine the various physical and mechanical properties; to determine young's modulus of elasticity of beam with the help of deflection produced at centre due to loads placed at centre & quarter points; to study the behaviour of materials (G.I. pipes; M.S.; C.I.) under torsion and to evaluate various elastic constants; to study load deflection and other physical properties of closely coiled helical spring in tension and compression; to perform the Rockwell; Vicker's and Brinell's Hardness tests on the given specimens; to perform the drop hammer test; Izod Test and Charpay's impact tests on the given specimens; to determine compressive strength of cement and concrete after making cubes; to measure workability of concrete (slump test; compaction factor test); torsion test on

mild steel specimen; to determine fatigue strength of a given specimen; to write detail report emphasizing engineering importance of performing tension; compression; bending; torsion; impact and hardness tests on the materials.

Suggested Readings:

1. Gosh, D. and Datta, A.K. (2011). A text book of Strength of Material. Newage International Publisher.
2. Bhavikatti, S.S. (2009). Strength of Materials. Vikash Publishing House.
3. Ramamurtham, S. (2010). Strength of Materials. Dhanpat Rai Publishing Pvt. Ltd.
4. Bansal, R.K. Text Book of Strength Material. Luxmi Publication.
5. Rattan, S.S. Strength of Material. Tata McGraw Hill.

CE 201	SOIL MECHANICS	2 (1+1)	SEM III

Theory

Introduction of soil mechanics; field of soil mechanics; phase diagram; physical and index properties of soil; classification of soils; effective and neutral stress; elementary concept of Boussinesq and Wester guards analysis; new mark influence chart; seepage analysis; quick condition-two dimensional flow-Laplace equation; velocity potential and stream function; flow net construction; shear strength; Mohr stress circle; theoretical relationship between principle stress circle; theoretical relationship between principal stress; Mohr coulomb failure theory; effective stress principle; determination of shear parameters by direct shear test; triaxial test & vane shear test; numerical exercise based on various types of tests; compaction; composition of soils standard and modified protector test; abbot compaction and Jodhpur mini compaction test field compaction method and control; consolidation of soil: consolidation of soils; one dimensional consolidation spring analogy; Terzaghi's theory; laboratory consolidation test; calculation of void ratio and coefficient of volume change; Taylor's and Casagrande's method; determination of coefficient of consolidation; earth pressure: plastic equilibrium in soils; active and passive states; Rankine's theory of earth pressure; active and passive earth pressure for cohesive soils; simple numerical exercises; stability of slopes: introduction to stability analysis of infinite and finite slopes friction circle method; Taylor's stability number.

Practical

Determination of water content of soil; determination of specific gravity of soil; determination of field density of soil by core cutter method; determination of field density by sand replacement method; grain size analysis by sieving (dry sieve analysis); grain size analysis by hydrometer method; determination of liquid limit by Casagrande's method; determination of liquid limit by cone penetrometer and plastic limit; determination of shrinkage limit; determination of permeability by constant head method; determination of permeability by variable head method; determination of compaction properties by standard proctor test; determination of shear parameters by direct shear test; determination of unconfined compressive strength of soil; determination of shear parameters by Tri-axial test; determination of consolidation properties of soils.

Suggested Readings:

1. Ranjan, Gopa and Rao, A.S.R. (2014). Basic of Applied Soil Mechanics. Newage International Publisher.
2. Punmia, B.C. Soil Mechanics & Foundation Engineering. Standard Book House Delhi.
3. Lamby, T. William and Whiteman. Soil Mechanics. John Willey and Sons.
4. Terzaghi, Karl. Soil Mechanics in Engineering Practice. John Willey and Sons.
5. Arora, K.R. Soil Mechanics & Foundation Engineering. Standard Publisher and Distributors.

CE 202	DESIGN OF STRUCTURES	2 (1+1)	SEM III

Theory

Loads and use of BIS Codes (IS 456; IS 800); design of riveted and welded connections; design of structural steel members in tension, compression and bending; design of steel roof truss; analysis and design of singly and doubly reinforced sections; shear, bond and torsion; design of flanged beams, slabs, columns, foundations, retaining walls and silos.

Practical

Design and drawing of single reinforced beam; double reinforced beam; design and drawing of steel roof truss; design and drawing of one way; two way slabs; design and drawing of RCC building; design and drawing of retaining wall.

Suggested Readings:

1. Raju, N. Krishna (2007). Structural Design and Drawing. Universities Press.
2. Ramamrtham, S. Design of Reinforced Conc. Structure and Steel Tables. Dhanpat Rai Publishing (P) Ltd.
3. Bandhyopadhyay, J. N. (2010). Design of Conc. Structure. PHI Learning Pvt. Ltd.
4. Ram, K.S. Sai (2013). Design of Steel Structures. Pearson, Dorling Kindersley (India) Pvt. Ltd.
5. Arya, A.S. and Ajmani. Design of Steel Structures. Nemchand and Brothers Pvt. Ltd. (IS456 and IS800 are also required Steel Tables).

CE 203	BUILDING CONSTRUCTION AND COST ESTIMATION	2 (2+0)	SEM IV

Theory

Building materials: rocks, stones, bricks properties and varieties of tiles, lime, cement, concrete, sand, glass, rubber, plastics, iron, steel, aluminium, copper, nickel, timber, building components, lintels, arches, stair cases; different types of floors; finishing: damp proofing and water proofing; plastering; pointing; white washing and distempering – painting; building design; design procedures; technology; building construction; types of agricultural buildings and related needs; application of design theory and practice to the conservation; sloped and flat roof buildings; construction economics: preliminary estimates; detailed estimates of buildings source of cost information; use of cost analyses for controlling design; factors affecting building costs; cost evaluation of design and planning alternatives for building and estate development; measurement and pricing; economic methods for evaluating investments in buildings and building systems: cost-in-use; benefit-to-costs and savings-to-investment ratios; rate of return; net benefits; payback.

Suggested Readings:

1. Punmia, B. C. and Jain, A. K. and others. Building Construction. Luxmi Publications Pvt. Ltd.
2. Varghese, P. C. Building Construction. PHI Leaning Pvt. Ltd.
3. Duggal, S. K. Building Materials. Newage International Publishing.
4. Mahajan, D. C. Estimating and Costing. Rainbow Book Company.
5. Dutta, B. N. & Dutta, S. Estimate and Costing Civil. UBS Publishers and Distributors.

ELECTRICAL AND COMPUTER ENGINEERING

EE 101	WEB DESIGNING AND INTERNET APPLICATIONS	2 (1+1)	SEM II

Theory

Basic principles in developing a web designing; planning process; five golden rules of web designing;

designing navigation bar; page design; home page layout; design concept. basics in web design; brief history of internet; world wide web; creation of a web site; web standards; audience requirement. introduction to JavaScript; variables & functions; working with alert; confirm and prompt; connectivity of web pages with databases; project.

Practical

FLASH: animation concept FPS; understanding animation for web; flash interface; working with tools; DREAM WEAVER :exploring dreamweaver interface; planning & setting web site structure; working with panels; understanding and switching views; using property inspector; formatting text; JAVA script: working with alert; confirm and prompt; understanding loop; arrays; creating rollover image; working with operator; GIF animation: learning to use FTP; Setting FTP; uploading of site; using control panel; FTP uploading site: understanding gif animation interface; knowing GIF file format; creating basic web banners; creating web banners with effects; creating animated web buttons.

Suggested Readings:

1. Jenkin (2007). Web Design (Edition1st). Willey India.
2. Godbole, Achyut, Kahate, Atul (2005). Web Technologies. (Edition 2nd). Tata McGraw Hill.
3. Falke and Morris (2013) Basic Web Design: HTML 5 & CSS 3. (Edition 2nd). Addison- Wesley.
4. Vora, Pawan (2009) Web Application Design Pattern. (Edition1st). M K Publications.
5. Joshi, Hiren (2011) Web Technology and Application Development. (Edition 2nd). Dreamtech Press.

EE 201	ELECTRICAL MACHINES AND POWER UTILIZATION	3 (2+1)	SEM III

Theory

Electro motive force; reluctance; laws of magnetic circuits; determination of ampere-turns for series and parallel magnetic circuits; hysteresis and eddy current losses; transformer: principle of working; construction of single phase transformer; EMF equation; phasor diagram on load; leakage reactance; voltage regulation; power and energy efficiency; open circuit and short circuit tests; principles; operation and performance of DC machine (generator and motor); EMF and torque equations; armature reaction; commutation; excitation of DC generator and their characteristics; DC motor characteristics; starting of shunt and series motor; starters; speed control methods-field and armature control; polyphase induction motor: construction; operation; phasor diagram; effect of rotor resistance; torque equation; starting and speed control methods; single phase induction motor: double field revolving theory; equivalent circuit; characteristics; phase split; shaded pole motors; various methods of three phase power measurement; power factor; reactive and apparent power; concept and analysis of balanced poly-phase circuits; series and parallel resonance.

Practical

To obtain load characteristics of DC shunt/series /compound generator; to study characteristics of DC shunt/ series motors; to study DC motor starters; to Perform load-test on 3 ph. induction motor & to plot torque V/S speed characteristics; to perform no-load & blocked –rotor tests on 3 ph. induction motor to obtain equivalent ckt. parameters & to draw circle diagram; to study the speed control of 3 ph. induction motor by cascading of two induction motors; i.e. by feeding the slip power of one motor into the other motor; to study star- delta starters physically and (a) to draw electrical connection diagram (b) to start the 3 ph. induction motor using it. (c) to reverse the direction of 3 ph. I.M.; to start a 3-phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. and to plot torque –speed characteristics; to perform no load & blocked –rotor test on 1 ph. induction motor & to determine the parameters of equivalent ckt. drawn on the basis of double revolving field theory;

to perform load –test on 1 ph. induction motor & plot torque –speed characteristics; to study power consumed in a three-phase circuit; two lights in series controlled by one switch; two lights in parallel controlled by one switch.

Suggested Readings:

1. Theraja, B. L. and Theraja, A. K. (2010). Electrical Technology Vol-II. (1st Edition). S Chand & company.
2. Bimbhra, P. S. (2004). Electrical Machines2nd Edition. Khanna Publishers.
3. Mehta, V. K. and Mehta, Rohit. (2002). Principle of Electrical Machines (3rd Edition). S. Chand & company.
4. Chapman, Stephan J. (2002). Electrical Machinery & Power System Fundamentals (2nd Edition). McGraw Hill.
5. Sawhney, A. K. (2014). Electrical Machine Design (2nd Edition). Dhanpat Rai.

EE 202	APPLIED ELECTRONICS AND INSTRUMENTATION	3 (2+1)	SEM IV

Theory

Semiconductors; pn junction; VI characteristics of pn junction; diode as a circuit element; rectifier; clipper; damper; voltage multiplier; capacitive filter; diode circuits for OR & AND (both positive and negative logic); bipolar junction transistor: operating point; classification (A, B & C) of amplifier; various biasing methods (fixed; self potential divider); h-parameter model of a transistor; analysis of small signal; CE amplifier; phase shift oscillator; analysis of differential amplifier using transistor; ideal OP-AMP characteristics; linear and non-linear applications of OP-AMP (adder, subtractor, integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator); zener diode voltage regulator; transistor series regulator; current limiting; OP-AMP voltage regulators; basic theorem of Boolean algebra; combinational logic circuits(basic gates; SOP rule and Kmap); binary ladder D/A converter; successive approximation A/D converter; generalized instrumentation; measurement of displacement; temperature; velocity; force and pressure using potentiometer; resistance thermometer; thermocouples; Bourclen tube; LVDT; strain gauge and tacho-generator.

Practical

To study V-I characteristics of pn junction diode; to study half wave; full wave and bridge rectifier; to study transistor characteristics in CE configurations; to design and study fixed and self bias transistor; to design and study potential divider bias transistor; to study a diode as clipper and clamper; to study a OP-AMP IC 741 as inverting and non- inverting amplifier; to study a OP-AMP IC 741 as differentiator and integrator to study a differential amplifier using two transistor; to study a OP-AMP IC 741 as differential amplifier: to study a zener regulator circuit; to study a OP-AMP IC 741 as a active rectifier; to study a OP-AMP IC 741 as a comparator; to familiarize with various types of transducers.

Suggested Readings:

1. Milliman, J. and Halkias, C. (1995). (Edition 2nd) Integrated Electronics. Tata McGraw Hill.
2. Boylestad, Nashelsky (2004). (Edition 2nd). Electronic Devices & Circuits. PHI.
3. Malvino and Leach (2005). (Edition 4th). Digital Principles & applications. McGraw Hill.
4. Gayakwad, R. A. (2000). (Edition 4th). OP-AMPs and linear Integrated Circuits. PHI.
5. Rangan, C.S., Sharma, G.R., and Mani, V.S.V. (2014). (32nd reprint) Instrumentation Devices and systems. McGraw Hill.

EE 301	COMPUTER PROGRAMMING AND DATA STRUCTURES	3 (1+2)	SEM VI

Theory

Introduction to high level languages; primary data types and user defined data types; variables; typecasting; operators; building and evaluating expressions; standard library functions; managing input and output; decision making; branching; looping; arrays; user defined functions; passing arguments and returning values; recursion; scope and visibility of a variable; string functions; structures and union; pointers; stacks; push/pop operations; queues; insertion and deletion operations; linked lists.

Practical

Familiarizing with Turbo C IDE; building an executable version of C program; debugging a C program; developing and executing simple programs; creating programs using decision making statements such as if; go to & switch; developing program using loop statements while; do & for; using nested control structures; familiarizing with one and two dimensional arrays; using string functions; developing structures and union; creating user defined functions; using local; global & external variables; using pointers; implementing stacks; implementing push/pop functions; creating queues; developing linked lists in C language; insertion/deletion in data structures.

Suggested Readings:

1. Kanetkar, Y. S. (2009) (Edition 15th) Let Us C. BPB Publications.
2. Ritchie, Dennis M. and Kerrigham, Brian W (2005). (Edition 4th) The C Programming Language PHI.
3. King, K. N. (1996). (Edition 2nd). C Programming- A Modern Approach. W W Nortan & Co.
4. Tenenbaum, A. M. (2001). (Edition 1st). Data Structures using C. PHI.
5. Ashok, Kamthane (2009) Programming & Data Structures (Edition 2nd). Pearson.

MECHANICAL ENGINEERING

ME 101	ENGINEERING DRAWING	2 (0+2)	SEM I

Practical

Introduction of drawing scales; first and third angle methods of projection; principles of orthographic projections; reference planes; points and lines in space and traces of lines and planes; auxiliary planes and true shapes of oblique plain surface; true length and inclination of lines; projections of solids (change of position method; alteration of ground lines); section of solids and interpenetration of solid surfaces; preparation of working drawing from models and isometric views; drawing of missing views; different methods of dimensioning; concept of sectioning; revolved and oblique sections; types of rivet heads and riveted joints; processes for producing leak proof joints; symbols for different types of welded joints; nomenclature; thread profiles; multi start threads; left and right hand threads; conventional representation of threads; forms of screw threads; square headed and hexagonal nuts and bolts; different types of lock nuts; studs; machine screws; cap screws and wood screws; foundation bolts; bolts- headed centre; stud screws; set screws; butt; hexagonal and square; keys-types; taper; sunk taper; hollow saddle etc.

Suggested Readings:

1. Dhawan, R. K. (2015-16). A Text Book of Engineering Drawing. Publisher, S.Chand.
2. Bhatt, N. D. (53rd edition 2016). Engineering Drawing. Charotkar publisher.
3. Gill, P. S. (13th edition, reprint 2017). Engineering Drawing. Publisher S.K. Kataria & Sons.

ME 102	HEAT AND MASS TRANSFER	2 (1+1)	SEM I

Theory

Concept; modes of heat transfer; thermal conductivity of materials; measurement; general differential equation of conduction; one dimensional steady state conduction through plane and composite walls; tubes and spheres with and without heat generation; electrical analogy; insulation materials; fins, free and forced convection; Newton's law of cooling; heat transfer coefficient in convection; dimensional analysis of free and forced convection; useful non dimensional numbers; equation of laminar boundary layer on flat plate and in a tube; laminar forced convection on a flat plate and in a tube; combined free and forced convection; absorptivity; reflectivity and transmissivity of radiation; black body and monochromatic radiation; Planck's law; Stefan-Boltzman law; Kirchoff's law; grey bodies and emissive power; solid angle; intensity of radiation; radiation exchange between black surfaces; geometric configuration factor; heat transfer analysis involving conduction; convection and radiation by networks; types of heat exchangers; fouling factor; log mean temperature difference; heat exchanger performance; transfer units; heat exchanger analysis restricted to parallel and counter flow heat exchangers; steady state molecular diffusion in fluids at rest and in laminar flow; Flick's law; mass transfer coefficients, Reynold's analogy.

Practical

Investigate and verify Fourier's Law for linear heat conduction; study of parallel flow and counter flow of heat; study of heat transfer through plane and composite wall for natural convection; determine thermal conductivity and temperature distribution across the width of the composite wall; study of heat transfer through plane and composite wall for forced convection; study of temperature distribution; heat transfer and fin efficiency of a pin fin in natural and forced convection; emissivity measurement; study LMTD; overall heat transfer coefficient and effectiveness of a heat exchanger in parallel flow and counter flow mode.

Suggested Readings:

1. Kumar, D.S. (9th edition, reprint 2017). HMT Text Book. Publisher S.K. Kataria & Sons.
2. Rajput, R.K. (2016). HMT Text Book. Publisher S. Chand.
3. Sukhatme, S.P. (4th edition 2013). HMT Text Book. Universities press.
4. Domkundwar. (2017). HMT Text Book. Dhanpat Rai & Co.
5. Domkundwar. (2016). HMT Data Book. Dhanpat Rai & Co.

ME 103	WORKSHOP TECHNOLOGY AND PRACTICE	3 (1+2)	SEM II

Theory

Introduction to various carpentry tools; materials; types of wood and their characteristics and processes or operations in wood working; introduction to smithy tools and operations; introduction to welding; types of welding; oxyacetylene gas welding; types of flames; welding techniques and equipment; principle of arc welding; equipment and tools; casting processes; classification; constructional details of center lathe; main accessories and attachments; main operations and tools used on center lathes; types of shapers; constructional details of standard shaper; work holding devices; shaper tools and main operations; types of drilling machines; constructional details of pillar types and radial drilling machines; work holding and tool holding devices; main operations; twist drills; drill angles and sizes; types and classification; constructional details and principles of operation of column and knee type universal milling machines; plain milling cutter; main operations on milling machine.

Practical

Preparation of simple joints: cross half lap joint and T-Halving joint; preparation of dovetail joint; mortise and tenor joint; jobs on bending; shaping etc.; jobs on drawing; punching; rivetting; introduction to tools and measuring instruments for fitting; jobs on sawing; filing and right angle fitting of MS Flat; practical in more complex fitting job; operations of drilling; reaming; and threading with tap and dies; introduction to tools and operations in sheet metal work; making different types of sheet metal joints using G.I. sheets. introduction to welding equipment; processes tools; their use and precautions; jobs on ARC welding – lap joint; butt joint; T-Joint and corner joint in arc welding; gas welding practice – lap; butt and T-Joints; introduction to metal casting equipment; tools and their use; mould making using one-piece pattern and two pieces pattern; demonstration of mould making using sweep pattern; and match plate patterns; introduction to machine shop machines and tools; demonstration on processes in machining and use of measuring instruments; practical jobs on simple turning; step turning; practical job on taper turning; drilling and threading; operations on shaper and planer; changing a round MS rod into square section on a shaper; demonstration of important operations on a milling machine; making a plot; gear tooth forming and indexing; any additional job.

Suggested Readings:

1. Jain, R. K. (18th edition). Production Technology. Khanna Publishers.
2. Khurmi, R. S. (2015-16). Workshop Technology. S.Chand.
3. Raghuwanshi, B. S. (10th reprint 2017). Workshop Tech. Vol I&II . Jain Book Depot.
4. Khanna, O. P. (17th edition). W.Tech. and Production Tech. Vol-I &II. Dhanpat Rai & Co.
5. Kalpakjian, Serope. (7th Edition). Manufacturing Engg & Technology. Pearson Education India publisher.

ME 104	THEORY OF MACHINES	2 (1+1)	SEM II

Theory

Elements, links, pairs, kinematics chain and mechanisms; classification of pairs and mechanisms; lower and higher pairs; four bar chain; slider crank chain and their inversions; determination of velocity and acceleration using graphical (relative velocity and acceleration) method; instantaneous centers; types of gears; law of gearing; velocity of sliding between two teeth in mesh; Involute and Cycloidal profile for gear teeth; spur gear; nomenclature; interference and undercutting; introduction to helical; spiral; bevel and worm gear; simple; compound; reverted; and epicyclic trains; determining velocity ratio by tabular method; turning moment diagrams; coefficient of fluctuation of speed and energy; weight of flywheel; flywheel applications; belt drives; types of drives; belt materials; length of belt; power transmitted; velocity ratio; belt size for flat and V belts; effect of centrifugal tension; creep and slip on power transmission; chain drives; types of friction; laws of dry friction; friction of pivots and collars; single disc; multiple disc; and cone clutches; rolling friction; anti friction bearings; types of governors; constructional details and analysis of Watt; Porter; Proell governors; effect of friction; controlling force curves; sensitiveness; stability; hunting; iso-chronism; power and effort of a governor; static and dynamic balancing; balancing of rotating masses in one and different planes.

Practical

Study of mechanisms; analysis of 4-bar mechanism; slider crank mechanism and their inversions; study of gears; gear trains and analysis-tabular method; synthesis of gear trains for a desired speed ratio; study of flywheel and governor action; study of cam profile for a desired follower motion; study on the cam follower demonstration machine for follower displacement as a function of cam rotation angle and phenomenon of follower jump; demonstration of static and dynamic balancing.

Suggested Readings:

1. Khurmi, R. S. (2016). Theory of Machines. S. Chand Publications.
2. Rattan, S. S. (4th edition 2014). Theory of Machines. Tata Mcgraw Hill.
3. Ballaney, P. L. (25th edition). Theory of Machines. Khanna Publishers.
4. Bansal, R. K. & Brar, J. S. (5th edition, Revised 2016). Theory of Machines. Laxmi Publications.
5. Singh, Sadhu. (3rd Edition). Theory of Machines. Pearson education.

ME 201	MACHINE DESIGN	2 (1+1)	SEM III

Theory

Meaning of design; phases of design; design considerations; common engineering materials and their mechanical properties; types of loads and stresses; theories of failure; factor of safety; selection of allowable stress; stress concentration; elementary fatigue and creep aspects; cotter joints; knuckle joint and pinned joints; turnbuckle; design of welded joints subjected to static loads; design of threaded fasteners subjected to direct static loads; bolted joints loaded in shear and bolted joints subjected to eccentric loading; design of shafts under torsion and combined bending and torsion; design of keys; design of muff; sleeve; and rigid flange couplings; design of helical and leaf springs; design of flat belt and V-belt drives and pulleys; design of gears; design of screw motion mechanisms like screw jack; lead screw; etc; selection of anti-friction bearings.

Practical

Tutorials on solution of design considerations towards material and properties; problems based on load/stress analysis of machine components; problems based on practical application of theories of failure and fatigue and determination of factor of safety; problems on design of shafts; keys and coupling; problems in selection; design of belts; problems on design of helical and leaf spring.

Suggested Readings:

1. Khurmi, R. S. (2016). Machine Design text book. S.Chand.
2. Bhandari, V. B. (4th edition 2016). Design of Machine Elements. Tata McGraw Hill.
3. Kumar, Arun. (4th edition 2017). Data Book for Designing Machine Elements. S.K. Kataria & Sons.
4. Norton, Robert, L. (2nd Edition) Machine Design: An Integrated Approach, 2/E, Pearson Education.
5. KulKarni, S. G. (2008) Machine Design, TMH publisher.

ME 202	THERMODYNAMICS; REFRIGERATION AND AIR CONDITIONING	3 (2+1)	SEM III

Theory

Thermodynamics properties; closed and open system; flow and non-flow processes; gas laws; laws of thermodynamics; internal energy. application of first law in heating and expansion of gases in non-flow processes; first law applied to steady flow processes; Carnot cycle; Carnot theorem; entropy; physical concept of entropy; change of entropy of gases in thermodynamics process; Otto; diesel and dual cycles; principles of refrigeration; - units; terminology; production of low temperatures; air refrigerators working on reverse Carnot cycle and Bell Coleman cycle; vapour refrigeration-mechanism; P-V;P-S;P-H diagrams; vapor compression cycles; dry and wet compression; super cooling and sub cooling; vapour absorption refrigeration system; common refrigerants and their properties; design calculations for refrigeration system. cold storage plants; thermodynamic properties of moist air; perfect gas relationship for approximate calculation; adiabatic saturation

process; wet bulb temperature and its measurement; psychometric chart and its use; elementary psychometric process; air conditioning – principles –type and functions of air conditioning; physiological principles in air conditioning; air distribution and duct design methods; fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling load calculations; types of air conditioners – applications.

Practical

Tutorials on thermodynamic air cycles; study and application of P V and T S chart in refrigeration; P H chart (or) Mollier diagram in refrigeration; numerical on air refrigeration cycle systems; numerical on vapour compression cycle refrigeration system; study of domestic water cooler; study of domestic household refrigerator; study of absorption type solar refrigeration system; study cold storage for fruit and vegetables; freezing load and time calculations for food materials; determination of refrigeration parameters using refrigeration tutor – ii; numerical on design of air conditioning systems; study of window air conditioner; study on repair and maintenance of refrigeration and air-conditioning systems. visit to chilling or ice making and cold storage plants.

Suggested Readings:

1. Khurmi, R.S. (2016). Thermal Engg. Publisher S.Chand.
2. Khurmi, R.S. (2016). RAC Text book. Publisher S.Chand.
3. Prasad, Manohar. R. (2nd edition, reprint 2015). AC Data Book**.** New Age Int.
4. Rajput, R.K. (3rd edition, reprint 2016). RAC Text Book. SkKataria.
5. Nag, P.K. (5th edition, 2013). Engineering Thermodynamics. TMH.
6. Khurmi, R.S. (2015-16). Steam Table, Refrigeration Tables with Charts. S. Chand.
7. Kothandaramn, C.P. (4th edition, 2015). Steam Tables. New age International Publisher.

ME 203	AUTO CAD APPLICATIONS	2 (0+2)	SEM IV

Practical

Application of computers for design; CAD- overview of CAD window – explanation of various options on drawing screen; study of draw and dimension tool bar; practice on draw and dimension tool bar; study of OSNAP; line thickness and format tool bar; practice on OSNAP; line thickness and format tool bar; practice on mirror; offset and array commands; practice on trim; extend; chamfer and fillet commands; practice on copy; move; scale and rotate commands; drawing of 2 D- drawing using draw tool bar; practice on creating boundary; region; hatch and gradient commands; practice on editing polyline- PEDIT and explode commands; setting of view ports for sketched drawings; printing of selected view ports in various paper sizes; 2D- drawing of machine parts with all dimensions and allowances- foot step bearing and knuckle joint; sectioning of foot step bearing and stuffing box; drawing of hexagonal nut and bolt and other machine parts; practice on 3-D commands-extrusion and loft; practice on 3-D commands-on sweep and press pull; practice on 3-D Commands-revolving and joining; demonstration on CNC machine and simple problems.

Suggested Readings:

1. Groover, M. (6th impression). CAD/CAM text book. Pearson publications.
2. Rao, P. N. (3rd edition, 2010). CAD/CAM:Principles and Applications. TMH.
3. Zeid, Ibrahim. (2nd edition, 2006). Mastering CAD/CAM (SIE), TMH.
4. Zeid, Ibrahim and Sivasubramanian, R. (2nd edition 2009). CAD/CAM: THEORY & PRACTICE. TMH.
5. AutoCAD version 2009, Study centre Books. AUTOCAD/ Solid Works/ NIIT/ APTECH /CDAC.



Indira Chakravarty College of Home Sciences


GREEN CONSUMER DAY
September 29 , 2014
HM Dept
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I.C.COLLEGE OF HOME SCIENCE




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Sardar Vallabhbhai Patel







I.C. COLLEGE OF HOME SCIENCES

B. Sc. (Hons.) Community Science, 4-Year Programme

Courses: Semester-wise

Course No.	Course Title	Credits
	Semester I	
FN 101	Principles of Human Nutrition	3 (3+0)
FRM 101	Management of Family Resources	2 (1+1)
HDFS 101	Fundamentals of Human Development	2 (2+0)
HDFS 102	Life-Span Development-I	3 (2+1)
HECM 101	Extension and Rural Development	2 (2+0)
TAD 101	Fundamentals of Clothing Construction	3 (1+2)
CHEM 100	Introductory Chemistry (For students from Arts stream)	4 (3+1) NC
ENG 102	General English	2 (1+1)
SOC 102	Introduction to Rural Sociology	2 (2+0)
ZOO 100	Elementary Zoology (For students from Arts and Math streams)	2 (1+1) NC
ZOO 102	Elementary Human Physiology	3 (2+1)
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**24 (16+8)**
	Semester II	
FN 102	Food Science and Processing	3 (2+1)
FRM 102	Fundamentals of Interior Decoration	3 (2+1)
HDFS 103	Life-Span Development-II	2 (1+1)
HECM 102	Women in Agriculture	2 (2+0)
HECM 103	Diffusion and Adoption of Homestead Technologies	3 (2+1)
TAD 102	Fundamentals of Fabric Construction	3 (2+1)
BOT 100	Elementary Botany (For students from Arts and Math streams)	2 (1+1) NC
COMP 102	Introductory Agricultural Informatics	2 (1+1)
ENG 103	Technical Writing	2 (1+1)
MATH 100	Introductory Mathematics (For students from Arts and Bio streams)	2 (2+0) NC
PHY 100	Introductory Physics (For students from Arts stream)	4 (3+1) NC
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**21 (13+8)**
	Semester III	
FN 201	Community Nutrition and Education	3 (2+1)
FN 202	Food Hygiene and Sanitation	2 (2+0)
FRM 201	Financial Management and Consumer Education	2 (2+0)
FRM 202	Ergonomics and Appropriate Technologies	2 (1+1)
HDFS 201/ HECM 201	Communication Skills and Personality Development (To be taught jointly by HDFS and EECM)	3 (2+1)

HECM 202	Extension Training Management	3 (2+1)
TAD 201	Textile Science and Fabric Care	3 (2+1)
BIOCHEM 102	Principles of Biochemistry	3 (2+1)
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)
NCC/NSS	National Cadet Corps/National Service Scheme	2 (0+2)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**26 (18+8)**
Semester IV		
FN 203	Normal and Therapeutic Nutrition	3 (2+1)
FRM 203	Housing and Space Management	3 (2+1)
FRM 204	Tourism and Hospitality Management	3 (2+1)
HDFS 202	Philosophy of Early Childhood Education	3 (3+0)
HDFS 203	Educational Psychology and Early Childhood Education	3 (2+1)
HECM 203	Communication and Instructional Technology	4 (2+2)
TAD 202	Textile Finishes	2 (1+1)
MICRO 101	Fundamentals of Food Microbiology	3 (2+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (16+9)**
Semester V		
FN 301	Food Standards and Quality Control	3 (2+1)
FRM 301	Residential and Commercial Space Design	3 (2+1)
HDFS 301	Marriage and Family Dynamics	3 (2+1)
HDFS 302	Developmental Challenges in Children	3 (2+1)
HECM 301	Programme Development for Rural Families	3 (1+2)
TAD 301	Principles of Dyeing and Printing	3 (2+1)
TAD 302	Computer Aided Textile and Apparel Designing	3 (1+2)
STAT 101	Elementary Statistics	3 (2+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (14+11)**
Semester VI		
FN 302	Clinical Nutrition and Dietetics	3 (2+1)
FN 303	Bakery and Confectionery	3 (2+1)
FRM 302	Entrepreneurship Development and Business Management	3 (2+1)
HDFS 303	Family Counseling and Community Welfare	3 (2+1)
HECM 302	Introduction to Mass Communication and Journalism	3 (2+1)
TAD 303	Apparel and Accessory Designing	3 (1+2)

TAD 304	Traditional Textiles of India	3 (2+1)
AG ECON 303	Economics and Marketing	3 (2+1)
CCA	Co-curricular Activity	1 (0+1)
TUT	Tutorial	1 (1+0) NC
	Total Credits	**25 (15+10)**
Semester VII		
Student READY Module/ Experiential Learning Programme/Hands on Training Students are required to choose one Module out of Modules I-V		
MODULE I	Experiential Learning in Bakery and Confectionary	20 (0+20)
MODULE II	Skill Development in Event Management	20 (0+20)
MODULE III	Skill Development in Early Childhood Education and Management	20 (0+20)
MODULE IV	Experiential Learning in Print and Electronic Media Production	20 (0+20)
MODULE V	Experiential Learning in Product Design: Digital Embroidered Home Furnishings	20 (0+20)
	Total Credits	**20 (0+20)**
Semester VIII **Student READY (Rural Entrepreneurship Awareness Development Yojana)**		
FN 491/ FRM 491/ HDFS 491/ HECM 491/ TAD 491	Rural Agricultural Work Experience and Industrial Attachment in Community Science	20 (0+20)
	Total Credits	**20 (0+20)**

B. Sc. (Hons.) Community Science, 4-Year Programme
Core Courses: Department-wise

Course No.	Course Title	Credits	Semester
Foods and Nutrition			
FN 101	Principles of Human Nutrition	3 (3+0)	I
FN 102	Food Science and Processing	3 (2+1)	II
FN 201	Community Nutrition and Education	3 (2+1)	III
FN 202	Food Hygiene and Sanitation	2 (2+0)	III
FN 203	Normal and Therapeutic Nutrition	3 (2+1)	IV
FN 301	Food Standards and Quality Control	3 (2+1)	V
FN 302	Clinical Nutrition and Dietetics	3 (2+1)	VI
FN 303	Bakery and Confectionary	3 (2+1)	VI
	Total Credits	**23 (17+6)**	

Course No.	Course Title	Credits	Semester
Family Resource Management			
FRM 101	Management of Family Resources	2 (1+1)	I
FRM 102	Fundamentals of Interior Decoration	3 (2+1)	II
FRM 201	Financial Management and Consumer Education	2 (2+0)	III
FRM 202	Ergonomics and Appropriate Technologies	2 (1+1)	III
FRM 203	Housing and Space Management	3 (2+1)	IV
FRM 204	Tourism and Hospitality Management	3 (2+1)	IV
FRM 301	Residential and Commercial Space Design	3 (2+1)	V
FRM 302	Entrepreneurship Development and Business Management	3 (2+1)	VI
	Total Credits	**21(14+7)**	
Human Development and Family Studies			
HDFS 101	Fundamentals of Human Development	2 (2+0)	I
HDFS 102	Life-Span Development –I	3 (2+1)	I
HDFS 103	Life-Span Development –II	2 (1+1)	II
HDFS 201/ HECM 201	Communication Skills and Personality Development (To be taught jointly by HDFS and EECM)	3 (2+1)	III
HDFS 202	Philosophy of Early Childhood Education	3 (3+0)	IV
HDFS 203	Educational Psychology and Early Childhood Education	3 (2+1)	IV
HDFS 301	Marriage and Family Dynamics	3 (2+1)	V
HDFS 302	Developmental Challenges in Children	3 (2+1)	V
HDFS 303	Family Counselling and Community Welfare	3 (2+1)	VI
	Total Credits	**25 (18+7)**	
Extension Education and Communication Management			
HECM 101	Extension and Rural Development	2 (2+0)	I
HECM 102	Women in Agriculture	2 (2+0)	II
HECM 103	Diffusion and Adoption of Homestead Technologies	3 (2+1)	II
HECM 201/ HDFS 201	Communication Skills and Personality Development (To be taught jointly by HDFS and EECM)	3 (2+1)	III
HECM 202	Extension Training Management	3 (2+1)	III
HECM 203	Communication and Instructional Technology	4 (2+2)	IV
HECM 301	Programme Development for Rural Families	3 (1+2)	V
HECM 302	Introduction to Mass Communication and Journalism	3 (2+1)	VI
	Total Credits	**23 (15+8)**	
Textile and Apparel Designing			
TAD 101	Fundamentals of Clothing Construction	3 (1+2)	I
TAD 102	Fundamentals of Fabric Construction	3 (2+1)	II
TAD 201	Textile Science and Fabric Care	3 (2+1)	III
TAD 202	Textile Finishes	2 (1+1)	IV
TAD 301	Principles of Dyeing and Printing	3 (2+1)	V
TAD 302	Computer Aided Textile and Apparel Designing	3 (1+2)	V
TAD 303	Apparel and Accessory Designing	3 (1+2)	VI
TAD 304	Traditional Textiles of India	3 (2+1)	VI
	Total Credits	**23(12+11)**	

Student READY Modules: Department-wise

Course No.	Course Title	Credits	Semester
Foods and Nutrition			
MODULE I	Experiential Learning in Bakery and Confectionary	20 (0+20)	VII
	Total Credits	**20 (0+20)**	
Family Resource Management			
MODULE II	Skill Development in Event Management	20 (0+20)	VII
	Total Credits	**20 (0+20)**	
Human Development and Family Studies			
MODULE III	Skill Development in Early Childhood Education and Management	20 (0+20)	VII
	Total Credits	**20 (0+20)**	
Extension Education and Communication Management			
MODULE IV	Experiential Learning in Print and Electronic Media Production	20 (0+20)	VII
	Total Credits	**20 (0+20)**	
Textile and Apparel Designing			
MODULE V	Experiential Learning in Product Design: Digital Embroidered Home Furnishings	20 (0+20)	VII
	Total Credits	**20 (0+20)**	

FN 491/ FRM 491/ HDFS 491/ HECM 491/ TAD 491	Rural Agricultural Work Experience and Industrial Attachment in Community Science (To be conducted jointly by EECM, FN, FRM, HDFS and TAD)	20 (0+20)	VIII
	Total Credits	**20 (0+20)**	

Supporting Courses: Department-wise

College of Agriculture

Course No.	Course Title	Credits	Semester
Agricultural Economics			
AG ECON 303	Economics and Marketing	3 (2+1)	VI
	Total Credits	**3 (2+1)**	
Forestry/ Agricultural Meteorology/ Soil Science/ Agricultural Economics/ Chemistry			
FOR 201/ AGM 201/ SOILS 201/ AG ECON 203/ CHEM 201	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III
	Total Credits	**3 (3+0)**	

College of Basic Sciences and Humanities

Course No.	Course Title	Credits	Semester
Botany and Plant Physiology			
BOT 100	Elementary Botany (For students from Arts and Math streams)	2 (1+1) NC	II
	Total Credits	**2 (1+1)**	
Chemistry and Biochemistry			
CHEM 100	Introductory Chemistry (For students from Arts stream)	4 (3+1) NC	I
BIOCHEM 102	Principles of Biochemistry	3 (2+1)	III
	Total Credits	**7 (5+2)**	
Computer Section			
COMP 102	Introductory Agricultural Informatics	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Languages and Haryanvi Culture			
ENG 102	General English	2 (1+1)	I
ENG 103	Technical Writing	2 (1+1)	II
	Total Credits	**4 (2+2)**	
Microbiology			
MICRO 101	Fundamentals of Food Microbiology	3 (2+1)	IV
	Total Credits	**3 (2+1)**	
Mathematics, Statistics and Physics			
MATH 100	Introductory Mathematics (For students from Arts and Bio streams)	2 (2+0) NC	II
STAT 101	Elementary Statistics	3 (2+1)	V
PHY 100	Introductory Physics (For students from Arts stream)	4 (3+1) NC	II
	Total Credits	**9 (7+2)**	
Sociology			
SOC 102	Introduction to Rural Sociology	2 (2+0)	I
	Total Credits	**2 (2+0)**	
Zoology			
ZOO 100	Elementary Zoology (For students from Arts and Math streams)	2 (1+1) NC	I
ZOO 102	Elementary Human Physiology	3 (2+1)	I
	Total Credits	**5 (3+2)**	

COURSE CONTENTS DEPARTMENT-WISE

FOODS AND NUTRITION

Course No.	Course Title	Credits	Semester
Core Courses			
FN 101	Principles of Human Nutrition	3 (3+0)	I
FN 102	Food Science and Processing	3 (2+1)	II
FN 201	Community Nutrition and Education	3 (2+1)	III
FN 202	Food Hygiene and Sanitation	2 (2+0)	III
FN 203	Normal and Therapeutic Nutrition	3 (2+1)	IV
FN 301	Food Standards and Quality Control	3 (2+1)	V
FN 302	Clinical Nutrition and Dietetics	3 (2+1)	VI
FN 303	Bakery and Confectionary	3 (2+1)	VI
	Total Credits	**23 (17+6)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
MODULE I	Experiential Learning in Bakery and Confectionery	20 (0+20)	VII
	Grand Total	**43 (17+26)**	

FN 101	PRINCIPLES OF HUMAN NUTRITION	3 (3+0)	SEM I

Theory

Historical development of nutrition; relationship of nutrition to health, growth and human welfare; definitions of terms used in nutrition-recommended dietary allowances, balanced diet, health, functional food, phytochemicals, nutraceuticals, dietary supplements; energy- units, sources, requirements, fuel value of foods, methods of measuring energy value of food, energy requirement of body, physical activity, thermogenic effect of food; BMR- methods of measurement, factors affecting BMR; digestion and absorption of carbohydrates; carbohydrates- types, functions, sources, requirement, health conditions affected by carbohydrates, significance of dietary fibre; digestion and absorption of fats/lipids; lipids- types, functions, sources, requirement, health problems associated with lipids; digestion and absorption of proteins; proteins- types, functions, sources, requirement, quality evaluation, improvement, deficiency disorders and protein energy malnutrition; vitamins- classification, functions, sources, requirement, deficiency and toxicity of the fat soluble vitamins- A, D, E, K and water soluble vitamins– C and B-complex- thiamine, riboflavin, niacin, B_6, B_{12}, folic acid; minerals- classification, functions, sources, requirements, deficiency and toxicity of calcium, phosphorus, iodine, fluorine, iron, sodium, potassium, chloride, copper and zinc; bioavailability and factors affecting calcium and iron; water- functions, sources, distribution in body, water and electrolyte balance.

Suggested Readings:

1. Agarwal, A. and Udipi, S. (2014). Text Book of Human Nutrition. Jaypee Medical Publication, Delhi.
2. Gopalan, C., Rama Shastri, B.V. and Balasubramanian, S.C. (2007). Nutritive Value of Indian Foods. NIN, ICMR, Hyderabad.
3. ICMR (2010). Dietary Guidelines for Indians. ICMR, NIN, Hyderabad.
4. ICMR (2010). Nutrient Requirement and Recommended Dietary Allowance for Indians. A Report of Expert Group of the ICMR, NIN, Hyderabad.
5. Jim, M. and Stewant, T.A. (2007). Essentials of Human Nutrition. 3rd Ed.: New York, Oxford University Press, New Delhi.

FN 102	FOOD SCIENCE AND PROCESSING	3 (2+1)	SEM III

Theory

Food groups; food guide pyramid and its importance; food as a source of nutrients; objectives of cooking, processing, preservation, methods of cooking with their merits and demerits; effect of cooking and heat on nutritive value of foods; cereals, millets and pulses- composition and nutritive value, types, storage, processing; cereal cookery; gluten and factors affecting the gluten formation; pulse cookery- effect of cooking, factors affecting cooking quality; toxic constituents in pulses; nuts and oilseeds- composition, nutritive value, types, storage, oil extraction, processing, toxic constituents and role in cookery; milk and milk products- composition and nutritive value, properties, processing and packaging, effect of heat, acid and enzymes; processed and indigenous milk products- their quality and role in cookery; eggs- structure, composition, nutritive value, storage, evaluation of quality of egg, role of egg in cookery; flesh foods- structure, composition, nutritive value, types, storage and evaluation of quality; selection of meat, fish and poultry, methods of cooking, brief description of ageing, tenderization and curing; vegetables and fruits- composition, nutritive value, types, storage, selection, post-harvest changes, effect of processing, preservation and cooking on different pigments of both fruits and vegetables; sugar and its products- composition, nutritive value, type, function and properties, stages in sugar cookery, role of sugar in cookery; fat and oils- composition, nutritive value, types, role in cookery and importance in daily diet; spices and herbs- types and its use; beverages and appetizers- classification, use in everyday lives with special reference to tea, coffee, cocoa and alcoholic drinks; leavening agents- classification and functions; processed and convenience foods- ready to eat foods, frozen foods, dehydrated foods, instant food mixes.

Practical

Laboratory conduct and responsibilities; knowledge of different food stuffs in English, Hindi and local language; terms used in cookery, weights and measures; identification and use of different kitchen items and equipments; identification and listing of various food groups; market survey of processed and preserved foods; cereal cookery- preparation of plain rice (open and pressure cooking), lime-rice, *pulao*, *paratha*, *chapatti*, *upma*, *halwa*; pulse cookery-preparation of plain *dal*, *dal* with green, *pakoras*, *sambar*; preparation of cereal and pulse combined recipes- *idlis*, *adai, missi roti*; nuts and oilseeds- preparation of *chikki, til ladoos*, *thandai*; milk cookery- preparation of curd and paneer; egg cookery; fruits and vegetables cookery- preparation of sauces, pickles, squash, chips, jams, jellies, marmalade, candy, preserves, chutneys, candies, syrup, *sabjis,* soups and salad; demonstration on canning and bottling of fruits and vegetables; sugar cookery- preparation of fudge and fondent; process of caramalization; demonstration of 1-thread and 2-thread consistency syrups; fats and oils- preparation of *puris*, cakes and biscuits; appetizers; visit to food industries.

Suggested Readings:

1. Kalia, M. and Sood, S. (2010). Food Preservation and Processing. Revised Edition, Kalyani Publishers, New Delhi.
2. Khadder, V. (1999). Text Book of Food, Storage and Preservation. Kalyani Publishers, New Delhi.
3. Potter, N. N. (1996). Food Science. The AVI Publishing Company, Inc.: Westport, Connecticut.
4. Sivasankar, B. (2002). Food Processing and Preservation. PHI Learning Pvt. Ltd., New Delhi.
5. Srilakshmi, B. (2011). Food Science. 5th Edition. New Age International Publishers, New Delhi.

FN 201	COMMUNITY NUTRITION AND EDUCATION	3 (2+1)	SEM II

Theory

Malnutrition-definition and causes; PEM- marasmus and kwashiorkor; vicious cycle of malnutrition; assessment of nutritional status-clinical signs and symptoms, nutritional anthropometry, biochemical tests, biophysical tests, diet survey methods; major nutritional problems prevalent in India and the State of protein energy malnutrition, anaemia, vitamin A deficiency, iodine deficiency disorders, obesity, hypertension, atherosclerosis, diabetes mellitus; national programmes and role of national and international agencies in improving nutritional status of the community-Integrated Child Development Service (ICDS), Supplementary Nutrition Program (SNP), Applied Nutrition Program (ANP), Mid Day Meal Program (MDMP), Vitamin A Prophylaxis Program, Anaemia Prophylaxis Programme. Food and Agricultural Organization (FAO), World Health Organization (WHO), United Nations Children's Fund (UNICEF), UNDP, CARE and other Voluntary and Government Agencies; nutrition education- objectives and methods.

Practical

Assessment of nutritional status of an individual/community using anthropometry and dietary survey- preparation of schedule, survey work, analysis of data and writing of report; visit to local health centre to identify clinical signs and symptoms of nutritional problems; identification of adulterants in common foods; visit to an ICDS Block; development of audio visual aids- radio script, popular articles, chart/posters, leaflets etc.; planning, implementation and evaluation of nutrition education for a target group.

Suggested Readings:

1. Rajalakshmi, R. (1990). Applied Nutrition (4th Edition). Oxford & IBH Publishing Co Pvt. Ltd., New Delhi.
2. Sehgal, S. and Raghuvanshi, R.S. (2007). Text Book of Community Nutrition. ICAR, New Delhi.
3. Srilakshmi, B. (2002). Nutrition Science. New Age International Limited Publishers, New Delhi.
4. Swaminathan, M.C. (2013). Advanced Text Book on Food and Nutrition (Vol. II) BAPPCO, Bangalore.

FN 202	FOOD HYGIENE AND SANITATION	2 (2+0)	SEM III

Theory

Meaning and principle of food hygiene; water requirement and use; sources of water supply; water pollution; purification of water; portable water and its quality- criteria and standards; hardness of water and its treatment; defluoridation of water; food hygiene- contamination of foods from various sources like green plants, animals, sewage, soil, air, water and their health hazards; food spoilage; perishable, semi perishable and non-perishable foods; sanitary procedures for preparation, handling and storage of foods; food poisoning caused by bacteria- Salmonella, Staphylococcal poisoning, Botulinum, Clostridium perfringens and B. cerus, sources, incubation period and mechanism of action; investigation of food poisoning, prevention and control; food poisoning caused by agents other than microorganism; poisonous plants, animals, chemicals, metals and pesticides etc.

Suggested Readings:

1. Adams, M.K. and Moss, M.O. (2000). Food Microbiology. Panima Corp., New Delhi.
2. Bhat, R.V and Rao, R.N. (1997). Food Safety. BAPPCO Ltd.: Banglore.

3. Longree, K.L. and Blaker, G.C. (1982). Sanitary Techniques in Food Service. John Wiley & Sons, New York.
4. Modi, H.A (2008). Food Borne Illnesses. Aavishkar Publishers, Jaipur, India.
5. Reddy, S. (2006). Food Hygiene and Sanitation. Tata McGraw-Hill Pub. Company Ltd., New Delhi.

FN 203	NORMAL AND THERAPEUTIC NUTRITION	3 (2+1)	SEM IV

Theory

Determination of nutritional requirements; recommended dietary allowance; calorie consumption unit; food exchange list method; maternal nutrition; physiological changes and nutritional requirements during pregnancy and lactation; infancy- growth, development and nutritional requirement; importance of breast feeding; weaning and supplementary foods; pre-school children- growth and development, food habits and nutritional requirements; school age children and adolescents- growth and development, food habits and nutritional requirements; geriatric nutrition; physiological and psychological changes during old age; nutritional requirements and consideration for diet planning; importance and modification of normal diet to therapeutic diets; methods of feeding; etiology, symptoms and dietary management in acute and chronic fevers- typhoid, influenza and tuberculosis; etiology, symptoms and dietary management in gastrointestinal disorders- diarrhea, constipation and peptic ulcer; etiology, symptoms and dietary management in liver diseases- hepatitis, jaundice and cirrhosis of liver; etiology, symptoms and dietary management in cardiovascular diseases- atherosclerosis and hypertension; etiology, symptoms and dietary management in diabetes mellitus; dietary management and prevention of overweight and obesity.

Practical

Standardization of serving size portions; planning and preparation of diets for different age groups- infancy, preschool age, school age, adolescent, adult, old age; planning and preparation of diets for pregnant and lactating women; planning and preparation of diets for special occasions like birthdays, festivals and packed lunches; planning and preparation of diets for following diseased conditions- diarrhea, constipation, hepatitis, hypertension, diabetes mellitus, overweight/ obesity.

Suggested Readings:

1. Agarwal, A. and Udipi, S. (2014). Text Book of Human Nutrition. Jaypee Medical Publication, Delhi.
2. ICMR (2010). Dietary Guidelines for Indians. ICMR, NIN: Hyderabad.
3. Gopalan, C., Rama Shastri, B.V. and Balasubramanian, S.C. (2007). Nutritive Value of Indian Foods. NIN, ICMR, Hyderabad.
4. ICMR (2010). Nutrient Requirement and Recommended Dietary Allowance for Indians. A Report of Expert Group of the ICMR, NIN, Hyderabad.
5. Khanna, K., Gupta, S., Seth, R. and Puri, S. (2013). Text Book of Nutrition and Dietetics. Phoenix Publishing House Pvt. Ltd., New Delhi.
6. Raghuvanshi, R.S. and Mittal, M. (2014). Food Nutrition and Diet Therapy. Westvills Publication, Delhi.
7. Srilakshmi, B. (2011). Dietetics (5th Ed.). New Age international Pvt. Ltd. Publishers, New Delhi.
8. Swaminathan, M.C. (2013). Advanced Text Book on Food and Nutrition (Vol. II) BAPPCO, Bangalore.

FN 301	FOOD STANDARDS AND QUALITY CONTROL	3 (2+1)	SEM V

Theory

Importance of quality control and assurance; food laws and regulations- FSSAI, Prevention of Food Adulteration Act, Fruit Product Order, Agmark, Essential Commodity Act, Consumer Protection Act, Bureau of Indian Standards, Codex Standards; specifications and application of food standards for raw materials and food products; food additives- preservatives, coloring agents, antioxidants, emulsifying agents, leavening agents and stabilizing agents; various methods for the assessment of quality of different foods; selection of sensory panel and sensory evaluation of food products; food safety, risks and hazards; assessment and prevention of food adulteration; food packaging and packaging material.

Practical

Sensory and nutritional evaluation of some finished products; detection of adulterants and preservatives in products.

Suggested Readings:

1. Inteaz, A. (2004). Food Quality Assurance: Principles and Practices. CRC Press, New York.
2. Jellinek, G. (1985). Sensory Evaluation of Foods: Theory and Practice. Ellis Honwood Ltd., Chichester, England.
3. Kalia, M. and Sood, S. (2010). Food Preservation and Processing (Revised ed.) Kalyani Publisher, New Delhi.
4. Many, N.S. and Shadaksharswamy, M. (1996). Food Facts and Principles. 2nd ed. New Age International Pvt. Limited, New Delhi.
5. Potter, N.N. (1996). Food Science. The AVI Publishing Company Inc., Westport, Connecticut.
6. Swaminathan, M. (1999. Food Science, Chemistry and Experimental Foods. 2nd Ed. The Banglore Printing & Publishing Co., Bangalore.

FN 302	CLINICAL NUTRITION AND DIETETICS	3 (2+1)	SEM VI

Theory

Clinical nutrition; common deficiency diseases; pathogenesis of nutritional deficiency diseases- macronutrient and micronutrient, protein calorie malnutrition, vitamin A deficiency, anemia and iodine deficiency disorders; gastro intestinal tract diseases- diseases of mouth and oesophagus, diseases of stomach and duodenum, diseases of small and large intestine, diverticulitis, malabsorptive syndrome, tropical sprue, diarrhea and constipation; diseases of liver; pancreatitis; diabetes mellitus; cardio vascular disease- risk factors, lipo and apo proteins, role of nutrients in preventing atherosclerosis, major enzymes used for diagnosis, congestive heart failure and hypertension; renal disease- functions of the kidney, nephritis, urinary calculi, types of renal failure, dialysis; cancer- causes of cancer cell development, impact of tumor on host metabolism, systematic effects of cancer; burns- physical destruction of skin, metabolic aberrations and alteration in nutritional requirement; interaction between nutrients, infection and drugs.

Practical

Estimation of albumin, glucose, ketone bodies, creatinine and creatine in urine; analysis of blood glucose level; estimation of total protein, albumin, haemoglobin; estimation of blood urea; estimation of total cholesterol, HDL, LDL, TG in blood; assignment and presentation.

Suggested Readings:

1. AOAC. (2000). Association of Official Analytical Chemists. Washington, DC.
2. Bamji, S.M., Rao, P.N and Reddy, V. (2003). Textbook of Human Nutrition. Oxford and IBH Publishing Co Pvt Ltd., New Delhi.
3. Bhavana, S. (1999). Nutrition and Clinical Care. Commonwealth Publishers, New Delhi.
4. Jean-FZ. (2005). Clinical Nutrition. Blackwell Publishing Company, UK.
5. Khetarpaul, N., Jood, S and Punia, D. (2011). Food Analysis. Daya Publishing House, New Delhi.
6. NIN. (2003). A Manual of Laboratory Techniques.
7. Weinsier and Butterworth (1981). Hand Book of Clinical Nutrition. C V Mosby Company, London.

FN 303	BAKERY AND CONFECTIONERY	3 (2+1)	SEM VI

Theory

Composition, structure, and quality of cereal grains; processing of wheat and other cereals; study of various types of bakery products; characterization and functional properties of cereal and their relationship with bakery products; grades of flour and evaluation of gluten content; physico-chemical properties of various bakery and confectionery ingredients-flours, leavening agent, sugar, fat and moistening agent; faults observed during preparation of bakery and confectionery products and their remedies; prospects and problems of bakery industries.

Practical

Study of various types of baking equipments; type of baking ingredients, flour, yeast, salt and their uses; balancing the formulae for bakery and confectionery products; preparation and cost calculation of different types of bakery and confectionery products: straight dough, sponge dough, fermented doughnuts, various types of breads- french bread, raisin bread, milk bread, whole meal bread, brown bread, buns- basic bun dough, hot cross buns, fruit buns, breakfast roll, danish pastry, bread sticks; cakes, pastries, muffins, creamroll, swissroll, sweet paste, biscuits, eclairs, madeleins, patties, pies; packaging and sale of products; visit to bakery and confectionery units.

Suggested Readings:

1. Khetarpaul, N., Grewal, R.B. and Jood, S. (2005). Bakery Science and Cereal Technology. Daya Publishing House, New Delhi.
2. Manley, D. (1991). Technology of Biscuits, Crackers and Cookies. Woodhead Pub. Ltd., Cambridge, UK.
3. Nagi, H.P.S., Sharma, S. and Sekhon, K.S. (2007). Hand book of Cereal Technology. Kalyani Publishers, Ludhiana.
4. Vogambal, A.K. (2011).Text book of Bakery and Confectionery, Second edition, PHI Learning Private Limited.

MODULE I	EXPERIENTIAL LEARNING IN BAKERY AND CONFECTIONERY	20 (0+20)	SEM VII

Developing a Business Plan/Project Proposal: Market survey of available bakery and confectionery products; developing a business Plan/ Project Proposal; identification of the product to be prepared; analysis of the existing status of the identified products and targeted market and customer; innovativeness and creativity; preparation of the project proposal with supply chain of inputs, personnel, production, and finance plan.

Plan for the Production: Selection and purchase of material used in bakery & confectionery for the preparation of value added products; purchase of ingredients; standardization of portion and costing as well as standardization of new products as per demand of consumers; plan for the production; organization of resources; organizing utility of resources; sequential grouping of activities/ time management.

Production and Sale: Preparation of bakery and confectionery items vis. cakes, different types of bread, buns, bread stics, danish pastry, pizzas, doughnuts, biscuits, cookies, muffins, swisroll, patties, pies, pastries etc. at large scale. Packaging and storage of developed products; product pricing-physical inputs, man-hours, depreciation etc.; quality assessment; market strategy and assessment of sales performance; profit generated including cost benefit ratio, payback period etc.

Documentation, Report Presentation and Evaluation.

FAMILY RESOURCE MANAGEMENT

Course No.	Course Title	Credits	Semester
Core Courses			
FRM 101	Management of Family Resources	2 (1+1)	I
FRM 102	Fundamentals of Interior Decoration	3 (2+1)	II
FRM 201	Financial Management and Consumer Education	2 (2+0)	III
FRM 202	Ergonomics and Appropriate Technologies	2 (1+1)	III
FRM 203	Housing and Space Management	3 (2+1)	IV
FRM 204	Tourism and Hospitality Management	3 (2+1)	IV
FRM 301	Residential and Commercial Space Design	3 (2+1)	V
FRM 302	Entrepreneurship Development and Business Management	3 (2+1)	VI
	Total Credits	**21 (14+7)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
MODULE II	Skill Development in Event Management	20 (0+20)	VII
	Grand Total	**41 (14+27)**	

FRM 101	MANAGEMENT OF FAMILY RESOURCES	2 (1+1)	SEM I

Theory

Systems approach to management; motivating factors of management: values, goals and standards, origin, classification and role; resources: definition, types, guidelines for use of resources, factors affecting, management of household resources and situation; management process: planning-importance, characteristics and techniques, organizing, controlling and evaluating; time: tools of time management, process of time management; decision making process: types, steps in decision making and factors affecting decision making; money management process: types and sources of income, steps in making budget, controlling budget and evaluation of budget.

Practical

Identification of individual and family values; identification of immediate, short term and long term goals of individual and family; standards for individual and family goals; decision making by individuals and families; listing out human and non human resources, listing community resources; application of management process to organize an event, planning, organization, evaluation; management of personal time record for a week.

Suggested Readings:

1. Bhargava, B. (2005). Family Resource Management and Interior Decoration. Apple Printer and V. R. Printers, Jaipur.

2. Mann, M.K. (2004). Home Management for Indian Families. Kalyani Publisher, Ludhiana.
3. Nickell, P. and Dorsey, J.M. (1970). Management of Family Living. Wiley Eastern, New Delhi.
4. Oberoi, K. (2006). Resource Management for Better Homes. R.K. Offset, Delhi.
5. Vargeese, M.N. Ogale, N.N. and Srinivasan, K. (1992). Home Management. Wiley Eastern, New Delhi.

FRM 102	FUNDAMENTALS OF INTERIOR DECORATION	3 (2+1)	SEM II

Theory

Introduction and objectives of interior decoration; elements of art and their importance in interior decoration; principles of design and their application to enrich the interiors; colour: sources of colour, properties of colour, emotional effect of colour, colour schemes, colour theories, colour plans for interiors; furniture: types of furniture, materials and finishes of furniture, factors affecting the selection of furniture, care and maintenance of furniture, furniture arrangement, points to be considered while selecting the furniture; wall classification, functional characteristics of walls, types of wall treatments; floor: importance, types of floor covering, care, maintenance and selection of floor covering; windows: importance, its functional and decorative treatments; accessories: classification, application of principles of design and decoration in the selection/development of accessories, and their placement; lighting: importance, types of lighting and its application; flower arrangement: materials used, principles involved, types, practical utility and care; table setting: linens, tableware etc. required for table setting, table etiquettes.

Practical

Learning elements of art and principles of design; development of motif and design through art principles; colour: colour schemes, values and intensity scale, colour wheel; furniture: care and arrangement of furniture; accessories: preparation and placements of accessories; flower arrangement; learning different types of table setting and napkin folding; window treatment; lighting, fixtures and their utility; market survey of different types of wall and floor coverings.

Suggested Readings:

1. Faulkner and Faulkner. (1975). Inside Today's Home. Holt, Rinehart and Winston, New York.
2. Gandotra, Shukul, Jaiswal. (2005). Introduction to Interior Design and Decoration. Dominant Publishers & Distributors, New Delhi.
3. Gewther, M. (1970). The Home, its Furnishings and Equipment. Mc. Graw Hill, U.S.A.
4. Parimalam, P. and Andal, A.(2008). A Text Book of Interior Decoration. Satish Serial Publishing House.
5. Ruth, M. (1975). The Home and its Furnishings. Mc. Graw Hill, U.S.A.
6. Seetharaman P. and Sethi M. (2002). Interior Design and Decoration. CBS Publishers and Distributors, New Delhi.
7. Stepat – Devan, D., S.D., Logan, K.C., Kness, M.K. and Szekely, L. (1980). Introduction to Interior Design. Macmillan Publishing Co. Inc, New York.

FRM 201	FINANCIAL MANAGEMENT AND CONSUMER EDUCATION	2 (2+0)	SEM III

Theory

Concepts, importance, objectives and major aspects of family finance; types of income: family as income producing and utilizing unit, factors affecting the use of family income; family budget: steps of budget making, factors influencing on budget making, advantages of budget making; Engel's law of consumption; credit: needs, types, use and source; savings and investment: types of savings/investment, saving institution and its importance, criteria for judging family investments;

taxation: objectives, characteristics and classification; will and its type; consumer: definition and role; types of market; consumer problems in rural and urban areas: unfair trade practices, adulteration, faulty weights and measures; consumer rights and responsibilities; consumerism and consumer protection: consumer protection act and Government legislation and order, NGO's for consumer protection and welfare; standard and standardization and legislative measures for regulating quality; sources of consumer information: advertisements, labels, packaging etc; consumer and environment.

Suggested Readings:

1. Bhargava, B. (2005). Family Resource Management and Interior Decoration. Univ. Book Home Pvt. Ltd. Jaipur.
2. Khetarpaul, N. and Grover, I. (2004). Consumer Guide for Home Maker. Agratech Pub Academy, Udaipur.
3. Mann, M.K. (2004). Home Management for Indian Families. Kalyani Publishers, New Delhi.
4. Seetharaman P. and Sethi M. (2002). Consumerism Strategies and Tactics. CBS Publishers and Distributors, New Delhi.
5. Shukul, M. and Gandotra, N. (2006). Home Management and Family Finance. Dominant Publishers and Distributors, New Delhi.
6. Tiwari, O.P. (2000). Consumer Protection Act. Allahabad Law Agency.

FRM 202	ERGONOMICS AND APPROPRIATE TECHNOLOGIES	2 (1+1)	SEM III

Theory

Work, worker and workplace relationship; work simplification techniques; principles of ergonomics; household drudgery: definition, drudgery reduction; household equipment: introduction, definition, classification and base materials used in construction; impact of household equipments on work, worker and environment; renewable and non renewable energy saving technologies; ways and methods in the reduction of energy consumption in household, farm and community.

Practical

Use and care of common household appliances: refrigerator, washing machine, vacuum cleaner, oven etc; demonstration of solar household technologies, biogas, zero energy cool chamber etc; motion Studies: process chart, operational chart etc; appropriate technologies in rural area for farm, home and dairy.

Suggested Readings:

1. Grandjean, E. (1981). Ergonomics of the Home Taylor and Francis Ltd., New York.
2. Grandjean, E. and Kroemer, K.H.E. (1999). Fitting the Task to the Human a Text Book of Occupational Ergonomics. Taylor and Francis, New York.
3. Peet, I.J. and Arnold, M.G. (1993). Household Equipment. John Wiley, New York.
4. Science and Technology for Women. (1993). Complied by Center of Science for Village. Waradha. Department of Science and Technology, New Delhi.
5. Singh, S. (2007). Ergonomics Integration for Health and Productivity. Himanshu Publication, Udaipur and New Delhi.
6. Steidle, R. and Bratton. (1968). Work in the Home. John Wiley and Sons Inc., New York.
7. Varghese, M.N., Ogale, N.N. and Srinivasan, K. (1992). Home Management. Wiley Eastern, New Delhi.

FRM 203	HOUSING AND SPACE MANAGEMENT	3 (2+1)	SEM IV

Theory

Housing: its importance, characteristics, effect of insufficient housing and factors to be considered in selection of family housing; selection of site, housing needs at different stages of family life cycle; housing problems: rural and urban housing problems in India; housing legislation and regulation; building act 1984; defective premises act 1972; disability discrimination act 1995; environment protection act etc; housing policies: government and non- government housing policies and housing schemes; housing standards; sanitary facility; food preparation and refuse disposal; space and security; thermal environment; illumination and electricity: structure and material; interior air quality; water supply; ownership vs. renter ship; site and neighbourhood; sanitary condition and smoke detectors; types of house planning: floor plan, site plan, cross sectional plan, perspective plan, elevation plan and landscape plan; housing finance: government and non government finance institutes; advantages and disadvantages of renting and owning a house; technology in housing: advance technology in housing construction, low cost building technology, low cost building materials; economy in housing construction; principles of house planning: orientation, privacy, grouping, roominess, sanitation, ventilation, flexibility, circulation, economy, furniture requirement; ergonomics and housing; space management, interior types based on functional needs; interior for youth, elderly and other special needs; functional design of areas in interior .

Practical

Learning architectural symbols; drawing of house plans for different income levels and activity groups; house plan for renovation according to needs of residents; designing of kitchen, bathroom etc. for special needs; market survey to study the available building materials in the local market.

Suggested Readings:

1. Cherunilam, F. and Heggade, O. (1987). Housing in India. Himalaya Publishing, Mumbai.
2. Mathur, G.C. (1993). Low Cost Housing in Developing Countries. Mohan Primlani, Oxford and IBH, New Delhi.
3. Parvez,R (2015). Housing and Space Management. Gyan Geeta Prakashan.
4. Reddy,M.V. and Salunke, R.(2013). Housing and Space Management. ICAR, New Delhi.
5. Tessis Agan, M.S. (1970). The House. Oxford and IBH, New Delhi.

FRM 204	TOURISM AND HOSPITALITY MANAGEMENT	3 (2+1)	SEM IV

Theory

Introduction to the hospitality and tourism industry; introduction to business: business plan; customer service management in tourism and hospitality; food and beverage operations, housekeeping operations, hospitality law and tourism regulations in India; hospitality cost controls; future prospects of tourism; travel itinerary including transportation, lodging, activities, safety tips and cost; promotion plan for the vacation package (individually produced component); hotel crises management; hotel specifications and standards; service quality management.

Practical

Menu planning for industrial canteen, hospital canteen, cafeteria, snack bar, residential hostel; housekeeping practices – bed making, room services etc.; visit to dietary department, cafeteria, 3-star hotel/restaurant, 5-star hotel/restaurant, industrial canteen; presentation of report on hospital canteen, cafeteria, 3-star hotel/restaurant, 5-star hotel /restaurant in terms of organizational set up, production, preparation and service; case studies on tourism and hospitality; acquaintance with softwares used in front office and by travel agencies.

Suggested Readings:

1. Barkat A.M.A (2015) Travel and Tourism Management . PHL Learning Private Ltd.
2. Foley Malcolm (1997) Hospitality, Tourism and Leisure Management: Issues in Strategy and Culture. Cengage Learning EMEA.
3. Roday Sunetra, Biwal, Archana, Joshi Vandana. (2009) Tourism: Operations and Management. Oxford Higher Education.
4. Ross Darren Lee (2007) HRM in tourism and Hospitality. Cengage Learning.
5. Sharma, L. (2011) Tourism and Hospitality Management. Centrum Press.

FRM 301	RESIDENTIAL AND COMMERCIAL SPACE DESIGN	3 (2+1)	SEM V

Theory

Design and space organization analysis of independent house of different income groups, apartments and flats; understanding on building bye laws; regulations and specifications essential for building, and service management; selecting materials and finishing scheme for interiors; estimation of cost of fittings, fixtures, furniture, lighting and materials for interior finishing for commercial buildings; appraisal on space needs in commercial buildings; study of commercial interiors for business establishments, hotels/restaurants, hospitals, educational buildings, public service buildings ; specifications writing: writing detailed clause by clause specification for materials; pre and post execution, tests, mode of measurements, manufacturers details and specifications etc.

Practical

Develop conceptual drawings and floor plans for various income groups; develop layouts of furniture, lighting, electrical and plumbing for various income groups; practical applications of design and space organization of apartments and flats and analysis; cost estimation for designing interiors of various income groups; planning of ergonomic work layout for private and commercial areas; evolving interior decoration details with material sample for the small project; evolving interior commercial area; presentation of the detailed work done for small projects; presentation of the detailed work done for large commercial projects.

Suggested Readings:

1. Binggeli, C. (2016) Building Systems for Interior Designers. John Wiley and Sons Inc., New York.
2. Bonda P. and Sonsnowchik, K. (2007). Sustainable Commercial Interiors. John Wiley and Sons Publication, New York.
3. Crafti (2004). The office – Designing for Success. Images Publication.
4. Harmon. S and Kennon, K.(2014) The Codes Guidebook for Interiors. Fifth Edition. John Wiley and Sons Publication, New York.
5. Kubba, S. (2003). Space Planning for Commercial and Residential Interiors. McGraw- Hill Companies.
6. Leibing W. R. (1999). Architectural Working Drawings ,4th edition. John Wiley and Sons Publication, New York.
7. Maureen M. (2003). Residential Interior Design: A Guide to Planning Space. McGraw Hill Education.
8. Simpson, C. (2001). Estimation for Interior Designers. Watson Guptill Publications.

FRM 302	ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT	3 (2+1)	SEM VI

Theory

Development of entrepreneurship; motivational factors: social factors, environmental factors;

characteristics of entrepreneurs, entrepreneurial attributes/competencies; concept, need and importance of entrepreneurial development; evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development; starting a project; factors influencing sensing the opportunities; infrastructure and support systems; good policies, schemes for entrepreneurship development; role of financial institutions and other agencies in entrepreneurship development; steps involved in functioning of an enterprise: selection of the product/services, selection of form of ownership, registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution; planning of an enterprise; project identification, selection and formulation of project; project report preparation; personal management: manpower planning; labour turn over, wages/salaries; financial management /accounting: funds, fixed capital and working capital, costing and pricing; long term planning and short term planning; book keeping, journal, ledger, subsidiary books, annual financial statement; taxation; marketing management: market, types, marketing assistance, market strategies; crisis management; raw material; production; leadership; market; finance etc.

Practical

Visit to small scale industries; interaction with successful entrepreneurs; visit to financial institutions and support agencies; preparation of project proposal for funding by different agencies.

Suggested Readings:

1. Desai, V. (2011). Entrepreneurial Development Potential beyond Boundaries. Himalaya Publishing House, New Delhi.
2. Khanka S.S. (2007) Entrepreneurial Development. S. Chand & Company Ltd.
3. Neck, H. M., Neck, C. P. and Murray, E. L. (2016). Entrepreneurship: The Practice and Mindset. Sage Publishing.
4. Norman, M. S. (2016). Essentials of Entrepreneurship and Small Business Management. Pearson Education Limited.
5. Shills, M. B. (2007). Entrepreneurship and Small Business Management. Kitab Mahal Publication, Delhi.

MODULE II	SKILL DEVELOPMENT IN EVENT MANAGEMENT	20 (0+20)	SEM VII

Developing a Business Plan/ Project Proposal: Market survey of Event organizing companies; developing a business plan/ project proposal; identification of the events to be organized; targeted market and customer; innovativeness and creativity; preparation of the project proposal with supply chain of inputs, personnel, production, and finance plan.

Plan for the Event Management: Selection and purchase of material used for organizing various events (big and small); purchase of ingredients; planning and pre preparation of decorative articles to be used for venue decoration as per demand of consumers; organization of resources; organizing utility of resources; sequential grouping of activities/ time management.

Managing Events (academic, social and religious): Advertising/publicity as a stakeholder; managing events (academic, social and religious) – weddings, conferences and parties etc. at large and small scale; preparation of decorative articles to be used for venue decoration; event costing - physical inputs, man-hours, depreciation etc.; quality assessment; market strategy and assessment of event; profit generated etc.

Documentation and Report Presentation and Evaluation.

HUMAN DEVELOPMENT AND FAMILY STUDIES

Course No.	Course Title	Credits	Semester
Core Courses			
HDFS 101	Fundamentals of Human Development	2 (2+0)	I
HDFS 102	Life-Span Development –I	3 (2+1)	I
HDFS 103	Life-Span Development –II	2 (1+1)	II
HDFS 201/ HECM 201	Communication Skills and Personality Development **(**To be taught jointly by HDFS and EECM**)**	3 (2+1)	III
HDFS 202	Philosophy of Early Childhood Education	3 (3+0)	IV
HDFS 203	Educational Psychology and Early Childhood Education	3 (2+1)	IV
HDFS 301	Marriage and Family Dynamics	3 (2+1)	V
HDFS 302	Developmental Challenges in Children	3 (2+1)	V
HDFS 303	Family Counselling and Community Welfare	3 (2+1)	VI
	Total Credits	**25 (18+7)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
MODULE III	Skill Development in Early Childhood Education and Management	20 (0+20)	VII
	Grand Total	**45 (18+27)**	

HDFS 101	FUNDAMENTALS OF HUMAN DEVELOPMENT	2 (2+0)	SEM I

Theory

Human development as a field of study; scope and importance of study of human development from a life-span perspective; relationship of the discipline of human development with other disciplines of study; growth and development- definition of growth and development, difference between growth and development; heredity and environment as determinants of human growth and development; principles of human growth and development; genetic basis and concepts associated with human life; stages of human life span development and developmental tasks; domains of human development and its characteristics; definition of ethics and research- practical and ethical principles and concerns in research with human subjects, research designs and methods of data collection- their merits and demerits, variables, hypothesis and sampling.

Suggested Readings:

1. Berk, E.L. (2013). Exploring Life Span Development (3rd Ed.). McGraw Hill, New York.
2. David, M.T., Garavan, L. and Dooley, M. (2012). Fundamentals of Human Resource Development. SAGE Publications Ltd., New Delhi.
3. Harris, J.R. and Liebert, R.M. (1987). The Child. Prentice Hall, Inc., New Jersey.
4. Hurlock, E. B. (2001). Child Development. Tata McGraw-Hill Education, India.
5. Papalia, D.E. and Olds, S.W. (2008). Human Development (11th Ed.). McGraw Hill, New York.
6. Santrock, J. (2012). Life Span Development (14th Ed.). McGraw Hill, New York.

HDFS 102	LIFE-SPAN DEVELOPMENT-I	3 (2 + 1)	SEM I

Theory

Prenatal and postnatal stages- issues and scientific concepts associated with conception, pregnancy, prenatal development, labour/birth process; infancy- developmental tasks, physical, motor, social,

emotional, cognitive, language and moral development; early childhood- developmental tasks, physical, motor, social, emotional, cognitive, language and moral development; stimulating approaches for optimizing development; middle and late childhood- developmental tasks, physical, motor, social, emotional, cognitive, language and moral development; antecedent influences on growth and development during infancy and childhood.

Practical

Visits to neo-natal clinic to observe full-term and pre-term babies; observation of children to evaluate individual differences; assessment of development at various stages infancy, early and late childhood and writing reports; preparation of resource file.

Suggested Readings:

1. Berk, E.L. (2013). Exploring Life Span Development (3rd Ed.). McGraw Hill, New York.
2. Grinder, R.E. (1993). Adolescence. John Wiley and Sons, New York.
3. Hurlock, E. B. (2001). Child Development. Tata McGraw-Hill Education, India.
4. Papalia, D.E. and Olds, S.W. (2008). Human Development (11th Ed.). McGraw Hill, New York.
5. Santrock, J. (2012). Life Span Development (14th Ed.). McGraw Hill, New York.
6. Schaimberg, L.B. (1988). Child and Adolescent Development. McGraw Hill, New York.

HDFS 103	LIFE-SPAN DEVELOPMENT-II	2 (1 + 1)	SEM II

Theory

Adolescence-developmental tasks, physical, motor, social, emotional, cognitive, moral, personality and temperament characteristics, identity and gender issues; the influence of the family and peers on the adolescents; socio-emotional problems during adolescents; solution-focused approaches to overcome adolescent's crisis; adulthood- developmental tasks, physical, motor, social, emotional and cognitive changes; old age- developmental tasks, physical, motor, social, emotional and cognitive changes, stimulating approaches for optimizing development; recent issues in growth and development from adolescence to old age.

Practical

Case studies of adolescents, adults and elderly; critical analysis of case study reports; preparation of resource files; collection of literature depicting adolescents, adults and elderly in media.

Suggested Readings:

1. Berk, E.L. (2013). Exploring Life Span Development (3rd Ed.). McGraw Hill, New York.
2. Grinder, R.E. (1993). Adolescence. John Wiley and Sons, New York.
3. Hurlock, E. B. (2001). Child Development. Tata McGraw-Hill Education, India.
4. Papalia, D.E. and Olds, S.W. (2008). Human Development (11th Ed.). McGraw Hill, New York.
5. Santrock, J. (2012). Life Span Development (14th Ed.). McGraw Hill, New York.
6. Schaimberg, L.B. (1988). Child and Adolescent Development. McGraw Hill, New York.

HDFS 201/ HECM 201	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT (To be taught jointly by HDFS and EECM)	3 (2 + 1)	SEM III

Theory

Communication skills- speaking, listening, writing and reading skills; verbal and nonverbal communication, dressing for formal and informal occasions, role of ICT in communication; recent advances in communication- print and electronic, internet, e-mail, fax, mobile, interactive video and teleconferencing, computer and e-governance; personality- meaning, definition, concept and nature;

theoretical perspectives and approaches to personality; personality pattern- development, types and molding; persistence and changes in personality patterns; determinants of personality-biological, physical, intellectual, cultural, psychological, social, educational, family and situational; aspirations and achievements; personality adjustment and hazards in personality development.

Practical

Oral, written, listening and reading skills, group discussion, individual and group presentations; developing questionnaire to study impact of physique, educational institutions, aspirations on personality; developing questionnaire to study social perceptions, gender and family on personality, aspirations and achievements; collecting data through the questionnaires on small samples; report writing and presentation; case study of an individual suffering with personality disorders.

Suggested Readings:

1. Adair, J. (2003). Effective Communication. Pan Macmillan Ltd., London.
2. Ajmani, J. C. (2012). Good English: Getting it Right. Rupa Pubications, New Delhi.
3. Aurther. J. (2006). Personality Development. Lotus Press, London.
4. Bonet, D. (2004). The Business of Listening (3rd Ed.) Viva Books, New Delhi.
5. Collins, P. (2009). Speak with Power and Confidence. Sterling, New York.
6. Ewen, R. B. (2003). An Introduction to Theories of Personality (6th Ed.). Psychology Press, USA.
7. Hasson, G. (2012). Brilliant Communication Skills. Pearson Education, Great Britain.
8. Little, T.D and Mroczek, D.K. (Eds.). (2006). Handbook of Personality Development. Lawrence Erlbaum, USA.
9. Ryckman, R. (2007). Theories of Personality. Cengage Learning, USA.
10. Shaffer, D.R. (2008). Social and Personality Development (6th Ed.). Wadsworth Publishing Co Inc., USA.

HDFS 202	PHILOSOPHY OF EARLY CHILDHOOD EDUCATION	3 (3 + 0)	SEM IV

Theory

A global history of early childhood education; early childhood in ancient India- *Gurukuls, Muktabs, Madarsas*; progress of education during Muslim period; philosophy of Indian educators- M.K.Gandhi, R.N. Tagore, Zakir Hussain, Sri Aurobindo, Krishnamurthi, Tarabai Modak, Jawaharlal Nehru, Kothari Commission, Yashpal Committee Report; preschool programmes- balwadis, anganwadis, nursery schools, crèches, infant schools and child care centers; philosophy of Western educators- Martin Luther, John Ames Comenius, Johan Pestalozzi, Friedrich Froebel, John Dewey, Robert Owen, Maria Montessori and Jean Piaget; ECCE in successive Five Year Plans, recent trends in early childhood education; principles of curriculum planning and evaluation; essentials of functional curriculum; basics of pre and primary school curriculum.

Suggested Readings:

1. Hendrick, J. (1980). Total Learning for the Whole Child. The C V Mosby, St. Louis.
2. Kaul, V. (1991). Early Childhood Education Programme. NCERT, New Delhi.
3. Kaul, V. and Bhatnagar, R. (1992). Early Childhood Education: A Trainer's Handbook. NCERT, New Delhi.

4. Lacper, S., Witherspoon, R. and Day, B. (1984). Good Schools for Young Children. Mac Millan, New York.

5. Maxim, G. (1985). The Very Young. Wadsworth Publishing Company, Belmount, California.

6. Murlidharan, R. and Asthana, S. (1991). Stimulation Activities for Young Children. NCERT, New Delhi.

7. Swaminathan, M. (1984). Play Activities for Young Children. UNICEF, New Delhi.

HDFS 203	EDUCATIONAL PSYCHOLOGY AND EARLY CHILDHOOD EDUCATION	3 (2 + 1)	SEM IV

Theory

Educational psychology- meaning, nature, scope and importance of educational psychology; learning- definition, concept, essential features, types and principles, learning traits- sensation, perception, imagination, attention and memory, remembering and forgetting; intelligence- reasoning, thinking, temperament, problem solving, information processing and learning environment; reinforcement- definition, types, schedules and importance in learning; learning theories- Watson, Skinner, Thorndike and Pavlov; early childhood years- meaning, characteristics and significance; programme planning in ECE- steps and types; activities to promote all round development of preschool children- physical, motor, cognitive, language, and socio-emotional; early childhood personnel- role, qualities and responsibilities.

Practical

Assessment of class room learning, evaluating performance and interpretation using different methods; study the impact of reinforcement, motivation and discipline on learning; observation and recording of activities in ECE centre; developing and conducting activities to promote all round development- gross and fine motor, cognitive, language, socio-emotional skills and creativity; preparation of teaching learning material for preschool children.

Suggested Readings:

1. Klausmier, H.J. (1985). Educational Psychology. Harper and Row, New York.

2. Mazur, J.E. (1989). Learning and Behaviour. Prentice Hall, New Delhi.

3. Mertens, M.D. (2014). Research and Evaluation in Education and Psychology. Sage Publications, New Delhi.

4. Papalia, D.E. and Olds, S. W. (2008). Human Development (11th Ed.). McGraw Hill, New York.

HDFS 301	MARRIAGE AND FAMILY DYNAMICS	3 (2 + 1)	SEM V

Theory

Marriage- definition, goals, functions, types and forms of marriage in India; rituals and ceremonies of marriage in different religions of India; readiness for marriage– definition and importance; mate selection- ways and guidelines for mate selection in Indian culture; engagement and its importance; marital roles- definition and importance; marital adjustment-areas and factors influencing marital adjustment, types of marital relations and adjustments, marital adjustment techniques, techniques of resolving differences, marital success, criteria of marital success; marital dissolution- definition, types, causes for legal marital dissolution, divorce, separation; consequences of divorce on children and family; family- definition, functions, types and structure; family relationships in India- pattern of changes in family structure and relationships, familial and extra familial factors responsible for changes and consequences; family life cycle- definition, importance, stages and developmental tasks

of different stages of family life cycle; typical and atypical families- single parent, female headed, childless, adoptive and dual earner families; alternatives to marriage- types, causes, merits and demerits; laws and acts regarding marriage, adoption, divorce and inheritance in India; counseling- premarital, marital and family, objectives and importance.

Practical

Survey on motives of marriage, marriage bureau and family counselling center; comparative study on nuclear and joint families, marital roles and adjustments, interviewing families of different background for understanding changing functions of families; cultural diversification and marital traditions in India; talk on marriage and family laws; preparing a questionnaire and studying at least ten families at different stages- cross section of the family life cycle stages.

Suggested Readings:

1. Adams B.N. (1980). The Family: A Sociological Interpretation (3rd Ed.). Rand McNally College Publishing Company, Chicago.
2. Ahuja, R. (2005). Indian Social System. Rawat Publication, New Delhi.
3. Benokraitis, V.N. (2014). Marriage and Families (8th Ed.). Pearson Publications, USA.
4. Goode, W.J. (1989). The Family. Prentice Hall, New Delhi.
5. Gordon, M. (1972). The Nuclear Family in Crises: The Search for an Alternative. Harper and Row Publishers, New York.
6. Kumar, R. (2000). Violence against Women. Anmol Publications, New Delhi.

HDFS 302	DEVELOPMENTAL CHALLENGES IN CHILDREN	3 (2 + 1)	SEM V

Theory

Children with special needs- definition, terminologies, prevalence, needs and attitudes towards special children; mainstreaming- definition, problems in implementing and effects of mainstreaming on children with special needs; mental retardation (MR)- definition, classification, causes, identification, psychological and behavioural characteristics, and educational considerations; learning disabilities (LD)- definition, causes, identification, psychological and behavioural characteristics, and educational considerations; emotional disorders (ED)- definition, classification, causes, identification, psychological and behavioural characteristics, and educational considerations; communication disorders (CD)- definition, speech and language disorders, causes, identification, psychological and behavioural characteristics, and educational considerations; hearing impairment (HI)- definition, classification, causes, identification, psychological and behavioural characteristics, and educational considerations; visual impairment (VI)- definition, classification, causes, identification, psychological and behavioural characteristics, and educational considerations; physical impairment (PI)- definition, neurological impairments, musculoskeletal conditions, congenital malformations, accidents, diseases and other health impairment, psychological and behavioural characteristics, and educational considerations; multiple disorders- disorders associated with cerebral palsy, hearing impairment, cleft palate or cleft lip, MR, ED and LD; giftedness- definition, identification, psychological and behavioural characteristics, and educational considerations; rights and provisions for children with special needs in India.

Practical

Observational visits to institutes for children with special needs; identification of children with special needs in the local community; developing educational material for children with special needs; organising educational programmes for families of children with special needs, planning, recreational and vocational activities for children with special needs; presentation of case study reports.

Suggested Readings:

1. Hallahan, D.P. and Kauffman, J.M. (1991). Introduction to Exceptional Children (5th Ed.). Allyn and Bacon, Boston.
2. Hegarty, S. (2002). Education and Children with Special Need. Sage Publication, New Delhi.
3. Philip, M. and Duckworth, D. (1985). Children with Disabilities and their Families: A Review of Research. National Foundation for Educational Research, Windsor.
4. Prasad, J. and Prakash, R. (1996). Education of Handicapped Children, Problems and Solution. Kanishka Publication, New Delhi.
5. Rozario, J. and Karanth, P. (2003). Learning Disability in India. Sage publication, New Delhi.
6. Werner, D. (1994). Disabled Village Children (Indian Edition). Voluntary Health Association of India, New Delhi.

HDFS 303	FAMILY COUNSELLING AND COMMUNITY WELFARE	3 (2 + 1)	SEM VI

Theory

Counselling- concept, nature, need, scope and principles; thrust areas and types of family counselling- educational, vocational, social, personal, premarital and marital; approaches to family counselling; methods of handling family problems; situational analysis of child, women, youth, elderly, disabled and reserved category in India- census, issues and challenges, determining factors for the present status; child welfare- definition, need, constitutional and legislative provisions, schemes/projects and policies; women welfare- definition, need, constitutional and legislative provisions, schemes/projects and policies; youth welfare- definition, need, schemes/projects and policies; elderly welfare- definition, need, constitutional and legislative provisions, schemes/projects and policies; disabled population welfare- definition, need, constitutional and legislative provisions, schemes/projects and policies; reserved category welfare- definition, need, constitutional and legislative provisions, schemes/projects and policies; national and international organizations and agencies working for child, women, youth, elderly and disabled- UNICEF, WHO, CARE, DWACRA, NIPCCD, CIF etc.

Practical

Visits to family counseling centre; identifying the families in need of counseling; case studies and conducting counseling sessions; visits to various government and non government organizations working for the welfare of the children, family and community; report writing and presentation.

Suggested Readings:

1. Boraian, P.M. (2008). Employment of Rural Women. Concept Publishing Company, New Delhi.
2. Devi, L. (1998). Child and Family Welfare. Anmol Publication, New Delhi.
3. Down, W.S. (2006). Child Welfare and Family Services (8th Ed.). Pearson Education Publishers.
4. Marasimhan, S. (2001). Employment of Women. Sage Publication, New Delhi.
5. Mehta, L.P and Jaiswal, S.S. (2001). Child Labour and the Laws. Deep and Deep publication, New Delhi.
6. Government of India (2012). Children in India: A Statistical Appraisal. Central Statistics Office, Ministry of Statistics and Programme Implementation, New Delhi
7. NIPCCD. (1994). Child in India: A Statistical Profile. NIPCCD: New Delhi.
8. Pecora, J.P. (2009). The Child Welfare Challenge: Policy, Practice and Research. Aldine Transaction Publisher.
9. Randhawa, M.S. (1991). The Rural and Urban Aged. National Book Organization: New Delhi.
10. UNICEF. (2011). The Situation of Children in India: A Profile.

MODULE III	SKILL DEVELOPMENT IN EARLY CHILDHOOD EDUCATION AND MANAGEMENT	20 (0+20)	SEM VII

Orientation to Methods and Materials for Teaching Young Children: Orientation on different methods and materials used for teaching young children; survey of different kinds of literature appropriate for preschoolers, visit to children's libraries; developing stories appropriate for infancy and early childhood; preparation of creativity file; creating rhymes and songs with music and rhythm movements, making simple musical instruments with indigenous material; scripting for short puppet show.

Review and Analysis of Early Childhood Education: Visits to nursery schools/ECCE centers for observation of material, space, personnel, finance, documentation; orientation on management of ECCE programmes- planning, organizing, staffing, leading, monitoring and controlling for quality; designing the activity corners in ECE center- block center, language and art center, creative art and construction center, science and collection center, math and manipulative material center, pretend play center, sand and water center, outdoor nature center; preparing ECCE project proposal- preparation of budget, brochures, leaflets, communication documents for parents and public; evaluation of daily, weekly and monthly schedule of activities; reporting on monitoring and evaluation of classroom arrangements, cleanliness, record keeping etc; planning and organizing field trips.

Developmental Assessment of Young Children: Screening and developmental assessment of young children for various developmental domains with different tools and techniques; writing case studies; assessment of readiness skills of preschool children; identifying the intervention needs of developmentally delayed children.

Planning and Implementation of Early Childhood Curriculum: Planning and implementing activities for physical, motor, language, cognitive, socio-emotional development and creativity; planning theme based developmentally appropriate programmes for crèche, Nursery, LKG and UKG children; preparing ECE plans- yearly, monthly, weekly and daily; management of ECCE programmes - planning, organizing, staffing, leading, monitoring and controlling for quality; designing the activity corners in ECE; implementation of prepared plans; organizing parent teacher conferences/meetings; planning parental participation in ECE programme- celebration of days and festivals; planning and implementation of intervention programmes and preparation of material; evaluation of effectiveness of intervention program.

Education and Counseling of Parents and Community: Orientation on need and importance of parent and community education; visit of local community to identify parents in need of counselling; rapport building, identifying families with problems and conducting case studies; identification of areas and issues for parent education; developing and implementing parent education programmes; organising counseling sessions for individuals, couples, parents and families.

Documentation, Report Presentation and Evaluation.

EXTENSION EDUCATION AND COMMUNICATION MANAGEMENT

Course No.	Course Title	Credits	Semester
Core Courses			
HECM 101	Extension and Rural Development	2 (2+0)	I
HECM 102	Women in Agriculture	2 (2+0)	II
HECM 103	Diffusion and Adoption of Homestead Technologies	3 (2+1)	II
HECM 201/ HDFS 201	Communication Skills and Personality Development (To be taught jointly by HDFS and EECM)	3 (2+1)	III
HECM 202	Extension Training Management	3 (2+1)	III
HECM 203	Communication and Instructional Technology	4 (2+2)	IV
HECM 301	Programme Development for Rural Families	3 (1+2)	V
HECM 302	Introduction to Mass Communication and Journalism	3 (2+1)	VI
	Total Credits	**23 (15+8)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
MODULE IV	Experiential Learning in Print and Electronic Media Production	20 (0+20)	VII
	Grand Total	**43 (15+28)**	

HECM 101	EXTENSION AND RURAL DEVELOPMENT	2 (2 + 0)	SEM I

Theory

Extension Education: concept, importance, philosophy, principles and objectives; evolution of extension education: glimpses of pre- and post-independence era; community: meaning and definition, types of communities, community and science; community mobilization: leadership, participation-PRA; Community Development Programme: concept, objectives, organization, activities, achievement and failures; rural development: concept, need, meaning, aim and functions; role of extension education in rural development; Panchayati Raj Institutions- concept, structure and function; five year plans; current rural development programmes and organizations: ICDS, MNREGA, Total Sanitation Scheme, *Beti Bachao, Beti Padhao*, DRDA etc.; role of Indian Council of Agricultural Research, State Agricultural Universities and Non Government Organizations in rural development.

Suggested Readings:

1. Chitambar, J.B. (2008). Introductory Rural Sociology. New Age International (P) Limited.
2. Sachdeva, D. R. and Bhushan, V. (2007). An Introduction to Sociology. Kitab Mahal Agency, Delhi.
3. Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Ray, G.L. (2003), Extension Communication and Management. Kalyani Publishers. Fifth Revised and Enlarged Edition, New Delhi.
5. Sandhu, A.S. (1993). Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

HECM 102	WOMEN IN AGRICULTURE	2 (2 + 0)	SEM II

Theory

Evolution of status of agriculture in India; general agricultural production activities; agricultural and allied sectors in rural India; role of women in agricultural and allied sectors; status of farm women; social, economic and health status of women in agriculture; women friendly tools and implements; gender issues; women in agriculture policy; programmes (government and non-government) and institutions for women in agriculture; women empowerment in agriculture; agripreneurship and training to farm women.

Suggested Readings:

1. Kumar, R. (1995) Women in Agriculture: Perspective, Issues and Experiences. M.D. Publications Pvt. Ltd.
2. Sandhu, A.S. (1993) Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Sethi, Raj Mohini (1991). Women in Agriculture. Rawat Publications, Jaipur.
4. Sridhara, S. (2009) Women in Agriculture and Rural Development. New India Publishing Agency.
5. Unni, Jeemol (1992). Women's Participation in Indian Agriculture. Oxford & IBH Pub. Co., New Delhi.

HECM 103	DIFFUSION AND ADOPTION OF HOMESTEAD TECHNOLOGIES	3 (2 + 1)	SEM II

Theory

Concept and elements of diffusion process; different terms used in diffusion of innovation and adoption process: adoption: meaning, definition and models; innovation: concept and characteristics; Innovation Decision Process model; innovativeness and adopter categories; rate of adoption and factors affecting adoption; types of innovation decision; consequences of innovations; homestead technology: concept and its relevance to innovation decision process; communication channels and their characteristics; social change: concept, theories, dimensions and factors; change agents and opinion leader; change proneness: acceptance and resistance to social change;

Practical

Survey on identification and use of appropriate homestead technologies by rural and urban families; calculation of adoption index of selected technologies; practice in demonstration of improved technologies supplemented with communication media for teaching rural women/ girls; visit to different successful SHGs; categories of adopters among SHG members; analysis and presentation of report; identification of change agents in a locality; presentation of report.

Suggested Readings:

1. Chitambar, J.B. (2008) Introductory Rural Sociology. New Age International (P) Ltd.
2. Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Ray, G.L. (2003) Extension Communication and Management. Kalyani Publishers. Fifth Revised and Enlarged Edition, New Delhi.
4. Sachdeva, D. R. and Bhushan, V. (2007). An Introduction to Sociology. Kitab Mahal Agency, Delhi.
5. Sandhu, A.S. (1993) Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

HECM 201/ HDFS 201	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT (To be taught jointly by HDFS and EECM)	3 (2 + 1)	SEM III

Theory

Communication skills-speaking, listening, writing and reading skills; verbal and nonverbal communication; role of ICT in communication; recent advances in communication- print and electronic, internet, e-mail, fax, mobile, interactive video and teleconferencing, computer, e-governance.

Meaning and definition of personality; theoretical perspectives on personality- behavioural trait and humanistic personality pattern; moulding the personality patterns; personality development- self perception, self concept, self esteem and gender stereotyping; persistence and changes; personality determinants (physical, intellectual, emotional, social, educational and family); aspirations, achievements and fulfillment; dressing for formal and informal occasions.

Practical

Oral, written, listening and reading skills, group discussion, individual and group presentations; developing questionnaire to study impact of physique, educational institutions, aspirations on personality; developing questionnaire to study social perceptions, gender and family on personality, aspirations and achievements; collecting data through the questionnaires on small samples; report writing and presentation; case study of an individual suffering with personality disorders.

Suggested Readings:

1. Adair, J. (2003). Effective Communication. Pan Macmillan Ltd., London.
2. Ajmani, J. C. (2012). Good English: Getting it Right. Rupa Pubications, New Delhi.
3. Aurther. J. (2006). Personality Development. Lotus Press, London.
4. Bonet, D. (2004). The Business of Listening (3rd Ed.) Viva Books, New Delhi.
5. Collins, P. (2009). Speak with Power and Confidence. Sterling, New York.
6. Ewen, R.B. (2003). An Introduction to Theories of Personality (6th Ed.). Psychology Press, USA.
7. Hasson, G. (2012). Brilliant Communication Skills. Pearson Education, Great Britain.
8. Little, T.D and Mroczek, D.K. (Eds.). (2006). Handbook of Personality Development. Lawrence Erlbaum, USA.
9. Ryckman, R. (2007). Theories of Personality. Cengage Learning, USA.
10. Shaffer, D.R. (2008). Social and Personality Development (6th Ed.). Wadsworth Publishing Co Inc., USA.

HECM 202	EXTENSION TRAINING MANAGEMENT	3 (2 + 1)	SEM III

Theory

Training: concept, need, definition, importance; types of training; training need: meaning, importance, type and techniques of need assessment; training process, different phases of training and its management; qualities of a good trainer: communication skills, training skills, motivational skills and handling difficult situations; different methods for training rural women and field functionaries; adult learning; characteristics of adult learner; facilitation skills in training; designing

training module: basic guidelines, steps in module designing; training methods; monitoring and evaluation of training programme: objectives, principle, steps and indicators of training evaluation. important training institutions in India

Practical

Visit to different types of training institutions to observe ongoing trainings; report writing and presentation; hands-on-experience with training need analysis; writing training objectives; development of training module based on needs in any area of home science; Experience in delivering the training package through various methods and techniques of training; evaluating the impact of instructional delivery/teaching with developed training package.

Suggested Readings:

1. Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Gupta, C.B. (2001). Human Resource Management. Sultan Chand and Sons.
3. Lynton, R.P. and Pareek, V. (2008). Training for Development. Vistaar Publications.
4. Narwani, G.S. (2002). Training for Rural Development. Rawat Publication, Jaipur.
5. Saxena, J.P. and Kakkar, A.T. (2000). Training and Development. NICE Printing Press.

HECM 203	COMMUNICATION AND INSTRUCTIONAL TECHNOLOGY	4 (2 + 2)	SEM IV

Theory

Communication: concept, importance, functions, models, elements and barriers; uses, importance and limitations of communication methods: lecture, demonstration discussion, meeting, field trip, camp/campaign, exhibition and printed material; audio visual aids: meaning, classification and functions; selection, use, advantages and limitations of graphic communication aids : charts, posters, leaflet, booklet, projected media OHP, public address system, LCD, video conferencing, electronic media:radio; TV and video, three dimensional aids: specimens, objects, models; psychological concepts in teaching and learning; evaluation of teaching and learning; concept and need of communication management.

Practical

Orientation to Microsoft Office-MS Word, MS Power Point, MS Excel; internet applications-web browsing, creating e-mail; orientation to basic graphic designing soft ware's- Corel draw and Photo shop; planning, preparation, presentation of posters, charts, pamphlet, greeting cards, PPT by using computers. handling of audio-visual equipments.

Suggested Readings:

1. Bhalla, C L (2009). Audio Visual Aids in Education. Cornell University.
2. Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Grover, I. 2002 (ed). Communicationand Instructional Technology. Agrotech Publishing Academy, Udaipur.
4. Ray, G.L. (2004). Extension Communication and Management. Kalyani Publishers, New Delhi.
5. Sandhu, A.S. (1993). Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

HECM 301	PROGRAMME DEVELOPMENT FOR RURAL FAMILIES	3 (1 + 2)	SEM V

Theory

Programme planning: concept, definition, objectives, principles; relevant terms used in programme planning : situation, aims, objectives, problem, solution, project, plan, plan of work, calendar of work etc; steps in extension programme planning; critical analysis of few major development programmes under five-year plans; leader and leadership: meaning, definition, identification of leader; monitoring and evaluation of extension programme: concept, importance, types and techniques; Five Year Plans and rural development; Concept and techniques of participatory rural appraisal; rural development programmes with special reference to women and children

Practical

Establishing rapport with rural families and identification of leaders, conducting baseline survey of village and household and analysis of information; different PRA tools; its applications in programme development and exercises; triangulation of information from conventional and PRA method; preparation of detailed plan of work for small need based programme; implementation of programme; evaluation of programme; documentation presentation of findings of programme.

Suggested Readings:

1. Dahama, O.P and Bhatnagar, O.P (2003). Education and Communication for Development. Oxfords IBH, New Delhi.
2. Ray, G.L. (2004). Extension Communication and Management. Kalyani Publishers, New Delhi.
3. Reddy, A.A (2001). Extension Education. Baptala: Sri Lakshmi Press.
4. Sandhu, A.S (2003), Extension Programme Planning. Oxford IBH, New Delhi.
5. Sehgal, S. and Raghuvanshi, R.S. (2007). Text Book of Community Nutrition. ICAR, New Delhi.

HECM 302	INTRODUCTION TO MASS COMMUNICATION AND JOURNALISM	3 (2 + 1)	SEM VI

Theory

Meaning, nature, importance and characteristics of mass communication; mass media laws and ethics; important media organizations in India; journalism: meaning and definition; qualities of journalists; concept, classification, history, careers and role of print and electronic media – newspaper, radio, television, video. new media ; orientation to photography and photographic equipments; different types of camera: parts, uses and care; familiarization with instructional video; stages in video production.

Practical

Handling and operation of different types of cameras: still, digital, video; writing of photo feature and captions; exercises on writing and recording; scripts for radio and TV programmes, orientation to news papers and other print publications.

Suggested Readings:

1. Bhatnagar, R. (2001). Print Media and Broadcast Journalism. Indian Publisher Distributors, Delhi.
2. Bhatt, S.C. (1993) Broadcast Journalism. Basic Principles Har Anand Publications, Delhi.

3. Millerson, G. and Owens, J. (2008) A Hand book of Video Production. Butterworth-Heinemann, Oxford.
4. Millerson, G. and Owens, J. (2009). Television Production. Focal Press, London.
5. Vasuki, B. (2013). Video Production. 2nd edition. Oxford University Press.
6. Zettle, H. (2005). Television Production Handbook. Thomson Learning, USA.
7. Zettle, H. (2010). Video Basics. Wadsworth Publishing, Belmont, California.

MODULE IV	EXPERIENTIAL LEARNING IN PRINT AND ELECTRONIC MEDIA PRODUCTION	20 (0 + 20)	SEM VII

Developing a Business Plan/ Project Proposal: Identification of the print and electronic media products to be manufactured; market survey; analysis of the existing status of the identified products and targeted market and customer; innovativeness and creativity; preparation of the project proposal with supply chain of inputs, personnel plan, production plan, finance plan etc. and its preparation.

Plan for the Production: Selection of material used in print and electronic media production; purchase of material; costing and standardization of new products as per demand of consumers; plan for the production; organization of resources; organizing utility of resources; sequential grouping of activities/ time management.

Production and Sale: Preparation of items viz. posters, charts, pamphlets, photo collage, other display material, colored and B&W printing, audio and video recording, editing etc. product pricing-physical inputs, man-hours, depreciation etc.; quality assessment; market strategy and assessment of sales performance; profit generated including cost benefit ratio, payback period etc.

Documentation, Report Presentation and Evaluation.

TEXTILE AND APPAREL DESIGNING

Course No.	Course Title	Credits	Semester
Core Courses			
TAD 101	Fundamentals of Clothing Construction	3 (1+2)	I
TAD 102	Fundamentals of Fabric Construction	3 (2+1)	II
TAD 201	Textile Science and Fabric Care	3 (2+1)	III
TAD 202	Textile Finishes	2 (1+1)	IV
TAD 301	Principles of Dyeing and Printing	3 (2+1)	V
TAD 302	Computer Aided Textile and Apparel Designing	3 (1+2)	V
TAD 303	Apparel and Accessory Designing	3 (1+2)	VI
TAD 304	Traditional Textiles of India	3 (2+1)	VI
	Total Credits	**23 (12+11)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
MODULE V	Experiential Learning in Product Design: Digital Embroidered Home Furnishings	20 (0+20)	VII
	Grand Total	**43 (12+31)**	

TAD 101	FUNDAMENTALS OF CLOTHING CONSTRUCTION	3 (1+2)	SEM I

Theory

Terminology related to clothing construction; sewing tools and equipments for measuring, drafting, cutting and stitching; selection and preparation of fabric for garment construction; importance and functions of clothes; socio- economic and psychological factors affecting clothing choices; clothing requirements for infants, toddlers, pre-schoolers and elementary school children.

Practical

Demonstration on sewing equipments and tools; sewing machine and its care; preparation of samples of hand stitches: basting, slip-stitching, hemming, smocking, over casting, attaching fasteners, button holing, mending and patching; machine stitches: seam and seam finishes, pleats, gathers, tucks, stay stitch, under stitching and placket opening; demonstration on taking body measurements; preparation of fabric for cutting; layout of paper pattern on different fabric patterns including plain, print, lines, plaid and check; drafting, cutting and stitching of baby frock, T-shirt and bloomer.

Suggested Readings:

1. Doongaji, S. and Deshpande, R. (1957). Basic Processes and Clothing Construction (3rd Ed.). Raj Prakashan, New Delhi.
2. Mansfield, E.A. and Lucas, E.L. (1974). Clothing Construction. (2nd Ed.) Houghton Mifflin Company, London.
3. Mazumdar, L. and Vatsala, R. (2004). Text Book of Fundamentals of Clothing Construction. ICAR, New Delhi.
4. Sannapapamma, K.J. and Jahan, S. TXAD111-Fundamentals of Clothing Construction. ecourse.iasri.res.in.
5. Vatsala, R. (2003). Textbook of Textiles and Clothing. ICAR, New Delhi.

TAD 102	FUNDAMENTALS OF FABRIC CONSTRUCTION	3 (2+1)	SEM II

Theory

Fabric construction techniques: terminology, weaving, knitting, non-woven, lace making, knotting, braiding and felting; weaving: origin, utility, technical terminology; handloom: kinds, principal parts, functions; important motions of the handloom; shed and its utility; weaving accessories; preparation of yarn for weaving; basic processes of weaving; basic weaves: plain, twill, satin - their variations and uses; knitting: terminology, principles and classification; knitting needles; stitches used in knitting; knitting machines: nomenclature and uses; types of knits: warp and weft knits, characteristics and uses.

Practical

Observation of fabric structures under magnifying glass; graphical representation of woven designs; handloom and its parts; yarn preparation for plain weave; setting of loom and weaving of plain weave fabric; knitting machine and its parts; hand knitting: plain, rib, purl; sample preparation of different fabric construction techniques.

Suggested Readings:

1. Hess, K. P. (1959). Textile Fibres and their Uses. (8th Ed.) Oxford and IBH Publishing Co., New Delhi.
2. Potter, M.D. and Corbman, B.P. (1967). Textiles: Fibre to Fabric. Macmillan Hill Co., New York.
3. Spencer, J. D. (1983).Knitting Technology. Pergamon Press.
4. Stout, E.E. (1970). Introduction to Textiles. (3rd Ed.) John Wiley and Sons Inc., New York.
5. Vatsala, R. (2003). Textbook of Textiles and Clothing. ICAR, New Delhi.
6. Wynne, A. (1997). Textiles. Macmillan Education Ltd., London.

TAD 201	TEXTILE SCIENCE AND FABRIC CARE	3 (2+1)	SEM III

Theory

Textile: terminology used in textiles; classification of textile fibres; properties of textile fibres: primary and secondary properties; molecular structure of textile fibres: monomers, polymers and their types, polymerization and its types, degree of polymerization and orientation; natural fibers: production, fibre morphology, physical, chemical and biological properties and end-uses of cotton, bast fibres (flax, jute, hemp and ramie), wool and silk; mechanical spinning: ring spinning; chemical spinning: wet, melt and dry spinning; man-made fibres: fibre manufacturing, microscopic structure, physical, chemical and biological properties and end-uses of regenerated cellulosic fibers (viscose, cupramonium and high wet modulus rayons); modified cellulosic fibres (diacetate and triacetate) and synthetic fibres (nylon, polyester and acrylic); agrotextiles: basic concepts; classification of yarn on the basis of structure: simple and novelty yarns, twist direction, twist amount, fibre length and end-uses; stain removal: classification of stains and methods of removing different stains; laundry: definition, principles, equipments used, laundry methods and dry cleaning; laundry agents: water, soap, laundry auxiliaries, stiffening agents, bleaches and blues; care of textiles: labelling and labelling Act, labels and tags used in textiles; storage of clothes.

Practical

Identification of textile fibres: visual, microscopic, burning and chemical test; study of yarns: type

and size; study of fabric: weight, thickness, count, bow and skewness; study of common fabrics available in the market; removal of common stains from different fabrics; demonstration of laundry equipments; washing, care and storage of textile articles: cotton, silk, wool, synthetics and other special articles – zari, embroidered and laced fabrics; visit to textile industry.

Suggested Readings:

1. Dantyagi, S. (1959). Fundamentals of Textiles and their Care. Orient Longman Limited, New Delhi.
2. Deulkar, D. and Tarabai.(1967). Household Textiles and Laundry Work. (3rd Ed). Atma Ram and Sons Ltd., Delhi.
3. Hall, A.J. (1969). A Students Textbook of Textile Science. Allman and Son Ltd., London.
4. Joseph, M. L. (1986). Introductory Textile Science. (5th Ed.) CBS College Publishing, New York.
5. Sekhri, S. (2011). Text Book of Fabric Science: Fundamentals to Finishing. PHI Learning Pvt. Ltd, New Delhi.
6. Vatsala, R. (2003). Textbook of Textiles and Clothing. ICAR, New Delhi.
7. Vilensky, L. D. and Gohl, E. P.G. Textile Science. CBS Publishers and Distributors, Delhi.
8. Wingate, I. B. (1970). Textile Fabrics and Their Selection. (6th Ed.) Prentice Hall Inc., New Jersey.

TAD 202	TEXTILE FINISHES	2 (1+1)	SEM IV

Theory

Textile finishing: definition and its importance; classification of textile finishes: chemical, mechanical, temporary, permanent, durable, renewable, semi permanent, reactive and additive finishes; processes of removing impurities from fabrics: scouring, desizing, degumming, carbonizing; basic finishes that alter hand or texture: fulling/milling, felting, singeing, stiffening, decatizing; surface finishes: bleaching, delustering, calendaring, beetling, napping, flocking, burnt out design, acid design, plisse design, tentering, shearing and brushing; functional finishes: water proof, water repellent, shrinkage control, wrinkle resistance, anti-static, anti-microbial, durable press and flame retardant finish.

Practical

Desizing and scouring of yarn and fabric; bleaching and mercerization of cotton fabric; study of labels pertaining to finishes; identification of finishes.

Suggested Readings:

1. Joseph, M. L. (1986). Introductory Textile Science. (5th Ed.). CBS College Publishing, New York.
2. Needles, H.L. (2001). Textile Fibres, Dyes, Finishes and Processes. Standard Publishers and Distributors, Delhi.
3. Stout, E.E. (1970). Introduction to Textiles. (3rd Ed.). John Wiley and Sons Inc., New York.
4. Tortora, P.G. (1978). Understanding Textiles. Macmillan Publishing Company, New York.
5. Wingate, I. B. (1970). Textile Fabrics and Their Selection. (6th Ed.) Prentice Hall Inc., New Jersey.
6. Wynne, A. (1997). Textiles. Macmillan Education Ltd., London.

TAD 301	PRINCIPLES OF DYEING AND PRINTING	3 (2+1)	SEM V

Theory

Dyeing and printing: concept and terminology; classification of dyes: indigenous and synthetic; synthetic dyes: application and properties - direct, acid, basic, vat, azoic, reactive, sulpher, disperse and pigments; selection of suitable dyes; dyeing methods: solution, fibre, yarn and fabric; printing styles: direct, mordant, resist and discharge; printing methods: hand block, stencil, screen, roller, transfer, flock, duplex and resist dyeing – tie and dye and batik; common dyeing and printing defects, causes and preventive measures.

Practical

Design development for apparel and utility articles with suitability to different printing techniques; preparation of yarn and fabric for dyeing; dyeing cotton with different classes of dyes; preparation of samples: block, screen and stencil printing, tie and dye and batik.

Suggested Readings:

1. Gopalkrishnan, D. and Karthik, T. (2016). Basics of Textile Chemical Processing. Daya Publishing House, Astral International Pvt. Ltd., New Delhi.
2. Koushik, C.V. and Josico, A.I. (2003). Chemical Processing of Textiles: Preparatory Processes and Dyeing. NCUTE, New Delhi.
3. Sekhri, S. (2011). Text Book of Fabric Science: Fundamentals to Finishing. PHI Learning Pvt. Ltd, New Delhi.
4. Shenai, V.A. (2000). Chemistry of Dyes and Principles of Dyeing. Sevak Publications, Mumbai.
5. Shehnai V.A. (1991). Introduction to the Chemistry of Dye Stuffs. Sevak Publications, Mumbai.
6. Sheikh, I.A., (2006). Dyeing, Printing and Finishing Expert. Edited and Published by Textile Info Society, Lahore, Pakistan.
7. Vatsala, R. (2003). Textbook of Textiles and Clothing. Indian Council of Agricultural Research, New Delhi.

TAD 302	COMPUTER AIDED TEXTILE AND APPAREL DESIGNING	3 (1+2)	SEM V

Theory

Importance of CAD in apparel and textile industry; selection of hardware and software for computer aided designing; basics of various textile and apparel designing softwares; uses and applications of CAD technology in textile and apparel industry.

Practical

Introduction to fundamental designing softwares; detailed use of designing, drawing and editing tools; sources of inspiration for basic designing; use of ethnic and traditional motifs for creating designs; creating geometrical, natural, stylized and abstract motifs and design development for various end-uses; developing colour ways; application and modification of scanned images using softwares to create new designs for specific end-uses; developing design catalogues of dresses for casual, party, night, sports, office and formal wears and different home textile articles; portfolio preparation of developed designs.

Suggested Readings:

1. Luther, C. (2008). Career in Textile and Fashion Designing. Abhishek Publications, Chandigarh.

2. Srivastva, M. and Deepthi, S.S. Computer Aided Designing – e-manual(TXAD). ecourse.iasri.res.in.
3. Vastrad, J., Sakshi and Deepthi, S.S. Computer Aided Designing – Textile Designing – e-manual (TXAD). ecourse.iasri.res.in.

TAD 303	APPAREL AND ACCESSORY DESIGNING	3 (1+2)	SEM VI

Theory

Apparel designing: importance, elements and principles of design applied to clothing; factors affecting clothing requirements; clothing requirements of adolescents, adults and senior citizens; clothing requirements of special groups: expectant and lactating mothers; role of apparel in personality development; clothing budget; wardrobe planning; accessories: introduction and classification; accessory types: footwear, handbags, belts, jewellery, gloves and head gears.

Practical

Preparation of samples of collars, sleeves and yokes; drafting and construction of blouse, *kameez, salwar*, *pyjami, kurta*, *pyjama* and night dress/gown; designing of accessories for women, men and children; selection of designs for construction of accessories; construction of one accessory for women/men/ children.

Suggested Readings:

1. Erwin, M. D. (1979). Clothing for Moderns. Macmillan Publishing Co. Inc., New York.
2. Gawne E. J.(1975). Dress: The Clothing Text Book. C.A. Bennett Co., New York.
3. Meadows, C. S. (2003). Know Your Fashion Accessories. Fairchild Books, New York.
4. Pankowski, E. (1972). Art Principles in Clothing. Macmillan Publishing Co., New York.
5. Peacock, J. (2000). Fashion Accessories- The Complete 20th Century Source Book. Thames and Hudson, London.

TAD 304	TRADITIONAL TEXTILES OF INDIA	3 (2+1)	SEM VI

Theory

Study of traditional woven textiles of India: Dacca muslin, brocades, sarees - Jamdani, Baluchari, Pochampalli, Patola, Ikat, Kanchipuram, Chanderi and Maheshwari; woven shawls of Kashmir, Himachal Pradesh, Sikkim and Manipur; carpets of India: Kashmir and Uttar Pradesh; traditional embroideries of India: Kashida of Kashmir, Chamba rumal of Himachal Pradesh, Phulkari and chope of Punjab, Kasuti of Karnataka, Chikankari and zari work of Uttar Pradesh, Kantha of Bengal, Manipuri embroidery, appliqué and patch work of Bihar, Kutch and Kathiawar embroideries of Gujarat.

Practical

Documentation of motifs of traditional Indian embroideries; sample preparation of traditional Indian embroideries; documentation of woven textiles of India; creative projects in the adaptation of traditional motifs and designs in contemporary textiles through collection of samples, sketches and development of scrap book.

Suggested Readings:

1. Bhatnagar, P. (2005). Decorative Design History in Indian Textiles and Costumes. Abhishek Publication, Chandigarh.
2. Chattopadhyay, K. (1977). Indian Embroidery. Wiley Eastern Limited, New Delhi.

3. Chattopadhaya, K. (1974). Carpet and Floor Covering of india. Vikas Publishing House Pvt. Ltd. Baroda, Gujarat.
4. Gillow, J. and Barnard, M. (1991).Traditional Indian Textiles. Thames and Hudson Ltd., London.
5. Naik, S. D. (1996). Traditional Embroideries of India. APH Publishing Co. New Delhi.
6. Pandit, S. (1979). Indian Embroideries and its Variegated Charms. Vikas Publishing House Pvt. Ltd.,Baroda, Gujrat.

MODULE V	EXPERIENTIAL LEARNING IN PRODUCT DESIGN: DIGITAL EMBROIDERED HOME FURNISHINGS	20 (0+20)	SEM VII

Developing a Business Plan: Market survey to study the prevailing trends in home furnishings; visit to local units of home textiles and accessories production; product selection as per demand analysis and market potential; preparation of the project proposal with supply chain of inputs, personnel, production and finance plan.

Plan for the Production: Sequential grouping of activities/ time management; designing product line for commercialization; theme based designing: selection of theme, conceptualization and mood board**;** creation of digital embroidery designs for selected home furnishing products; development of collection; preparation of spec sheets, work sheets and designer's costing sheets; selection and purchase of material used in preparation of home textiles and accessories.

Production and Sale : Development of selected product line of home furnishings; finishing and packaging; marketing of products: promotion, sale and distribution; maintaining stock-sales records; projection of work.

Documentation of Developed Products, Preparation of Reports and Evaluation.

Student READY (Rural Entrepreneurship Awareness Development Yojana)

FN 491/ FRM 491/ HDFS 491/ HECM 491/ TAD 491	**RURAL AGRICULTURAL WORK EXPERIENCE AND INDUSTRIAL ATTACHMENT IN COMMUNITY SCIENCE** (To be conducted jointly by EECM, FN, FRM, HDFS and TAD)	**20 (0+20)**	**SEM VIII**

Orientation and basic training (1week): introduction, objectives and modus operandi of Rural Agricultural Work Experience (RAWE); briefing about general Community Science messages and developing questionnaire for need assessment and evaluation of RAWE program; RAWE through placement with families (4 weeks): rapport building among farm women and interns, conducting survey of village, family and personal profile, need assessment, organizing skill trainings and demonstrations on income generating activities/ appropriate technology related to Extension Education and Communication Management, Foods and Nutrition, Family Resource Management, Human Development and Family Studies and Textile and Apparel Designing and its implication at mass level; organizing village fair, exhibition and competitions; preparation and presentation of report on RAWE; Inplant/ Industrial Attachment (3 months): placement of interns with industry, study of structure, functioning, objective, ethics and mandates of the industry; understand various materials, machines, processes, products and their applications; selecting department/area of work according to one's interest and capabilities; getting training and expertise on the selected area; understand the scope, functions and job responsibilities in various departments of an organization; presentation and evaluation of report on the basis of punctuality, enthusiasm, conduct, leadership qualities, sincerity and devotion displayed by the interns; report preparation and presentation (one week).



College of Basic Sciences and Humanities

















COLLEGE OF BASIC SCIENCES AND HUMANITIES

College of Basic Sciences and Humanities does not have its own graduation programme but this college has important contribution for teaching of B. Sc. (Hons.) Agriculture, B.Tech. (Agricultural Engineering) and B. Sc. (Hons.) Community Science.

Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme

Department-wise

Course No.	Course Title	Credits	Semester
	Botany and Plant Physiology		
BIO 1	Biology-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	I
BIO 2	Biology-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	II
BIO 21	Biology-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5(4+1)	III
BIO 22	Biology-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
	Chemistry and Biochemistry		
CHEM 1	Principles of Chemistry–I	5 (4+1)	I
CHEM 2	Principles of Chemistry–II	5 (4+1)	II
CHEM 21	Principles of Chemistry–III	5 (4+1)	III
CHEM 22	Principles of Chemistry–IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
	Computer Section		
COMP 1	Computer Techniques–I	2 (0+2)	I
COMP 2	Computer Techniques–II	3 (0+3)	II
COMP 21	Computer Techniques–III	2 (0+2)	III
COMP 22	Computer Techniques–IV	3 (0+3)	IV
	Total Credits	**10 (0+10)**	
	Languages and Haryanavi Culture		
ENG 1	Composition and Elementary Grammar	3 (2+1)	I
ENG 2	Applied Grammar and Comprehension	3 (2+1)	II
ENG 21	English Composition and Comprehension	3 (2+1)	III
ENG 22	Functional English	3 (2+1)	IV
	Total Credits	**12 (8+4)**	

Mathematics, Statistics and Physics			
Mathematics			
MATH 1	Algebra and Trigonometry	5 (5+0)	I
MATH 2	Coordinate Geometry, Calculus and Elementary Statistics	5 (5+0)	II
MATH 21	Matrices, Determinants, Differential Calculus and Probability	5 (5+0)	III
MATH 22	Integral Calculus, Vectors and 3D Geometry	5 (5+0)	IV
	Total Credits	**20 (20+0)**	
Physics			
PHY 1	Principles of Physics–I	5 (4+1)	I
PHY 2	Principles of Physics–II	5 (4+1)	II
PHY 21	Principles of Physics–III	5(4+1)	III
PHY 22	Principles of Physics–IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	

Supporting Courses for B. Sc. (Hons.) Agriculture, 4-Year/6-Year Programme Department-wise

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Botany and Plant Physiology			
BOT 101/ ZOO 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
PL PHY 102	Fundamentals of Crop Physiology	2 (1+1)	II/VI
	Total Credits	**4 (2+2)**	
Chemistry and Biochemistry			
CHEM 201/ FOR 201/ AGM 201/ SOILS 201/ AG ECON 203	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	III/VII
BIOCHEM 101/ MBB 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	I/V
	Total Credits	**6 (5+1)**	
Computer Section			
COMP 301/ AGM301/ AGRON 307	Agricultural Informatics (To be taught jointly by Computer Science, Agronomy & Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**2 (1+1)**	
Languages and Haryanavi Culture			
ENG 101	Comprehension and Communication Skills in English	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	

Mathematics, Statistics and Physics			
MATH 101	Elementary Mathematics (For students from Bio stream)	2 (1+1)	I/V
STAT 102	Statistical Methods	2 (1+1)	II/VI
	Total Credits	**4 (2+2)**	
Microbiology			
MICRO 102	Agricultural Microbiology	2 (1+1)	II/VI
MICRO 204/ SOILS 204/ AGRON 206	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
	Total Credits	**4 (2+2)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 8	Bioagents and Biofertilizers Production	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	
Molecular Biology, Biotechnology and Bioinformatics			
MBB 101 / BIOCHEM 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	I/V
	Total Credits	**3 (2+1)**	
Sociology			
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)	I/V
	Total Credits	**2 (2+0)**	
Zoology			
ZOO 101/ BOT 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	

Supporting Courses for B. Tech. (Agricultural Engineering), 4-Year Programme Department-wise

Course No.	Course Title	Credits	Semester
Chemistry and Biochemistry			
CHEM 101	Engineering Chemistry	3 (2+1)	I
	Total Credits	**3 (2+1)**	
Languages and Haryanvi Culture			
ENG 201	Communication Skills and Personality Development	2 (1+1)	III
	Total Credits	**2 (1+1)**	
Mathematics, Statistics and Physics			
MATH 104	Engineering Mathematics-I	3 (2+1)	I
MATH 105	Engineering Mathematics-II	3 (2+1)	II
MATH 201	Engineering Mathematics-III	3 (2+1)	III
PHY 101	Engineering Physics	3 (2+1)	I
	Total Credits	**12 (8+4)**	

Supporting Courses for B. Sc. (Hons.) Community Science, 4-Year Programme Department-wise

Course No.	Course Title	Credits	Semester
Botany and Plant Physiology			
BOT 100	Elementary Botany (For students from Arts and Math streams)	2 (1+1) NC	II
	Total Credits	**2 (1+1)**	
Chemistry and Biochemistry			
CHEM 100	Introductory Chemistry (For students from Arts stream)	4 (3+1) NC	I
BIOCHEM 102	Principles of Biochemistry	3 (2+1)	III
	Total Credits	**7 (5+2)**	
Computer Section			
COMP 102	Introductory Agricultural Informatics	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Languages and Haryanvi Culture			
ENG 102	General English	2 (1+1)	I
ENG 103	Technical Writing	2 (1+1)	II
	Total Credits	**4 (2+2)**	
Mathematics, Statistics and Physics			
MATH 100	Introductory Mathematics (For students from Arts and Bio streams)	2 (2+0) NC	II
STAT 101	Elementary Statistics	3 (2+1)	V
PHY 100	Introductory Physics (For students from Arts stream)	4 (3+1) NC	II
	Total Credits	**9 (7+2)**	
Microbiology			
MICRO 101	Fundamentals of Food Microbiology	3 (2+1)	IV
	Total Credits	**3 (2+1)**	
Sociology			
SOC 102	Introduction to Rural Sociology	2 (2+0)	I
	Total Credits	**2 (2+0)**	
Zoology			
ZOO 100	Elementary Zoology (For students from Arts and Maths stream)	2 (1+1) NC	I
ZOO 102	Elementary Human Physiology	3 (2+1)	I
	Total Credits	**5 (3+2)**	

COURSE CONTENTS: DEPARTMENT-WISE
BOTANY AND PLANT PHYSIOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
BIO 1	Biology-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	I
BIO 2	Biology-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	II
BIO 21	Biology-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	III
BIO 22	Biology-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Supporting course for B. Sc. (Hons.) Community Science			
BOT 100	Elementary Botany (For students from Arts and Math stream)	2 (1+1)NC	II
	Total Credits	**2 (1+1)**	
Supporting courses for B. Sc. (Hons.) Agriculture			
BOT 101/ ZOO 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
PL PHY 102	Fundamentals of Crop Physiology	2 (1+1)	II/VI
	Total Credits	**4 (2+2)**	

BIO 1	BIOLOGY-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM 1

Theory

Living organisms: diversity and classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom); systematics and binomial system of nomenclature; plant diversity: salient features of plants (major groups); classification of angiosperms up to subclass, botanical gardens, herbaria; animal diversity: salient features of animals (non-chordates up to phylum level and chordates up to class level); zoological parks and museums; tissues in animals; morphology, anatomy and functions of different systems of earthworm, cockroach and frog; human physiology: digestion and absorption, breathing and respiration, body fluids and circulation, excretory products and elimination, locomotion and movement, control and coordination.

Practical

To study the parts of a dissecting and compound microscope; study of specimens and identification with reasons: bacteria, *Oscillatoria, Spirogyra, Rhizopus,* mushroom, yeast, liverwort, moss, fern, pines, one monocotyledon and one dicotyledon and one Lichen; diversity in shape and size of cells in different plant and animal tissues *(e.g.* parenchyma, palisade, collenchyma, sclerenchyma, xylem,

phloem, squamous epithelium, muscle fibres and mammalian blood smear through temporary/ permanent slides); study of specimens and identification: Amoeba, Hydra, Liverfluke, Ascaris, leech, earthworm, prawn, silkworm, honey bee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit; observation of the following spots: human skeleton and different types of joints; morphology of earthworm, cockroach and frog through models/preserved specimens.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 2	BIOLOGY-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM 1I

Theory

Plant kingdom: morphology and functions of different parts of flowering plants- root, stem, leaf, inflorescence, flower, fruit and seed; plant anatomy: tissue, tissue systems and anatomy of root, stem and leaf of dicotyledonous plants and comparison with monocotyledonous plants; plant physiology: plants and water relations, movement of water, food, nutrients and gases; mineral nutrition, respiration, photosynthesis; plant growth and development; structural organization in animals, cell as a unit of life: discovery of the cell, origin of prokaryotic and eukaryotic cells, cell theory, animal cell structure - cell wall, cell membrane; brief outline of structure and function of cell organelles: mitochondria, nucleus, ER, golgi apparatus, dictyosomes, plastids, lysosomes, ribosomes, vacuoles, centrioles, cytoskeleton, chromosomes, microbodies and nuclear organization; cell division: mitosis, meiosis, cell cycle; biomolecules: basic chemical constituents of living bodies, structure and functions of carbohydrates, proteins, lipids and nucleic acids; enzymes: types, properties and function.

Practical

Study and description of locally available common flowering plants one each from (Solanaceae, Fabaceae and Liliaceae); types of root (tap or adventitious), stem (herbaceous/woody), leaf arrangement/shapes/ venation, simple or compound; preparation and study of T.S. of dicot and monocot root and stem (primary); study of osmosis by potato osmometer; plasmolysis in epidermal peels *(e.g., rhoeo* leaves); study of distribution of stomata in the upper and lower surface of leaves, stomatal index; comparative study of the rates of transpiration in the upper and lower surface of leaves; test for the presence of sugars, starch, proteins and fats in suitable plant and animal materials *(e.g.,* wheat, potato, groundnut, milk or other such suitable material); separation of chlorophyll pigments through paper chromatography; study of rate of respiration in flower buds and germinating seeds; effect of salivary amylase on starch; testing the presence of urea, sugar, albumin and bile salts in urine sample (simulated sampled may be used); observation of the following spots -study of mitosis in onion root tip cells, different modifications in root, stem and leaves; identification and comments on different types of inflorescences; imbibition in seeds/raisins; observations and comments on the experimental set up on: anaerobic respiration, phototropism, apical bud removal, suction due to transpiration.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 21	BIOLOGY-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM III

Theory

Plant kingdom: morphology and functions of different parts of flowering plants- root, stem, leaf, inflorescence, flower, fruit and seed; plant anatomy: tissue, tissue systems and anatomy of root, stem and leaf of dicotyledonous plants and comparison with monocotyledonous plants; plant physiology:

plants and water relations, movement of water, food, nutrients and gases; mineral nutrition, respiration, photosynthesis; plant growth and development; structural organization in animals, cell as a unit of life: discovery of the cell, origin of prokaryotic and eukaryotic cells, cell theory, animal cell structure - cell wall, cell membrane; brief outline of structure and function of cell organelles: mitochondria, nucleus, ER, golgi apparatus, dictyosomes, plastids, lysosomes, ribosomes, vacuoles, centrioles, cytoskeleton, chromosomes, microbodies and nuclear organization; cell division: mitosis, meiosis, cell cycle; biomolecules: basic chemical constituents of living bodies, structure and functions of carbohydrates, proteins, lipids and nucleic acids; enzymes: types, properties and function.

Practical

Study and description of locally available common flowering plants one each from (Solanaceae, Fabaceae and Liliaceae); types of root (tap or adventitious), stem (herbaceous/woody), leaf arrangement/shapes/ venation, simple or compound; preparation and study of T.S. of dicot and monocot root and stem (primary); study of osmosis by potato osmometer; plasmolysis in epidermal peels *(e.g., rhoeo* leaves); study of distribution of stomata in the upper and lower surface of leaves, stomatal index; comparative study of the rates of transpiration in the upper and lower surface of leaves; test for the presence of sugars, starch, proteins and fats in suitable plant and animal materials *(e.g.,* wheat, potato, groundnut, milk or other such suitable material); separation of chlorophyll pigments through paper chromatography; study of rate of respiration in flower buds and germinating seeds; effect of salivary amylase on starch; testing the presence of urea, sugar, albumin and bile salts in urine sample (simulated sampled may be used); observation of the following spots -study of mitosis in onion root tip cells, different modifications in root, stem and leaves; identification and comments on different types of inflorescences; imbibition in seeds/raisins; observations and comments on the experimental set up on: anaerobic respiration, phototropism, apical bud removal, suction due to transpiration.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 22	BIOLOGY-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM IV

Theory

Health, agriculture and industry: recombinant DNA technology and application in health, agriculture and industry, genetically modified (GM) organisms, bio-safety issues; plant breeding, tissue culture, food production, microbes in house hold processing, industrial production; sewage treatment and energy generation; *Bt* cotton; genetics and evolution: Mendelian inheritance, chromosome theory of inheritance, deviations from Mendelian ratio; gene interaction: epistasis, incomplete dominance, co-dominance, complementary genes, multiple alleles, sex determination in human beings; linkage and crossing over; inheritance pattern of haemophilia, blood groups in human beings; DNA and applied zoology: DNA replication, transcription, translation; genetic code, gene expression and regulation; DNA fingerprinting, recombinant DNA technology and its applications; basic concepts of immunology and vaccines: pathogens, parasites; cancer and AIDS; adolescence and drug/ alcohol abuse; animal husbandry, bee keeping and fisheries; evolution: theories and evidences.

Practical

Prepration of a temporary mount of onion root tip to study mitosis; study of effect of the different temperatures and three different pH on the activity of salivary amylase on starch; observations on the following spots: study Mendelian inheritance using seeds of different colour/size of any plant; preparation of pedigree charts of genetic traits such as rolling of tongue, blood groups, widow's peak, colour blindness; exercise on controlled pollination -emasculation, tagging and bagging;

identification of the common disease causing organisms like *Ascaris, Entamoeba, Plasmodium*, ringworm through permanent slides or specimens and symptoms of diseases caused by them.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi
2. Biology – Text book for class XII, NCERT, New Delhi

BOT 100	ELEMENTARY BOTANY (For B. Sc. (Hons.) Community Science students from Arts and Math stream)	2 (1+1) NC	SEM II

Theory

Morphological features of angiosperms; pollination, fertilization, seed and fruit development; tissue: structure and functions, internal structure of dicot and monocot stem, root and leaf; plant systematics and its utility, binomial nomenclature, general classification; concept of water potential with respect to plant cell, absorption and translocation of water/sap; basic concepts of plant growth and development, respiration and photosynthesis.

Practical

Morphology of various vegetative and reproductive parts in plants, study of slides and specimens pertaining to above topics; demonstration, experiments of diffusion, imbibition, osmosis, ascent of sap; extraction of plant pigments; measurement of plant growth.

Suggested Readings:

1. Bhatia, K.N. and Tyagi, M.P. (2015). Elementary Biology, volume- I & II. A Trueman Publications.
2. Biology Textbook for Class 12 (2017). NCERT, New Delhi.
3. Dhami, P.S., Chopra, G. and Srivastva, H.N. (2015). A Text Book of Biology, Part-I & II. Pardeep's Publication.
4. NCERT Biology (2015). New Delhi.

BOT 101/ ZOO 101	INTRODUCTORY BIOLOGY (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	SEM I/V

Theory

Introduction to the living world, diversity and characteristics of life, origin of life, evolution and eugenics; binomial nomenclature and classification cell and cell division; morphology and anatomy of flowering plants; seed and seed germination; plant systematics viz; Brassicaceae, Fabaceae and Poaceae; role of animals in agriculture.

Practical

Morphology of flowering plants– root, stem and leaf and their modifications; inflorence, flower and fruits; cell, tissues & cell division; internal structure of root, stem and leaf; study of specimens and slides; description of plants- Brassicaceae, Fabaceae and Poaceae; study of type animals of major phyla.

Suggested Readings:

1. Bhatia, K.N. and Tyagi, M.P. (2015). Elementary Biology, volume- I & II. Trueman Publication.
2. Biology Textbook for Class 12 (2017). NCERT, New Delhi.
3. Dhami, P.S., Chopra, G. and Srivastva, H.N. (2015). A Text Book of Biology, Part-I & II. Pardeep's Publication.
4. NCERT Biology (2015). New Delhi.
5. Pandey, B.D. and Rath, R.K. (2014). Zoology at a Glance, Scientific Publishers, Jodhpur, India.

PL PHY 102	FUNDAMENTALS OF CROP PHYSIOLOGY	2 (1+1)	SEM II/VI

Theory

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; diffusion and osmosis; absorption of water, transpiration and stomatal physiology; mineral nutrition of plants: functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; photosynthesis: light and dark reactions, C3, C4 and CAM plants; respiration: glycolysis, TCA cycle and electron transport chain; fat metabolism: fatty acid synthesis and breakdown; plant growth regulators: physiological roles and agricultural uses, physiological aspects of growth and development of major crops: growth analysis, role of physiological growth parameters in crop productivity.

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, separation of photosynthetic pigments through paper chromatography, rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, measurement of photosynthetic CO2 assimilation by infra red gas analyser (IRGA).

Suggested Readings:

1. Bhatia, K.N. and Tyagi, M.P. (2015). Elementary Biology, volume- I & II. A Trueman Publications.
2. Biology Textbook for Class 12 (2017). NCERT, New Delhi.
3. Dhami, P.S., Chopra, G. and Srivastva, H.N. (2015). A Text Book of Biology, Part-I & II. Pardeep's Publication.
4. Pandey, S.N. and Sinha, B.K. Plant Physiology Vikas Publishing House PVT LTD, New Delhi, India.
5. V.K Jain. Fundamentals of Plant Physiology, S.Chand Publication.

CHEMISTRY AND BIOCHEMISTRY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
CHEM 1	Principles of Chemistry-I	5 (4+1)	I
CHEM 2	Principles of Chemistry-II	5 (4+1)	II
CHEM 21	Principles of Chemistry-III	5 (4+1)	III
CHEM 22	Principles of Chemistry-IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Supporting Course for B. Sc. (Hons.) Community Science			
CHEM 100	Introductory Chemistry (For students from Arts stream)	4 (3+1)NC	I
	Total Credits	**4 (3+1)**	
Supporting Course for B. Tech. (Agricultural Engineering)			
CHEM 101	Engineering Chemistry	3 (2+1)	I
	Total Credits	**3 (2+1)**	
Supporting Course for B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science			
CHEM 201/ FOR 201/ AGM 201/ SOILS 201/ AG ECON 203	Environmental Studies and Disaster Management (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry)	3 (3+0)	Agri.: III/VII B.Tech.: II CS: III
	Total Credits	**3 (3+0)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
BIOCHEM 101/ MBB 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	I/V
	Total Credits	**3 (2+1)**	
Supporting Course for B. Sc. (Hons.) Community Science			
BIOCHEM 102	Principles of Biochemistry	3 (2+1)	III
	Total Credits	**3 (2+1)**	

CHEM 1	PRINCIPLES OF CHEMISTRY-I	5 (4+1)	SEM I

Theory

Some basic concepts of chemistry: general introduction, importance and scope of chemistry; historical approach to particulate nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules; atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry

and calculations based on stoichiometry; properties of matter and their measurements, uncertainity in measurement.

Structure of atom: atomic number, isotopes and isobars, Thomson's model and its limitations, Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de broglie's relationship, heisenberg uncertainty principle, concept of orbitals, quantum numbers, shape of s,p and d orbitals, rules for filling electrons in orbitals – Aufbau principle, Pauli's exclusion principle and hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals, bohr's model for hydrogen atom.

Classification of elements and periodicity in properties: significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements –atomic radii, ionic radii, ionization enthalpy, electron gain enthalpy, electro negativity, valency.

Chemical bonding and molecular structure: valence electrons, ionic bond, covalent bond: bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbital and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond.

States of matter: gases and liquids- three states of matter, intermolecular interactions, thermal energy, types of interaction, boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation; deviation from ideal behaviour; liquid state- vapour pressure, viscosity and surface tension (qualitative idea only), kinetic theory of gases.

Thermodynamics: system and types of system, surrounding, work, heat, energy, extensive and intensive properties, state functions; first law of thermodynamics -internal energy and enthalpy, heat capacity and specific heat, measurement of ΔU and ΔH, calorimetry, Hess's law of constant heat summation, enthalpies of bond dissociation, combustion, formation atomization, sublimation, phase transformation, ionization and solution; introduction of entropy as a state function, free energy change for spontaneous and non - spontaneous process criteria for equilibrium.

Equilibrium: Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium - Le Chatelier's principle, ionic equilibrium-ionization of acids and bases, strong and weak electrolytes, degree of ionization, concept of pH, hydrolysis of salts (elementary idea), buffer solution, solubility product, common ion effect (with illustrative examples).

Practical

Basic laboratory techniques: cutting glass tube and glass rod, bending a glass tube, drawing out a glass jet, boring a cork; experiments based on pH: any one of the following experiments- determination of pH of some solutions obtained from fruit juices, varied concentrations of acids, bases and salts using pH paper or universal indicator, comparing the pH of solutions of strong and weak acids of same concentration; chemical Equilibrium: one of the following experiments- study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/ decreasing the concentration of either ions; study the shift in equilibrium between $[Co(H_2O)_6]^{2+}$ and chloride ions by changing the concentration of either of the ions; thermochemistry: any one of the following experiments- enthalpy of dissolutions of copper sulpahte or potassium nitrate, enthalpy of neutralization of strong acid (HC1) and strong base (NaOH), determination of enthalpy change during interaction (hydrogen bond formation) between acetone and chloroforms; quantitative estimation: using a chemical balance, preparation of standard solution of oxalic acid, determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic

acid, preparation of standard solution of sodium carbonate, determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

Suggested Readings:

1. Chemistry (Class - XI) (Part - I) 01 by NCERT (2016).
2. Pradeep's New Course Chemistry Class-XI (Set of 2 Vols) by Pradeep Publications (2014).
3. Modern's abc of Chemistry Class - 11 (Part 1 & 2) by S. P. Jauhar (2017).
4. Comprehensive Chemistry for Class - 11 (Set of 2 Volumes) New Edition by N . K. Verma, S. K. Khanna, B. Kapila (2017).
5. Dinesh Companion Chemistry - Volume 1 and 2 (Class 11) by S. K. Malhotra (2017).

CHEM 2	PRINCIPLES OF CHEMISTRY-II	5 (4+1)	SEM II

Theory

Redox reactions: concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, application of redox reactions; hydrogen: position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, physical and chemical properties of water, heavy water, hydrogen peroxide - preparation, properties and structure, hydrogen as a fuel, hydrides – ionic, covalent and interstitial.

Group 1 and group 2 elements (alkali and alkaline earth metals): general introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses; preparation and properties of some important compounds: sodium chloride, sodium hydroxide and biological importance of sodium and potassium; calcium oxide and calcium carbonate and industrial uses of lime and limestone, biological importance of magnesium and calcium.

General introduction to p- block elements: group 13 elements- general introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, boron - physical and chemical properties, some important compounds, boron hydrides, borax, boric acid, aluminium- reactions with acids and alkalies, uses; group 14 elements: general introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements of the group, carbon -catenation, allotropic forms, physical and chemical properties, important compounds of silicon and their uses- silicates and zeolites, silicones.

Organic chemistry: some basic principles and technique- general introduction, methods of qualitative and quantitative analysis, classification and iupac nomenclature of organic compounds; electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyperconjugation; homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles.

Classification of hydrocarbons: alkanes- nomenclature, isomerism, conformation (ethane only), physical properties, chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis; Alkenes: nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions- addition of hydrogen, halogen, water, hydrogen halides (markonikov's addition and peroxide effect), ozonolysis, mechanism of electrophilic addition; Alkynes: nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction with -hydrogen, halogens, hydrogen halides and water; aromatic hydrocarbons: introduction, IUPAC nomenclature, benzene- resonance, aromaticity, chemical reactions- nitration

sulphonation, halogenation, friedel craft's alkylation and acylation, mechanism of electrophilic substitution; directive influence of a substituted in mono- substituted benzene, carcinogenicity and toxicity.

Environmental chemistry: environmental pollution - air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutions, acid rain, ozone and its reactions, depletion of ozone layer and its effect, greenhouse effect and global warming-pollution due to industrial wastes, green chemistry as an alternative tool for reducing pollution, strategy for control of environment pollution.

Practical

Characterization and purification of chemical substances: crystallization of an impure sample of any one of the following: alum, copper sulphate, benzoic acid; qualitative analysis: determination of one anion and one cation in a given salt- Cations - Pb^{2+}, Cu^{2+}, As^{3+}, $A1^{3+,}$ $Fe^{3+,}$ Mn^{2+}, Ni^{2+}, Zn^{2+}, Co^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+, Anions – CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}, $C_2O_4^{2-}$, CH_3COO^-, (Note: Insoluble salts excluded); extra elements -nitrogen, sulphur, chlorine, bromine and iodine (Periods 10) in an organic compound; project: scientific investigations involving laboratory testing and collecting information from other sources.

A Few suggested Projects:

Checking the bacterial contamination in drinking water by testing sulphide ion; study of the methods of purification of water; testing the hardness, presence of iron, fluoride, chloride etc. Depending upon the regional variation in drinking water and study of causes of presences of these ions above permissible limit (if any); investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on it; study the acidity of different samples of tea leaves; determination of the rate of evaporation of different liquids; study the effect of acids and bases on the tensile strength of fibers; study of acidity of fruit and vegetable juices.

Suggested Readings:

1. Chemistry (Class - XI) (Part - I) 01 by NCERT (2016).
2. Pradeep's New Course Chemistry Class-XI (Set of 2 Vols) by Pradeep Publications (2014).
3. Modern's abc of Chemistry Class - 11 (Part 1 & 2) by S. P. Jauhar (2017).
4. Comprehensive Chemistry for Class - 11 (Set of 2 Volumes) New Edition by N . K. Verma, S. K. Khanna, B. Kapila (2017).
5. Dinesh Companion Chemistry - Volume 1 and 2 (Class 11) by S. K. Malhotra (2017).

CHEM 21	PRINCIPLES OF CHEMISTRY-III	5 (4+1)	SEM III

Theory

Solid state: general characteristics of solids, amorphous and crystalline solids, classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), crystal lattices and unit cells, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, imperfection in solids, electrical and magnetic properties.

Solutions: types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solubility, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, vapour pressure of liquids, ideal and non-ideal solutions.

Electrochemistry: electrochemical cells, conductance in electrolytic solutions, specific and molar

conductivity, variations of conductivity with concentration, Kohlrausch's law, electrolysis and law of electrolysis (elementary idea), dry cell -electrolytic cells and galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, nernst equation and its application to chemical cells, fuel cells, corrosion.

Chemical kinetics: rate of a reaction (average and instantaneous), factors affecting rate of reaction-concentration, temperature, catalyst order and molecularity of a reaction, rate law and specific rate constant, integrated rate equation and half life (only for zero and first order reactions), collision theory (elementary idea, no mathematical treatment).

Surface chemistry: adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, colloids distinction between true solutions, colloids and suspension, lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, brownian movement, electrophoresis, coagulation, emulsion -types of emulsions, catalysis.

General principles and processes of isolation of elements: occurrence of metals, concentration of ores, principles and methods of extracting - concentration, oxidation, reduction - electrolytic method and refining, occurrence and principles of extraction of aluminium, copper, zinc and iron and uses of aluminium, copper, zinc and iron.

P-block elements: group 15 elements- general introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; compounds of nitrogen- preparation and properties of ammonia and nitric acid, phosphorous - allotropic forms, compounds of phosphorous: preparation and properties of phosphine, halides (pci_3, pci_5) and oxoacids (elementary idea only); group 16 elements: general introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, simple oxides, ozone, sulphur allotropic forms; compounds of sulphur: sulphuric acid- industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only); group17elements: general introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only); group 18 elements: general introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

Practical

Surface Chemistry: preparation of one lyophilic and one lyophobic sol-lyophilic sol -starch, egg albumin and gum; lyophobic sol - aluminium hydroxide, ferric hydroxide, arsenous sulphide; study of the role of emulsifying agents in stabilizing the emulsion of different oils; chemical kinetics: effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid; study of reaction rates of any one of the following- reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions, reaction between potassium iodate, (KIO_3) and sodium sulphite: (Na_2SO_3) using starch solution as indicator (clock reaction); electrochemistry: variation of cell potential in $Zn/Zn^{2+}||\ Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature; preparation of inorganic compounds: preparation of double salt of ferrous ammonium sulphate or potash alum, preparation of potassium ferric oxalate; preparation of organic compounds: preparation of any two of the following compounds: Acetanilide, Di -benzal acetone, p-Nitroacetanilide, Aniline yellow or 2- Naphthol aniline dye, lodoform; determination of concentration/ molarity of $KMnO_4$ solution by titrating it against a standard solution of: Oxalic acid, Ferrous ammonium sulphate (Students will be required to prepare standard solutions by weighing themselves).

Suggested Readings:

1. Chemistry (Class - XII) (Part - 2) 01 by NCERT (2012).
2. Pradeep's New Course Chemistry Class-XII (Set of 2 Vols) by Pradeep Publications (2014).
3. Modern's abc of Chemistry Class - 12 (Part 1 & 2) by S. P. Jauhar (2017).

4. Comprehensive Chemistry for Class - 12 (Set of 2 Volumes) by N . K. Verma, S. K. Khanna, B. Kapila (2017).

5. Dinesh Companion Chemistry - Volume 1 and 2 (Class 12) by S. K. Malhotra (2017).

CHEM 22	PRINCIPLES OF CHEMISTRY-IV	5 (4+1)	SEM IV

Theory

d and *f* Block Elements :-general introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals - metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$; Lanthanoids: electronic configuration, oxidation states and lanthanoid contraction; Actinoids: electronic configuration, oxidation states; coordination compounds: introduction, ligands, coordination number, colour, magnetic

properties and shapes, IUPAC nomenclature of mononuclear coordination compounds, bonding and isomerism in coordination compounds, importance and applications of coordination compounds (in qualitative analysis, extraction of metals and biological system), Werner's theory of coordination compounds, bonding in metal carbonyls, stability of coordination compounds.

Haloalkanes and Haloarenes: Haloalkane classification, nomenclature, nature of C -X bond, physical and chemical properties, mechanism of substitution reactions.

Haloarenes: nature of C -X bond, substitution reactions (directive influence of halogen in monosubstituted compounds only), uses and environmental effects of - trichloromethane, tetrachloromethane, iodoform.

Alcohols, Phenols and Ethers: alcohols classification, nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses of methanol and ethanol; Phenols: nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols; Ethers-nomenclature, methods of preparation, physical and chemical properties; uses.

Aldehydes, ketones and carboxylic acids: aldehydes and ketones- nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophillic addition, reactivity of alpha hydrogen in aldehydes, uses; carboxylic acids-nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses. Organic compounds containing nitrogen: amines- nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines; Cyanides and isocyanides - will be mentioned at relevant places in context; Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Biomolecules: carbohydrates- classification (aldoses and ketoses), monosaccahrides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), importance; proteins: elementary idea of ά - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins and renaturation of proteins; Vitamins: classification and functions; Nucleic Acids: - DNA and RNA.

Polymers: classification natural and synthetic, semi-synthetic, methods/types of polymerization (addition and condensation), copolymerization, some important polymers-natural and synthetic like polythene, nylon polyesters, bakelite, rubber, biodegradable polymers, commercial importance of polymers; chemistry in everyday life: chemicals in medicines - analgesics, tranquilizers antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines; chemicals in

food: preservations, artificial sweetening agents; cleansing agents: soaps and detergents, cleansing action; drugs and their classification- drug-target interaction, therapeutic action of Drugs.

Practical

Chromatography: separation of pigments from extracts of leaves and flowers by paper chromatography and determination of R_f values, separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in $R_f$values to be provided); tests for the functional groups present in organic compounds: unsaturation, alcoholic, phenolic, aldehydic, ketone, carboxylic and amino (Primary) groups; characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs; qualitative analysis: determination of one anion and one cation in a given salt- Cations - Pb^{2+}, Cu^{2+}, As^{3+}, $A1^{3+}$, Fe^{3+} ,Mn^{2+}, Ni^{2+}, Zn^{2+}, Co^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+ , Anions – CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}, $C_2O_4^{2-}$, CH_3COO^-, (Note: Insoluble salts excluded)

Project: scientific investigations involving laboratory testing and collecting information from other sources.

A few suggested projects: study of the presence of oxalate ions in guava fruit at different stages of ripening; study of quantity of casein present in different samples of milk; preparation of soybean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc.; study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc.); study of digestion of starch by salivary amylase and effect of pH and temperature on it; comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice etc.; extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom); study of common food adulterants in fat, oil, butter, sugar, turmeric powder, chilli powder and pepper.

Suggested Readings:

1. Chemistry (Class - XII) (Part - 2) 01 by NCERT (2012).
2. Pradeep's New Course Chemistry Class-XII (Set of 2 Vols) by Pradeep Publications (2014).
3. Modern's abc of Chemistry Class - 12 (Part 1 & 2) by S. P. Jauhar (2017).
4. Comprehensive Chemistry for Class - 12 (Set of 2 Volumes) by N . K. Verma, S. K. Khanna, B. Kapila (2017).
5. Dinesh Companion Chemistry - Volume 1 and 2 (Class 12) by S. K. Malhotra (2017).

CHEM 100	INTRODUCTORY CHEMISTRY (For B. Sc. (Hons.) Community Science Students from Arts stream)	4 (3+1) NC	SEM I

Theory

Atoms, molecules, mole concept, states of matter, atomic structure; periodic classification of elements; chemical bonding, transition metals co-ordination compounds; basic concepts of organic chemistry; classification and nomenclature of organic compounds, isomerism-structural and stereoisomerism, petroleum-sources of organic compounds; some important methods of preparation and properties of methane/ethane, ethylene, acetylene, benzene, ethyl alcohol, phenol, acetone, acetic acid, benzoic acid, protein and amino acids, introduction of biomolecules: glucose, fructose, sucrose, lipids, vitamins and dyes.

Practical

Acid-base titration; identification of acid radicals; detections of elements (N,S,X) and functional groups, any two preparations: iodoform, asprin, orange dye; removal of colour stains from clothes.

Suggested Readings:

1. Chemistry (Class – XI, XII) by NCERT (2012).

2. Pradeep's New Course Chemistry Class- XI, XII (Set of 2 Vols) by Pradeep Publications (2014).
3. Modern's abc of Chemistry Class – 11,12 (Part 1 & 2) by S. P. Jauhar (2017).
4. Comprehensive Chemistry for Class – 11,12 (Set of 2 Volumes) by N . K. Verma, S. K. Khanna, B. Kapila (2017).
5. Dinesh Companion Chemistry - Volume 1 and 2 (Class 11, 12) by S. K. Malhotra (2017).

CHEM 101	ENGINEERING CHEMISTRY	3 (2+1)	SEM I

Theory

Phase rule and its application to one and two component systems. Fuels: classification; calorific value; colloids: classification; properties; corrosion: causes; types and method of prevention; Water: temporary and permanent hardness; disadvantages of hard water, scale and sludge formation in boilers, boiler corrosion; analytical methods like thermo-gravimetric; polarographic analysis; nuclear radiation; detectors and analytical applications of radioactive materials; enzymes and their use in the manufacturing of ethanol and acetic acid by fermentation methods; principles of food chemistry; introduction to lipids, proteins, carbohydrates, vitamins, food preservators, colouring and flavouring reagents of food; lubricants: properties; mechanism; classification and tests; polymers; types of polymerization; properties; uses and methods for the determination of molecular weight of polymers; introduction to IR spectroscopy.

Practical

Determination of temporary and permanent hardness of water by EDTA method: estimation of chloride in water: estimation of dissolved oxygen in water: determination of BOD in water sample: determination of COD in water sample: estimation of available chlorine in bleaching powder: determination of viscosity of oil: estimation of activity of water sample: estimation of alkalinity of water sample: determination of carbonate and non- carbonate hardness by soda reagent: determination of coagulation of water and chloride ion content: determination of specific rotation of an optically active compound: determination of calorific value of fuel: chromatographic analysis: determination of molar refraction of organic compounds.

Suggested Readings:

1. Dara, S. S.&Umare, S. S. (2014). A text book of Engineering Chemistry. S. Chand, Delhi.
2. Haram, Nand (2016). Engineering Chemistry. Everest Publisher, Delhi.
3. Singh, Etal (2012). Engineering Chemistry. Universities Press, Delhi.
4. Srivastava, H.C. (2010). Engineering Chemistry. Pragti Parkashan, Meerut.
5. Jain & Jain (2008). Engineering Chemistry. Dhanpat Rai, Delhi.

CHEM 201/ FOR 201/ AGM 201/ SOILS 201/ AG ECON 203	ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (To be taught jointly by Forestry, Agricultural Meteorology, Soil Science, Agricultural Economics and Chemistry) [For B. Sc. (Hons.) Agriculture, B.Tech. (Agri. Engg.) and B. Sc. (Hons.) Community Science]	3 (3+0)	SEM Agri.: III/VII B.Tech.: II CS: III

Theory

Multidisciplinary nature of environmental studies: definition, scope and importance; natural resources: renewable and non-renewable resources, natural resources and associated problems; forest resources: use and over-exploitation, deforestation, case studies, timber extraction, mining, dams and their effects on forest and tribal people, wasteland management through tree plantations; water resources: use and over-utilization of

surface and ground water, floods, drought, conflicts over water, dams-benefits and problems; mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies; food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies; energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources; case studies; land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles; ecosystems: concept of an ecosystem, structure and function of an ecosystem; producers, consumers and decomposers, energy flow in the ecosystem; ecological succession, food chains, food webs and ecological pyramids; introduction, types, characteristic features, structure and function of the ecosystem: forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries); biodiversity and its conservation: introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India; value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; biodiversity at global, national and local levels, India as a mega-diversity nation; hot-sports of biodiversity; threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity; environmental pollution: definition, cause, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards; solid waste management: causes, effects and control measures of urban and industrial wastes; role of an individual in prevention of pollution; peaceful uses of chemistry; recycling and reusing the biodegradable and dry waste; social issues and environment: from unsustainable to sustainable development, 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, nuclear accidents and holocaust dies; wasteland reclamation; consumerism and waste products; environment protection act; air (prevention and control of pollution) act; water (prevention and control of pollution) act; wildlife protection act; forest conservation act; issues involved in enforcement of environmental legislation; 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.

Disaster management

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; man made disasters: nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents; disaster management: effect to migrate natural disaster 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:

1. Anil, K Gupta and Nair, Sreeja S. (2012). Environmental Extremes: Disaster Risk Management addressing Climate Change, NIDM, New Delhi.
2. Baskar, Sushmitha and Baskar, R. (2007). Environmental Studies for Undergraduate Courses. Unicorn Books, New Delhi.
3. Bharucha Erach (2004). Environmental Science for undergraduate courses. University Grants Commission, New Delhi.
4. Dwivedi, A.P. (1992). Agroforestry: Principles and Practices. Oxford & IBH.
5. Singh, Y.K. (2006). Environmental Science. New Age International (p) Limited, New Delhi.

BIOCHEM 101/ MBB 101	FUNDAMENTALS OF PLANT BIOCHEMISTRY AND BIOTECHNOLOGY (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bionformatics)	3 (2+1)	SEM I/V

Theory

Importance of biochemistry; carbohydrate: importance and classification; structures of monosaccharides, reducing and oxidizing properties of monosaccharides, mutarotation; structure of disaccharides and polysaccharides; lipid: importance and classification; structures and properties of fatty acids; storage lipids and membrane lipids; proteins: importance of proteins and classification; structures and zwitterions nature of amino acids; structural organization of proteins; enzymes: general properties; classification; mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; nucleic acids: importance and classification; structure of nucleotides, B-DNA; RNA: types and secondary & tertiary structure; metabolism of carbohydrates: glycolysis, TCA cycle, Glyoxylate cycle, electron transport chain; metabolism of lipids: beta oxidation; concepts and applications of plant biotechnology: scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; micro-propagation methods; organogenesis and embryogenesis, synthetic seeds and their significance; embryo rescue and its significance; somatic hybridization and cybrids; somaclonal variation and its use in crop improvement; cryo-preservation; introduction to recombinant DNA technology: methods of gene transfer physical (gene gun method), chemical (PEG mediated) and agrobacterium mediated gene transfer methods; transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; marker assisted breeding in crop improvement; biotechnology regulations.

Practical

Preparation of solution, pH & buffers; qualitative tests of carbohydrates and amino acids; quantitative estimation of glucose/ proteins; effect of pH, temperature and substrate concentration on enzyme action, paper chromatography/TLC demonstration for separation of amino acids/monosaccharides; sterilization techniques; composition of various tissue culture media and preparation of stock solutions for MS nutrient medium; callus induction from various explants; micro-propagation, hardening and acclimatization; demonstration on isolation of DNA; demonstration of gel electrophoresis techniques and DNA finger printing.

Suggested Readings:

1. Conn, Eric E. and Stumpf, P. K. (2009). Outlines of Biochemistry, Wiley and Sons.
2. Gupta, P.K. (2004). Biotechnology and Genomics, Rastogi Publishing.
3. Jain, J.L. (2004). Fundamentals of Biochemistry, S. Chand Publishing.
4. Nelson, David L. and Cox, Michael M. (2012). Principles of biochemistry, Lehninger, Freeman & Company.
5. Singh, B.D. (2010). Biotechnology: Expanding Horizon, Kalyani Publishing.

BIOCHEM 102	PRINCIPLES OF BIOCHEMISTRY	3 (2+1)	SEM III

Theory

Recapitulation of basic chemistry and biology; water, pH and buffers, acid-base balance; cellular constituents; structure and function: amino acid and proteins, carbohydrates, lipids and bio membranes, nucleic acids; vitamins and minerals, enzymes, function, properties; metabolism of cellular constituents; carbohydrates metabolism: glycolysis, HMP pathway, TCA cycle; electron transport chain; gluconeogenesis; lipids metabolism: Beta-oxidation, ketone bodies; general reactions of amino acid metabolism; general reactions of nitrogen assimilation and excretion; replication, transcription, translation and genetic code.

Practical

Preparation of buffers and pH determination; qualitative and quantitative tests of carbohydrates, lipids and proteins; paper chromatography of amino acids or carbohydrates ascending and descending; determination of starch, sugar; analysis of proximate constituents in food.

Suggested Readings:

1. Conn, E.E. and Stumpf, P.K. (1987). Outlines of Biochemistry. John Wiley.
2. Hames B.D., Hooper N.M. and Houghton J.D. (1997). Instant Notes in Biochemistry. BIOS Scientific Publishers.
3. Jayaram, T. (1981). Laboratory manual in biochemistry. Wiley Estern Ltd., New Delhi.
4. Nelson, D.L. and Cox, M.M. (2004). Lehninger Principles of Biochemistry (4th Ed.) MacMillan.
5. Plummer, D. (1988). An Introduction to Practical Biochemistry (3rd Ed.). Tata McGraw Hill: New Delhi.
6. Voet. D., Voet, J.G. and Pratt, C.W. (2007). Fundamentals of Biochemistry. John Wiley.

COMPUTER SECTION

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
COMP 1	Computer Techniques-I	2 (0+2)	I
COMP 2	Computer Techniques- II	3 (0+3)	II
COMP 21	Computer Techniques-III	2 (0+2)	III
COMP 22	Computer Techniques-IV	3 (0+3)	IV
	Total Credits	**10 (0+10)**	
Supporting Course for B. Sc. (Hons.) Community Science			
COMP 102	Introductory Agricultural Informatics	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
COMP 301/ AGRON 307/ AGM 301	Agricultural Informatics (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	V/IX
	Total Credits	**2 (1+1)**	

COMP 1	COMPUTER TECHNIQUES-I	2 (0+2)	SEM I

Practical

Computer: definition, characteristics, limitations and uses; structures of computer showing its different units (I/P,O/P,CPU), various I/O devices (keyboard, mouse, scanner, OMR, MICR, bar code reader, MIC, monitor, printer - DMP, laser, plotter; concept of memory: primary memory (RAM, ROM, PROM, EPROM, EEPROM), secondary memory (floppy, disk, hard disk, CD/DVD, flash drives); WINDOWS- desktop, main group, application group, accessories group, startup group and other miscellaneous applications and features; MS Word: introduction to word processor, features of MS Word –file menu, edit menu, view, menu, format menu; data representation: number system - decimal, octal, binary, hexadecimal, conversion of a number system to other, representation of integers- (sign and magnitude, 1's complement 2's complement); computer architecture- motherboard cache memory, parts (serial, parallel, USB), SMPS, MS Excel: introduction to spreadsheet, define cell, cell address, cell pointer, row, column, worksheet, workbook etc.; types of data in a cell (text, number, date and formula),built in function- SUM, AVG, COUNT, MAX, MIN., cell referencing- absolute, relative mixed; project work: designing result sheet of a class, designing salary slip of an employee of organization.

COMP 2	COMPUTER TECHNIQUES-II	3 (0+3)	SEM II

Practical

MS-Access: data base management: data base, examples, records, fields, field types; getting started: starting access, creating a database, creating a table; listing a table: viewing records, record-numbers, displaying all records, closing the database; creating database: planning the structure, creating the structure, modifying the structure, delete, insert and rearranging fields in a table; entering and deleting data: appending records, saving the database, editing records, moving to the ends, deleting records, using data sheet; form: creating a form, view the records in a form, add and save the records with a form, print, save and close a form; querying a database: creating a query, modifying a query;

databasestructure: fields, record data types, RDBMS, field structures and relations; SQL: using SQL in microsoft access, using SQL to view and modify quarries, creating tables with access SQL, writing select queries in SQL using SQL; aggregate functions: select, FROMWHERE, ORDERBY, AS, GROUP BY, HAVING CLAUSE.

COMP 21	COMPUTER TECHNIQUES-III	2 (0+2)	SEM III

Practical

HTML fundamental: HTML building blocks, writing HTML - the rules, HTML, tags attributes, nesting tags, HTML and white space, the structure of a page, working with the browser and text editor; getting started - viewing your webpages, viewing the source code of a page; creating webpage using text editor and browser together, working with attributes; text formatting- using a default text size, changing the font face, making text bold and italic, changing the text size, choosing a default color, changing individual text color; inserting special character subscript and superscripts, underline and monospace font, adding comments; page layout: using of background color, using background image, centering alignment on the page- A next trick, indenting on both the left and right, working with preformatted text, using pixel shims, line break, keeping line together and discovery line break; using images: inserting images, aligning images with text, wrapping text around and image, stopping text wrap, adding space around an image, specifying and changing the size of an image, adding alternate text to an image, adding horizontal rule, competing the page; text hyperlinks - about hyperlinks, creating hyperlinks to page in the same folder and in the different folder creating a navigation line, creating a hyperlinks to send an email message; other type of hyperlinks; URL formats for different services and types of resources on the web, Using different tools to help create webpages, putting information on the WWW; working with lists - creating a simple ordered list, setting the type attribute for list, setting a start value for the list, list and line breaks; list and indenting, setting the type attribute for an individual list item, setting a start value for an individual list item.

COMP 22	COMPUTER TECHNIQUES-IV	3 (0+3)	SEM IV

Practical

System analysis and design introduction: need for system analysis and design, steps and techniques system analysis; role of system analysis, system development life cycle (SDLC) data flow diagrams, documentation; financial accounting package: theory and practical introduction to accounting, objectives, use of tally package and its functions-introduction to various features and functions available in the software package, solving small live financial problems of company/university departments using the available features and function in Tally, security measures- implementing the various security issues using internal security measures available; company creation; accounting heads; voucher entry, balance sheet, display trial balance.

COMP 102	INTRODUCTORY AGRICULTURAL INFORMATICS	2 (1+1)	SEM II

Theory

Introduction to computers, anatomy of computers, memory concepts, units of memory, operating system, definition and types; application of MS-Office for creating, editing and formatting a document, data presentation, tabulation and graph creation, statistical analysis, mathematical expressions; database: Concepts and types, creating database, uses of DBMS in health and nutrition. Internet and World Wide Web (WWW): concepts, components and creation of web, HTML, XML coding.

Practical

Study of computer components, accessories, practice of important DOS commands; introduction of different operating systems such as windows, Unix/Linux, creating, files and folders, file management;

use of MS-WORD and MS Power-point for creating, editing and presenting a scientific document; MS-EXCEL: creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: creating database, preparing queries and reports; introduction to World Wide Web (WWW) and its components, presentation and management of health information through web; use of smart phones and other devices health warning signs and dietary management; hands on practice on preparation of decision support system.

Suggested Reading:

1. Sinha P. Computer Fundamentals. BPB Publications, Daryaganj, New Delhi.
2. Rajaraman and Adabala. Fundamentals of Computers, Sixth Edition, Prentice Hall of India.
3. Rogers Silvester. The Beginner's Guide to Microsoft Word, IT Pro Publishing.
4. James D Scott. Introduction to the Internet, Third Edition, Prentice Hall of India.
5. Rose T Marshall. Introduction To Internet Management, Second Edition, Prentice Hall of India.
6. Corner E Douglas. Computer Networks and Internets, Sixth Edition, Pearson.

COMP 301/ AGRON 307/ AGM 301	AGRICULTURAL INFORMATICS (To be taught jointly by Computer Section, Agronomy and Agricultural Meteorology)	2 (1+1)	SEM V/IX

Theory

Introduction to computers, anatomy of computers, memory concepts, units of memory, operating system, definition and types, applications of MS-Office for creating, editing and formatting a document, data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, database, concepts and types, creating database, uses of DBMS in agriculture, internet and World Wide Web (WWW), concepts and components; computer programming, general concepts, introduction to visual basic, java, fortran, C/ C++, etc, concepts and standard input/output operations; e-agriculture, concepts, design and development; application of innovative ways to use information and communication technologies (IT) in agriculture; computer models in agriculture: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation; smartphone mobile apps in agriculture for farm advises; geospatial technology, concepts, techniques, components and uses for generating valuable agri-information; decision support systems, concepts, components and applications in agriculture, preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of computer components, accessories, practice of important DOS commands; introduction of different operating systems such as windows, Unix/Linux, creating, files & folders, file management; use of MS-WORD and MS Power-point for creating, editing and presenting a scientific document; MS-EXCEL - creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: creating database, preparing queries and reports, demonstration of agri-information system; introduction to World Wide Web (WWW) and its components; introduction of programming languages such as Visual Basic, Java, Fortran, C, C++; hands on practice on crop simulation models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost; use of smart phones and other devices in agro-advisory and dissemination of market information; introduction of geospatial technology for generating information important for agriculture; hands on practice on preparation of decision support system; preparation of contingent crop planning.

Suggested Readings:

1. Balagurusamy, E. (1987). Office Automation and Word Processing, Mc Graw-Hill Education, New Delhi.
2. Basandra, Suresh K. (2010). Computer Today, Galgotia Publications Pvt. Ltd.
3. Sinha, P.K. (1992). Computer Fundamentals – Concept, System and Application, BPB, Publication, New Delhi.
4. Vanitha, G. and Kalpana, M. (2011). Agro-Informatics, New India Publishing Agency, New Delhi.
5. Xavier, C. (1998). Introduction to Computers and Basic Programming, New Age International, New Delhi.

LANGUAGES AND HARYANVI CULTURE

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
ENG 1	Composition and Elementary Grammar	3 (2+1)	I
ENG 2	Applied Grammar and Comprehension	3 (2+1)	II
ENG 21	English Composition and Comprehension	3 (2+1)	III
ENG 22	Functional English	3 (2+1)	IV
	Total Credits	**12 (8+4)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
ENG 101	Comprehension and Communication Skills in English	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	
Supporting Courses for B. Sc. (Hons.) Community Science			
ENG 102	General English	2 (1+1)	I
ENG 103	Technical Writing	2 (1+1)	II
	Total Credits	**4 (2+2)**	
Supporting Course for B. Tech. (Agricultural Engineering)			
ENG 201	Communication Skills and Personality Development	2 (1+1)	III
	Total Credits	**4 (2+2)**	

ENG 1	COMPOSITION AND ELEMENTARY GRAMMAR	3 (2+1)	SEM I

Theory

Prose: The Portrait of a Lady, We're Not Afraid to Die- if We Can All Be Together, Discovering Tut: the Saga Continues, Landscape of the Soul, The Summer of Beautiful White Horse, The Address, Ranga's Marriage, Albert Einstein at School; Poetry: A Photograph, The Laburnum Top.

Practical

Grammar: determiners; tenses: present tense, past tense, future tense; clauses: adjective clause, adverb clause, noun clause; modals.

Suggested Readings:

- Hornbill and Snapshots NCERT Books.

ENG 2	APPLIED GRAMMAR AND COMPREHENSION	3 (2+1)	SEM II

Theory

Prose: The Ailing Planet the Green, Movement's Role, The Browning Version, The Adventure, Silk Road, Mother's Day, The Ghat of the Only World, Birth, The Tale of Melon City; Poetry: The Voice of the Rain, Childhood, Father to Son.

Practical

Grammar: determiners; tenses: present tense, past tense, future tense; clauses: noun clause, adjective clause, adverb clause; modals.

Suggested Readings:

- Hornbill and Snapshots NCERT Books.

ENG 21	ENGLISH COMPOSITION AND COMPREHENSION	3 (2+1)	SEM III

Theory

Prose: The Last Lesson, Lost Spring, Deep Water, The Rattrap, The Third Level, The Tiger King, Journey to the End of Earth, The Enemy; Poetry: My Mother at Sixty Six, An Elementary School Classroom in a Slum, Keeping Quiet.

Practical

Grammar: tense (correct form of the verb); paragraph writing; comprehension passages (unseen); letter writing: formal and informal; narration.

Suggested Readings:

- Flamingo and Vistas NCERT Books.

ENG 22	FUNCTIONAL ENGLISH	3 (2+1)	SEM IV

Theory

Prose: Indigo, Poets and Pancakes, The Interview Part-I and Part-II, Going Places, Should Wizard Hit Mommy, On the Face of it, Evans Tries an O- Level, Memories of Childhood – The Cutting of My Long Hair, We Too are Human Beings; Poetry: A Thing of Beauty, Road Side Stand, Aunt Jennifer's Tiger.

Practical

Grammar: voice: active and passive voice; use of articles; modals; comprehension passages (unseen); notices.

Suggested Readings:

- Flamingo and Vistas NCERT Books.

ENG 101	COMPREHENSION AND COMMUNICATION SKILLS IN ENGLISH	2 (1+1)	SEM I/V

Theory

The pointed vision: an anthology of short stories by Usha Bande and Krishan Gopal; vocabulary-antonyms, synonyms, homophones, homonyms, often confused words; exercises to help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations; functional grammar: articles, prepositions, verb, subject-verb agreement, transformation, synthesis; direct and indirect narration; written skills: paragraph writing; precis writing; report writing and proposal writing; the style: importance of professional writing; preparation of curriculum vitae and job applications; synopsis writing; interviews: kinds, importance and process.

Practical

Listening comprehension: listening to short talks lectures, speeches (scientific, commercial and general in nature); oral communication: phonetics, stress and intonation; conversation practice; conversation: rate of speech, clarity of voice, speaking and listening, politeness & reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills; mock interview: testing initiative, team spirit: leadership, intellectual ability; group discussions.

Suggested Readings:

1. Bansal, R.K. and Harrison, J.B. (2015). Spoken English for India. Orient Longman Ltd., Hyderabad.
2. Gupta, R. (2015). Essentials of Communication. Pragati Prakashan, Meerut.
3. Hornby, A.S. (2016). Oxford Advanced Learner's Dictionary. Oxford University Press, Delhi.

4. Suri, P. L. and Pal, R. (2015). English Grammar and Composition. 19th Edition. Sultan Chand and Sons Publications.
5. Wren and Martin (2014). High School English Grammar & Composition. S. Chand & Company Pvt. Ltd. New Delhi.

ENG 102	GENERAL ENGLISH	2 (1+1)	SEM I

Theory

Word-Formation; prepositions; idiomatic expressions; conditional sentences and modal verbs; synthesis and transformation; essay writing (5 topics to be discussed); precis writing; The Bachelor of Arts by R.K. Narayan.

Practical

Based on lectures language work: the prescribed lessons having a bearing on the topics covered in lectures; identification of phonetic sounds and symbols; stress and intonation; listening, comprehension and conversation practice.

Suggested Readings:

1. Allen, W. S. (1962). Living English Structure. Orient Longmans, London.
2. George, H.V. (1970). Common Errors in English learning. M/s Newbury House, London.
3. Jones, D. (1993). Everyman's English Pronouncing Dictionary. University Book Stall, New Delhi.
4. Jones, D. (1970). An Outline of English Phonetics. Arnold, London.
5. Sharma, S.D. (1984). A textbook of Spoken and Written English. Vikas Publishers, Delhi.

ENG 103	TECHNICAL WRITING	2 (1+1)	SEM II

Theory:

Nature of technical versus general style; reading comprehension of general articles; writing process (prewriting, drafting, rewriting and editing); paragraph writing: definition, requirements of a good paragraph (unity, coherence and emphasis); various orders to develop a paragraph (inductive, deductive, questions to answers, exposition, time order, comparison and contrast, enumeration and space order); report writing: definition and cardinal characteristics of report, analysing the report, report formats-blank form, letter form, memorandum form and general survey report; technical correspondence (general principles of technical correspondence, parts of a letter (heading, address, salutation, body, complimentary closing, signature), types of letters (letters giving instructions, inquiries, answers to inquiries, complaints and adjustments, letter urging action, applications and resumes); vocabulary (synonyms, antonyms, homonyms); grammar (error analysis, concord, collocation and one word substitution and sentence construction).

Practical:

Exercise on identification of phonetic sounds, symbols, consonants, pure vowels, diphthongs, organs of speech, place of articulation and manner of articulation (voiceless and voiced sounds).

Suggested Readings:

1. Alvarez, J.A. (1980). The elements of technical writing. Harcourt, New York.
2. Bansal, R.K. and Harrison, J.B. (1983). Spoken English. Orient Longman, New Delhi.
3. Connor, J.D. (1992). Better English pronunciation. University Book Stall, New Delhi.
4. Jones, D. and Glimson, A.C. (1997). English pronouncing dictionary. London.

5. Krishnamohan and Banerjee, M. (1990). Developing Communication Skills. MacMillan India Ltd., New Delhi.
6. Leegget, G. C.; Mead, D. and Charvat, W. (1988). Essentials of grammar and composition. Prentice- Hall, New Delhi.
7. Sherman, T.A. and Simon, S. J. (1990). Modern technical writing. Prentice-Hall, New Jersey.
8. Strunk, Jr.; William and White, E.B. (1967). The elements of style. Macmillan, New York.

ENG 201	COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT	2 (1+1)	SEM III

Theory

Communication Skills: Structural and functional grammar-sentence construction (verb pattern), one word substitution, concord, collocation, tense, voice and transformation of sentences; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; group discussion. organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; bibliographic procedures; reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations, Introduction to phonetics.

Suggested Readings:

1. Hornby, A.S.(2015). Oxford Advanced Learner's Dictionary (9th Edition). Oxford University Press, Delhi.
2. Miglani, Seema &Shikha,Goyal. (2009). Communication Skills- I&II. . Vayu Education of India.
3. Gupta, Rajhans. (2006).The Essentials of Communication. PragatiPrakashan: Meerut.
4. Bansal, R.K. & HarrisonJ.B. (1988). Spoken English for India. Orient Longman Ltd. Hyderabad.
5. Aggarwal, N.K. (2014). A Senior English Grammar & Composition. Goyal Brothers Prakashan.
6. Suri, Prem Lata & Pal, Rajendra. (2016). English Grammar and Composition. Sultan Chand And Sons Publications.

MATHEMATICS, STATISTICS AND PHYSICS

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
MATHEMATICS			
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
MATH 1	Algebra and Trigonometry	5 (5+0)	I
MATH 2	Coordinate Geometry, Calculus and Elementary Statistics	5 (5+0)	II
MATH 21	Matrices, Determinants, Differential Calculus and Probability	5 (5+0)	III
MATH 22	Integral Calculus, Vectors and 3D Geometry	5 (5+0)	IV
	Total Credits	**20 (20+0)**	
Supporting Course for B. Sc. (Hons.) Community Science			
MATH 100	Introductory Mathematics (For students from Arts and Bio stream)	2 (2+0) NC	II
	Total Credits	**2 (2+0)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
MATH 101	Elementary Mathematics (For students from Biology stream)	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	
Supporting Courses for B. Tech. (Agricultural Engineering)			
MATH 104	Engineering Mathematics-I	3 (2+1)	I
MATH 105	Engineering Mathematics-II	3 (2+1)	II
MATH 201	Engineering Mathematics-III	3 (2+1)	III
	Total Credits	**9 (6+3)**	
STATISTICS			
Supporting Course for B. Sc. (Hons.) Community Science			
STAT 101	Elementary Statistics	3 (2+1)	V
	Total Credits	**3 (2+1)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
STAT 102	Statistical Methods	2 (1+1)	II/VI
	Total Credits	**2 (1+1)**	
PHYSICS			
Bridge Courses for B. Sc. (Hons.) Agriculture 6-Year Programme			
PHY 1	Principles of Physics-I	5 (4+1)	I
PHY 2	Principles of Physics-II	5 (4+1)	II
PHY 21	Principles of Physics-III	5 (4+1)	III
PHY 22	Principles of Physics-IV	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Supporting Course for B. Sc. (Hons.) Community Science			
PHY 100	Introductory Physics (For students from Arts stream)	4 (3+1)NC	II
	Total Credits	**4 (3+1)**	
Supporting Course for B. Tech. (Agricultural Engineering)			
PHY 101	Engineering Physics	3 (2+1)	I
	Total Credits	**3 (2+1)**	

MATH 1	ALGEBRA AND TRIGONOMETRY	5 (5+0)	SEM I

Theory

Sets: introduction and their representation, types of sets, empty set, finite set, infinite sets, equal sets, subsets, power set, universal set, complement of a set, Venn diagrams, operations on sets, practical problems on union and intersection of two sets; relations and functions: introduction, cartesian product of sets, relations, functions; trigonometric functions: introduction, angles, trigonometric functions, trigonometric function of sum and difference of two angles, trigonometric equations, principle of mathematical induction: introduction, motivation, principle of mathematical induction; complex numbers and quadratic equations: introduction, complex numbers, algebra of complex numbers, modulus and the conjugate of a complex number, Argand plane and polar representation, quadratic equations; linear inequalities: introduction, inequalities, algebraic solutions of linear inequalities in one variable and their graphical representation, graphical solution of linear inequalities in two variables, solution of system of linear inequalities in two variables; permutation and combinations: introduction, fundamental principle of counting, factorial n, permutation, combination; binomial theorem: introduction, binomial theorem for positive integral indices, general and middle term in binomial expansion, simple applications.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class – XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.
4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017)**.** Mathematics Vol. 1 & 2**,** Dhanpat Rai Publications.

MATH 2	COORDINATE GEOMETRY, CALCULUS AND ELEMENTARY STATISTICS	5 (5+0)	SEM II

Theory

Sequences and series: introduction, sequences, series, arithmetic progression (A.P), geometric progression (G.P.), relation between A.M. and G.M, sum to n terms of the special series; straight lines: introduction, slope of a line, various forms of the equation of a line, general equation of a line, distance of a point from a line, conic section: introduction, sections of a cone, circle, parabola, ellipse, hyperbola; three dimensional geometry: introduction, coordinate axes and coordinate planes in three dimensional space, coordinates of a point in space, distance between two points, section formula; limits and derivatives: introduction, intutive idea of derivatives, limits, limits of trigonometric functions, derivatives; mathematical reasoning: introduction, statements, new statements from old, special words phrases, implications, validating statements; statistics: introduction, measure of dispersion, range, mean deviation, variance and standard deviation analysis of frequency distributions; probability: introduction, random experiments, events, axiomatic approach to probability.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class – XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.
4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017)**.** Mathematics Vol. 1 & 2**,** Dhanpat Rai Publications.

MATH 21	MATRICES, DETERMINANTS, DIFFERENTIAL CALCULUS AND PROBABILITY	5 (5+0)	SEM III

Theory

Relations and functions: introduction, types of relations, types of functions, composition of functions, invertible functions, binary operations; inverse trigonometric functions: introduction, basic concepts, properties of inverse trigonometric functions; matrices: introduction, matrix, types of matrices, operations on matrices, transpose of a matrix, symmetric and skew symmetric matrices, elementary (operations) transformations, invertible matrices; determinants: introduction, applications of determinant, properties of determinants, area of a triangle, minors and cofactors, adjoint and inverse of ants and matrices; continuity and differentiability: introduction, continuity, differentiability; continuity of exponential and logarithmic functions, logarithmic differentiations, derivative of functions in parametric forms, second order derivative; mean value theorem; probability: introduction, conditional probability, multiplication theorem on probability, independent events, Baye's theorem, random variable and its probability distributions, Bernouli trials and binomial distribution.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class – XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.
4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017)**.** Mathematics Vol. 1 & 2**,** Dhanpat Rai Publications.

MATH 22	INTEGRAL CALCULUS, VECTORS AND 3D GEOMETRY	5 (5+0)	SEM IV

Theory

Application of derivatives: introduction, rate of change of quantities, increasing and decreasing functions, tangents and normal, approximations, maxima and minima; integrals: integration as inverse process of differentiation, methods of integration, integrals of some particular functions, integration by partial fractions, integration by parts, definite integrals, fundamental theorem of calculus, evaluation of definite integrals by substitution, some properties of definite integrals; application of integrals: introduction, area under simple curves, area between two curves; differential equations: introduction, basic concepts, general and particular solutions of a differential equation; formation of a differential equation whose general solution is given, methods of solving first order, first degree differential equations; vector algebra: introduction, some basic concepts, types of vectors, addition of vectors, multiplication of a vector by a scalar, product of two vectors; three dimensional geometry: introduction, direction cosines and direction ratios of a line, equation of a line in space; angle between two lines, shortest distance between two lines, plane, coplanirity of two lines, angle between two planes, distance of a point from a plane, angle between a line and a plane; linear programming: introduction, linear programming problem and its mathematical formulation, different type of linear programming problems.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class – XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.

4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017). Mathematics Vol. 1 & 2, Dhanpat Rai Publications.

MATH 100	INTRODUCTORY MATHEMATICS (For B. Sc. (Hons.) Community Science Students from Arts and Bio stream)	2 (2+0) NC	SEM II

Theory

Algebra: arithmetic series, geometric series and problems based on these, permutations of n different things, permutation of n things when some or all of them are alike, circular permutation, combinations, binomial theorem, matrices and their properties, determinants, adjoint of matrix, inverse of a matrix, solution of linear equations by matrices and determinants; co-ordinate geometry: distance between two points, section-formulae, area of a triangle, straight line, various forms of the equation of a line, angle between two lines, distance of a point from a line; trigonometry: T-ratios of five standard angles, heights and distances, allied angles, addition and subtraction formulae, sum and product formulae; differential calculus: limit, continuity and differentiation of function, maxima and minima of functions of single variable; integral calculus: elementary integration, integration by substitution and by parts.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class – XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.
4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017). Mathematics Vol. 1 & 2, Dhanpat Rai Publications.

MATH 101	ELEMENTARY MATHEMATICS	2 (1+1)	SEM I/V

Theory

Distance formula, section formula, area of a triangle, change of axes (only origin changed); straight line: equation of co-ordinate axes, equations of lines parallel to axes, slope-intercept form, slope-point form, two point form, intercept form, normal form and general form of equation of a line, point of intersection of two straight lines, angles between two straight lines; circle: equation of circle whose centre and radius is known, general equation of a circle, equation of circle passing through three given points, equation of a circle in diameter form; trigonometry: addition and subtraction formulae, multiple and submultiples angles; differential calculus: definition of function, limit and continuity, limit, continuity, differentiation of x^n , e^x , sin x & cos x from first principle, derivatives of sum, difference, product and quotient of two functions, differentiation of functions of functions, logarithmic differentiation, differentiation of parametric functions; differentiation of inverse trigonometric functions; maxima and minima of the functions of the form y=f (x); integral calculus: integration of simple functions, integration by substitution method, by parts and by partial fraction methods; definite integral (simple problems based on it), area under simple well-known curves; matrices and determinants: definition of matrices, addition, subtraction, multiplication, transpose and inverse up to 3rd order, properties of determinants up to 3rd order and their evaluation.

Practical

Problem based on finding distance between two points, section formula and area of a triangle; problem based on different forms of straight lines, angle between two lines and simple problems on

finding equation of a circle; problems based on applications of trigonometry; simple problems on finding limit, continuity and derivatives of different type of functions; simple problems based on application of derivatives to find maxima and minima of functions; problems based on finding integration of functions by different methods and application of integration to find area under simple curves; problems on addition, multiplication, transpose and inverse of the matrix; problems based on solution of system of equations.

Suggested Readings:

1. Aggarwal, M.L. (2017). Hints and Solutions Mathematics Class–XI & XII, Arya Publications.
2. Aggarwal, R.S. (2017). Senior Secondary School Mathematics for Class 11 & 12, Bharati Bhawan Publishers & Distributors, Thirteenth edition.
3. Dass, H.K. and Verma, R. (2005). S. Chand's Mathematics for Class XII, Vol. I & II, S Chand Publishing.
4. Mathematics Textbook for Class 11 &12 (2012). NCERT, First edition.
5. Sharma, R.D. (2017). Mathematics Vol. 1 & 2, Dhanpat Rai Publications.

MATH 104	ENGINEERING MATHEMATICS-I	3 (2+1)	SEM I

Theory

Matrices: elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, eigen values and eigen vectors, cayley-hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, quadratic forms. PAQ form, echelon form, solution of linear equations, nature of rank, using Cayley-Hamilton theorem to find inverse of a mztrix. Differential calculus: Taylor's and Maclaurin's expansions; indeterminate form; curvature, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, maxima and minima; integral calculus: volumes and surfaces of revolution of curves; double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume. vector calculus: differentiation of vectors, scalar and vector point functions, vector differential operator del, gradient of a scalar point function, divergence and curl of a vector point function and their physical interpretations, identities involving del, second order differential operator; line, surface and volume integrals, stoke's, divergence and green's theorems (without proofs).

Practical

Tutorials on rank of a matrix, reduction to normal form, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, diagonalization of matrices, quadratic forms; Taylor's and Maclaurin's expansion, indeterminate form, curvature, tracing of curves, partial differentiation, maxima and minima, volume and surface of revolution, multiple integrals, Beta and Gama functions, differentiation of vectors, gradient, divergence and curl of a vector point function, line, surface and volume integrals, Stoke's divergence and Green's Theorems.

Suggested Readings:

1. Grewal, B. S. (2017). Higher Engineering Mathematics, Khanna Publications, 44th Edition.
2. Bali, N. P. (2016). A Textbook of Engineering Mathematics, Laxmi Publications (P) Ltd, 12th Edition.
3. Sastry, S. S. (2012). Engineering Mathematics, PHI Learning Private Limited, 4th Edition.
4. Dass, H. K. and Verma, Rajnish (2014). Higher Engineering Mathematics, S Chand publishing.
5. Kreyszig, Erwin (2015). Advanced Engineering Mathematics, Wiley, 10th Edition.

MATH 105	ENGINEERING MATHEMATICS-II	3 (2+1)	SEM II

Theory

Ordinary differential equations: exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques, Bessel's and Legendre's differential equations; functions of a complex variable: limit, continuity and analytic function, cauchy-riemann equations, harmonic functions. infinite series and its convergence, periodic functions, fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, harmonic analysis. Fourier sine and cosine series, Fourier series for function having period 2L, elimination of one and two arbitrary function; partial differential equations: formation of partial differential equations higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one dimensional wave and heat flow equations, Laplace Equation.

Practical

Tutorials on solution of ordinary differential equations of first and higher orders; series solutions of differential equations; Bessel's and Legendre's differential equations, Convergence of infinite series; Fourier series, harmonic analysis, analytical functions, Cauchey-Riemann equations, harmonic functions, Solution of partial differential equations, Application of partial differential equations.

Suggested Readings:

1. Grewal, B. S. (2017). Higher Engineering Mathematics, Khanna Publications, 44th Edition.
2. Bali, N. P. (2016). A Textbook of Engineering Mathematics, Laxmi Publications (P) Ltd, 12th Edition.
3. Sastry, S. S. (2012). Engineering Mathematics, PHI Learning Private Limited, 4th Edition.
4. Dass, H. K. and Verma, Rajnish (2014). Higher Engineering Mathematics, S Chand publishing.
5. Kreyszig, Erwin (2015). Advanced Engineering Mathematics, Wiley, 10th Edition.

MATH 201	ENGINEERING MATHEMATICS-III	3 (2+1)	SEM III

Theory

Numerical analysis: finite difference, various difference operators and their relationships; factorial notation, interpolation with equal integrals; Newton's forward and backward interpolation formula. Bessel's and Stirling's difference interpolation formulae; interpolation with unequal intervals; Newton's divided difference formula. Lagrange's interpolation formula; numerical differentiations, numerical integrations, difference equations and their solutions, numerical solutions of ordinary differential equations by Picard's Taylor's series; Fuller's and modified Fuller's methods; Runga-Kutta method; Laplace transformation and its applications to the solutions of ordinary and simultaneous differential equations; testing of hypothesis-level of significance-degrees of freedom-statistical errors, large sample test (z-test), small sample test t-test (one tailed, two tailed and paired tests), testing of significance through variance (F-test), Chi -square test, contingency table, correlation, regression.

Practical

Interpolation, numerical differentiation and integration solutions of difference equations, numerical solution of ordinary differential equations of first order and first degree, laplace and inverse Laplace transformations and their application to solution of ordinary and simultaneous differential equations;

problems on one Sample, two sample Z-tests when population S.D. is known and unknown, problems on one sample, two sample and paired t-test, Chi-square test – 2x2 and m x n, calculation of correlation coefficient and its testing, contingency Table and F-test.

Suggested Readings:

1. Grewal, B. S. (2017). Higher Engineering Mathematics, Khanna Publications, 44th Edition.
2. Bali, N. P. (2016). A Textbook of Engineering Mathematics, Laxmi Publications (P) Ltd, 12th Edition.
3. Dass, H. K. and Verma, Rajnish (2014). Higher Engineering Mathematics, S Chand publishing.
4. Kreyszig, Erwin (2015). Advanced Engineering Mathematics, Wiley, 10th Edition.
5. Gupta, S. C. and Kapoor, V. K. (2014). Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

STAT 101	ELEMENTARY STATISTICS	3 (2+1)	SEM V

Theory

Introduction to statistics: definitions, functions, uses and limitations; classification and tabulation of data: qualitative and quantitative classification, discrete and continuous variables, frequency tables of grouped and ungrouped data; diagrammatic representation of data: one, two and three dimensional diagrams with applications; graphical representation of data: histogram, frequency polygon, frequency curve, ogives; measures of central tendency: introduction to basic concepts of logarithms, AM, GM, HM, median and mode with merits, demerits and uses, relationship between AM, GM and HM, quartile deviation, mean deviation from AM, median and mode; measures of dispersion: range coefficients, inter quartile range, quartile deviation, coefficient of quartile deviation, variance, standard deviation, coefficient of variation; moments: raw moments, central moments for ungrouped and grouped data, relationship between raw moments and central moments; measures of skewness and kurtosis: definitions of symmetrical distribution, skewness and kurtosis, relationship between mean, median and mode and between quartiles for symmetrical and skewed distributions; probability theory: introduction to simple problems of permutations and combinations, definition of random experiment, sample space, events, mutually exclusive and equally likely events, definition of probability, simple problems based on probability, addition and multiplication theorem of probability, conditional events and independent events; correlation and linear regression analysis: definition of correlation and its types, scatter diagram, Karl Pearson's formula of correlation coefficient, properties of correlation coefficient, definition of regression, regression equations of Y on X and of X on Y, relationship between correlation coefficient and regression coefficients, problems based on correlation and regression; tests of significance: basic definitions, hypothesis, null and alternative hypothesis, tests statistic, testing of hypothesis, one sample t-test and two sample fisher's t-test; Chi-square test of goodness of fit and Chi-square test of independence of attributes; introduction to sampling methods: definition of population, random sample, sampling versus complete enumeration.

Practical

Graphical representation of data; diagrammatic representation of data; measures of central tendency with calculation of quartiles, deciles and percentiles for ungrouped and grouped data; measures of dispersion for ungrouped and grouped data; moments: measures of skewness and kurtosis for ungrouped and grouped data; correlation and regression analysis; application of one sample t-test and two sample Fisher's t-test; Chi-square test of goodness of fit and Chi-square test of independence of attributes.

Suggested Readings:

- Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan chand and sons. New Delhi.
- Nageswara Rao, G. 2007. Statistics for Agricultural Sciences. B.S. Publications, Hyderabad.
- Rangaswamy, R.1995. A Text Book of Agricultural Statistics. New Age International Publishing Limited, Hyderabad.

STAT 102	STATISTICAL METHODS	2 (1+1)	SEM II/VI

Theory

Introduction to statistics and its applications in agriculture, graphical representation of data, measures of central tendency & dispersion, definition of probability, addition and multiplication theorem (without proof); simple problems based on probability; binomial & poisson distributions, definition of correlation, scatter diagram; Karl Pearson's coefficient of correlation; linear regression equations; introduction to test of significance, one sample & two sample t-test for means, chi-square test of independence of attributes in 22 contingency table; introduction to analysis of variance, analysis of one way classification; introduction to sampling methods, sampling versus complete enumeration, simple random sampling with and without replacement, use of random number tables for selection of simple random sample.

Practical

Graphical representation of data; measures of central tendency (ungrouped data) with calculation of quartiles, deciles & percentiles; measures of central tendency (grouped data) with calculation of quartiles, deciles & percentiles; measures of dispersion (ungrouped data); measures of dispersion (grouped data); moments, measures of skewness & kurtosis (ungrouped data); moments, measures of skewness & kurtosis (grouped data); correlation & regression analysis; application of one sample *t*-test; application of two sample Fisher's *t*-test; chi-square test of goodness of fit; chi-square test of independence of attributes for 22 contingency table; analysis of variance one way classification; analysis of variance two way classification; selection of random sample using simple random sampling.

Suggested Readings:

1. Aggarwal, B.L. (2015). Basic Statistics, New Age International.
2. Chandel, S.R.S. (2015). A Handbook of Agricultural Statistics, Achal Prakashan Mandir, Kanpur.
3. Gupta, S C. (2009). Fundamentals of Statistics, Himalaya Publishing House, New Delhi.
4. Gupta, S.C. and Kapoor, V.K. (2015). Fundamental of Mathematical Statistics, S.Chand & Co., New Delhi.
5. Jain, P.R. and Aggarwal, S.C. (2017). Business Statistics, VK Global Publication.

PHY 1	PRINCIPLES OF PHYSICS-I	5 (4+1)	SEM I

Theory

Physical world and measurements: scope and excitement of physics, nature of physical laws, physics, technology and society, need for measurement, units of measurement, systems of units, SI units, fundamental and derived units, length, mass and time measurements, accuracy and precision of measuring instruments, significant figures, dimensions of physical quantities, dimensional analysis and its applications; kinematics: frame of reference, motion in a straight line-position-time graph, speed and velocity; uniform and non-uniform motion; speed and velocity: average and instantaneous;

uniformly accelerated motion, velocity-time graph and position-time graph, equations for uniformly accelerated motion - graphical treatment only; simple introduction to elementary concepts of differentiation and integration for describing motion; scalar and vector quantities: vectors, notation, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors; position and displacement vectors, relative velocity, unit vector; resolution of a vector in a plane: rectangular components, motion in a plane; projectile motion, circular motion; laws of motion: Aristotle's fallacy, the law of inertia, Newton's first law of motion, Newton's second law of motion, Newton's third law of motion; conservation of momentum; equilibrium of particle; common forces of mechanics; circular motion; solving problems in mechanics; work, energy and power: definition of work and kinetic energy, work-energy theorem, work done by a constant force and a variable force; kinetic energy, concept of potential energy, potential energy of a spring, conservative forces-conservation of mechanical energy-kinetic and potential energies; non-conservative forces: elastic collisions and elementary idea of inelastic collisions; system of particles and rotational motion: centre of mass; motion of centre of mass; linear momentum of a system of particles; vector product of two vectors; angular velocity and its relation with linear velocity; torque and angular momentum; equilibrium of rigid body; moment of inertia; theorems of perpendicular and parallel axes; kinematics of rotational motion about a fixed axis; dynamics of rotational motion about a fixed axis; angular momentum in case of rotations about a fixed axis.

Practical

The use of Vernier callipers: to measure diameter of a small spherical/cylindrical body, to measure dimensions of a given regular body of known mass and hence find its density, to measure internal diameter and depth of a given beaker/calorimeter and hence find its volume; use of screw gauge to measure diameter of a given wire and to measure thickness of a given sheet; to determine radius of curvature of a given spherical surface by a spherometer; to find the weight of a given body using parallelogram law of vectors; using a simple pendulum, plot L-T and L-T^2 graphs: to find the effective length of second's pendulum using appropriate graph, to find acceleration due to gravity; to study the relationship between force of limiting friction and normal reaction and to find co-efficient of friction between a block and a horizontal surface.

Activities on: to make a paper scale of given least count, e.g. 0.2cm, 0.5cm.; to determine mass of a given body using a metre scale by principle of moments; to plot a graph for a given set of data, with proper choice of scales and error bars; to measure the force of limiting friction for rolling of a roller on a horizontal plane; to study the variation in range of a jet of water with angle of projection; to study the conservation of energy of a ball rolling down on inclined plane using a double inclined plane.

Suggested Readings:

1. Physics – Text book for class XI, NCERT, New Delhi.
2. Physics – Text book for class XII, NCERT, New Delhi.

PHY 2	PRINCIPLES OF PHYSICS-II	5 (4+1)	SEM II

Theory

Gravitation: Kepler's laws of planetary motion, the universal law of gravitation, acceleration due to gravity and its variation with altitude and depth, gravitational potential energy, gravitational potential, escape speed; earth satellite, energy of orbital satellite; geostationary satellites, weightlessness, mechanical properties of solids, fluid and matter: elastic behaviour of solids, stress-strain; Hooke's law; stress strain curve, elastic moduli, applications of elastic behaviour of materials; pressure; streamline flow; Bernoulli's principle, viscosity; Reynolds number; surface tension; heat temperature, thermal expansion, specific heat capacity – calorimetry, change of state – latent heat, heat transfer, conduction, convection and radiation; thermal conductivity, newton's law of cooling;

thermodynamics: thermal equilibrium and definition of temperature- zeroth law of thermodynamics; heat, work and internal energy; first law of thermodynamics; second law of thermodynamics: reversible and irreversible processes; heat engines and refrigerators; kinetic theory and behavior of perfect gas: molecular nature of matter, behaviour of gases; kinetic theory of an ideal gas; law of equipartition of energy; specific heat capacity; mean free path; oscillations and waves: periodic and oscillatory motions; simple harmonic motion and uniform circular motion; velocity and acceleration in simple harmonic motion; force law for simple harmonic motion; energy in simple harmonic motion; some systems executing simple harmonic motion; damped simple harmonic motion; forced oscillations and resonance; transverse and longitudinal waves; displacement relations in a progressive wave; speed of a traveling wave; principle of superposition of waves; reflection of waves; beats; Doppler effect.

Practical

To determine Young's modulus of elasticity of the material of a given wire; to find the force constant of a helical spring by plotting graph between load and extension; to study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between P and V, and between P and I/V; to determine the surface tension of water by capillary rise method; to determine the coefficient of viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body; to study the relationship between the temperature of a hot body and time by plotting a cooling curve; to study the relation between frequency and length of a given wire under constant tension and the relation between the length of a given wire and tension for constant frequency using sonometer; to find the speed of sound in air at room temperature using a resonance tube by two resonance positions; to determine specific heat capacity of a given solid, liquid, by method of mixtures.

Activities: to observe change of state and plot a cooling curve for molten wax; to observe and explain the effect of heating on a bi-metallic strip; to note the change in level of liquid

in a container on heating and interpret the observations; to study the effect of detergent on surface tension by observing capillary rise; to study the factors affecting the rate of loss of heat of a liquid; to study the effect of load on depression of a suitably clamped metre scale loaded at its end in the middle.

Suggested Readings:

1. Physics – Text book for class XI, NCERT, New Delhi.
2. Physics – Text book for class XII, NCERT, New Delhi.

PHY 21	PRINCIPLES OF PHYSICS-III	5 (4+1)	SEM III

Theory

Electrostatics: electric charges, conductors and insulators, charging by induction, basic properties of electric charge, coulomb's law, forces between multiple charges, electric field, electric field lines, electric flux, electric dipole, dipole in a uniform external field; continuous charge distribution, gauss's law, application of gauss's law; electrostatic potential; potential due to a point charge; potential due to an electric dipole; potential due to a system of charges; equipotential surfaces; potential energy of a system of charges; potential energy in an external field; electrostatics of conductors; dielectrics and polarization; capacitors and capacitance; parallel plate capacitor; effect of dielectric on capacitance; combination of capacitors; energy stored in a capacitor; van de graaff generator.

Current electricity: electric current; electric currents in conductors; ohm's law; limitations of ohm's law; drift of electrons and the origin of resistivity; resistivity of various materials; temperature dependence of resistivity; electrical energy, power; combination of resistors-series and parallel; cells, emf, internal resistance, cells in series and in parallel; kirchhoffs laws; wheatstone bridge; meter bridge; potentiometer; magnetic effects of current: magnetic force; motion in a magnetic field;

motion in combined electric and magnetic fields; magnetic field due to a current element, Biot-Savart law; magnetic field on the axis of a circular current loop; Ampere's circuital law; solenoid and toroid; force between two parallel currents, the ampere; torque on current loop, magnetic dipole; moving coil galvanometer; bar magnet; magnetism and gauss's law; earth's magnetism; magnetization and magnetic intensity; magnetic properties of materials; permanent magnets and electromagnets; electromagnetic induction and alternating currents: experiments of Faraday and Henry; magnetic flux; Faraday's law of induction; Lenz's law and conservation of energy; motional electromotive force; energy consideration - a quantitative study; eddy currents; inductance, AC generator, AC voltage applied to a resistor, representation of AC current and voltage by rotating vectors – phasors, AC voltage applied to an inductor, AC voltage applied to a capacitor, AC voltage applied to a series LCR circuit, power in ac circuit - power factor; LC oscillations; transformers.

Practical

To determine resistance per cm of a given wire by plotting a graph of potential difference versus current; to find resistance of a given wire using metre bridge and hence determine the specific resistance of its material; to verify the laws of combination of resistances -series/parallel using a metre bridge; to compare the emf of two given primary cells using potentiometer; to determine the internal resistance of given primary cell using potentiometer; to determine resistance of a galvanometer by half-deflection method and to find its figure of merit; to convert the given galvanometer of known resistance and figure of merit into an ammeter and voltmeter of desired range and to verify the same; to find the frequency of the a.c. mains with a sonometer.

Activities on: to measure the resistance and impedance of an inductor with or without iron core; to measure resistance, voltage (AC/DC), current (AC) and check continuity of a

given circuit using multimeter; to assemble a household circuit comprising three bulbs, three (on/off) switches, a fuse and a power source; to assemble the components of a given electrical circuit; to study the variation in potential drop with length of a wire for a steady current; to draw the diagram of a given open circuit comprising at least a battery, resistor/rheostat, key, ammeter and voltmeter; mark the components that are not connected in proper order and correct the circuit and also draw the circuit diagram.

Suggested Readings:

1. Physics – Text book for class XI, NCERT, New Delhi.
2. Physics – Text book for class XII, NCERT, New Delhi.

PHY 22	PRINCIPLES OF PHYSICS-IV	5 (4+1)	SEM IV

Theory

Electromagnetic waves: displacement current; electromagnetic waves and their qualitative characteristics; transverse nature of electromagnetic waves, electromagnetic spectrum; radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays including elementary facts about their uses.

Optics: reflection of light by spherical mirrors, total internal reflection; refraction; refraction at spherical surfaces and by lenses; refraction through a prism; dispersion by a prism; some natural phenomena due to sunlight; optical instruments; Huygens principle; refraction and reflection of plane waves using Huygens principle, coherent and incoherent addition of waves, interference of light waves and young's experiment; diffraction; polarization; dual nature of matter and radiation: dual nature of radiation; photoelectric effect, experimental observation and their significance, hertz and lenard's observations; Einstein's photoelectric equation- particle nature of light – photon; wave nature of matter, Davisson-Germer experiment; atoms and nuclei: alpha-particle scattering

experiment; Rutherford's model of atom; Bohr model; energy levels, hydrogen spectrum; composition and size of nucleus, atomic masses, isotopes, isobars; isotones; radioactivity alpha, beta and gamma particles/rays and their properties, radioactive decay law, mass-energy relation, mass defect, binding energy per nucleon and its variation with mass number, nuclear fission, nuclear reactor, nuclear fusion; electronic devices: classification of metals, conductors and semiconductors; intrinsic semiconductor, extrinsic semiconductor; semiconductor diode; p-n junction; application of junction diode as a rectifier, special purpose p-n junction diodes, junction transistor; digital electronics and logic gates; integrated circuits; communication devices: elements and basic terminology used in communication system, bandwidth of signals, bandwidth of transmission medium, propagation of electromagnetic waves; need for modulation; production and detection of an amplitude-modulated wave.

Practical

To find the value of v for different values of u in case of a concave mirror and to find the focal length; to find the focal length of a convex lens by plotting graphs between u and v or between l/u and l/v; to find the focal length of a convex mirror, using a convex lens; to find the focal length of a concave lens, using a concave lens; to determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation; to determine refractive index of a glass slab using a traveling microscope; to find refractive index of a liquid by using a convex lens and plane mirror; to draw the I-V characteristic curve of a p-n junction in forward bias and reverse bias; to draw the characteristic curve of a zener diode and to determine its reverse break down voltage; to study the characteristics of a common - emitter npn or pnp transistor and to find out the values of current and voltage gains.

Activities on: to study effect of intensity of light by varying distance of the source on an L.D.R.; to identify a diode, an LED, a transistor, and IC, a resistor and a capacitor from mixed collection of such items; use of multimeter to identify base of transistor, distinguish between npn and pnp type transistors, see the unidirectional flow of current in case of a diode and an LED; check whether a given electronic component (e.g. diode, transistor or IC) is in working order; to observe refraction and lateral deviation of a beam of light incident obliquely on a glass slab; to observe polarization of light using two polaroids; to observe diffraction of light due to a thin slit; to study the nature and size of the image formed by convex lens and concave mirror on a screen by using a candle and a screen for different distances of the candle from the lens/ mirror; to obtain a lens combination with the specified focal length by using two lenses from the given set of lenses.

Suggested Readings:

1. Physics – Text book for class XI, NCERT, New Delhi.
2. Physics – Text book for class XII, NCERT, New Delhi.

PHY 100	INTRODUCTORY PHYSICS (For B. Sc. (Hons.) Community Science Students from Arts stream)	4 (3+1) NC	SEM II

Theory

Units, dimensions and measurements; motion in one dimension, equations of motion: position time graph, velocity time graphs; vectors, composition and resolutions, force and inertia, first law of motion, momentum, second law of motion, third law of motion and friction; kinetic and potential energies, conservation of energy, mass energy equivalence and law of conservation of energy; gravity, gravitation, Newton's laws of gravitation, variation of 'g' with altitude, depth; satellites and their applications; fundamentals of heat flow and measurement of temperature, refrigerators, solar cooker; reflection of light, refraction of light, dispersion, optical instruments: microscope, telescope; electric current; elementary idea of magnetic effect of current, electromagnetic induction: AC

generator, DC motor, transformer, household wiring, fuse, heater, geyser, vacuum cleaner; washing machine and thermostat.

Practical

Use of vernier caliper; 'g' by simple pendulum; refraction through slab, refraction through prism; focal length of concave mirror and convex lens; Ohm's law.

Suggested Readings:

1. Physics – Text book for class XI, NCERT, New Delhi.
1. Physics – Text book for class XII, NCERT, New Delhi.

PHY 101	ENGINEERING PHYSICS	3 (2+1)	SEM I

Theory

dia, para and ferromagnetism-classification. langevin theory of dia and paramagnetism. adiabatic demagnetization; weiss molecular field theory and ferromagnetism; curie-weiss law; wave particle quality, de-broglie concept, uncertainty principle; wave function; time dependent and time independent schrodinger wave equation, qualitative explanation of zeeman effect, stark effect and paschan back effect, raman spectroscopy; statement of bloch's function; bands iii solids, velocity of bloch's electron and effective mass; distinction between metals; insulators and semiconductors; intrinsic and extrinsic semiconductors, law of mass action; determination of energy gap in semiconductors; donors and acceptor levels; superconductivity, critical magnetic field; meissner effect; isotope effect; type-i and ii superconductors, josephson's effect DC and AC, squids; introduction to high t_c superconductors. spontaneous and stimulated emission, einstein a and b coefficients; population inversion, he-ne and ruby lasers; ammonia and ruby masers, holography-note; optical fiber; physical structure; basictheory; mode type, input output characteristics of optical fiber and applications; illumination: laws of illumination, luminous flux, luminous intensity, candle power, brightness.

Practical

To find the frequency of A.C. supply using an electrical vibrator; to find the low resistance using Carey Foster Bridge without calibrating the bridge wire; To determine dielectric constant of material using De Sauty's Bridge; to determine the value of specific charge (e/m) for electrons by helical method; to study the induced e.m.f. as a function of velocity of the magnet; to obtain hysteresis curve (B-H curve) on a C.R.O. and to determine related magnetic quantities; to study the variation of magnetic field with distance along the axis of a current carrying circular coil and to detuning the radius of the coil; to determine the energy band gap in a semiconductor using a p-n Junction diode; to determine the slit width from Fraunhofer diffraction pattern using laser beam; to find the numerical aperture of optical fiber: to set up the fiber optic analog and digital link; to study the phase relationships in L.R. circuit; to study LCR circuit; to study the variations of thermo emf of a copper-constantan thermo-couple with temperature; to find the wave length of light by prism.

Suggested Readings:

1. Jain, Mahesh C.(2010). Textbook of Engineering Physics, PHI Learning Pvt.Ltd, N.Delhi.
2. Taneja, S.P. (2011). Modern Physics for Engineers, R.Chand&Co, N.Delhi.
3. Singh, Devraj (2010). Fundamentals of Optics, PHI Learning Pvt.Ltd, N.Delhi.
4. Prakash, Satya (2015). Engineering Physics, PragatiPrakashnan, Meerut.
5. Rajam, J.B. (2004). Atomic Physics, S.Chand&Co, N.Delhi.

MICROBIOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Supporting Course for B. Sc. (Hons.) Community Science			
MICRO 101	Fundamentals of Food Microbiology	3 (2+1)	IV
	Total Credits	**3 (2+1)**	
Supporting Courses for B. Sc. (Hons.) Agriculture			
MICRO 102	Agricultural Microbiology	2 (1+1)	II/VI
MICRO 204/ SOILS 204/ AGRON 206	Agricultural Waste Management (To be taught jointly by Soil Science, Agronomy and Microbiology)	2 (1+1)	IV/VIII
	Total Credits	**4 (2+2)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 8	Bioagents and Biofertilizers Production	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

MICRO 101	FUNDAMENTALS OF FOOD MICROBIOLOGY	3 (2+1)	SEM IV

Theory

Introduction, scope and brief history of food microbiology; prokaryotic and eukaryotic cell organization; major groups of microorganisms associated with food; sources of microbial contamination in food; factors affecting growth and survival of microorganisms in foods; physical and chemical methods to control microorganisms; food fermentations: traditional, fermented foods based on milk, meat, grains, fruits, vegetables and beverages; probiotics, prebiotics and synbiotics; microorganisms and food spoilage: spoilage of milk, meat, grains, fruits and vegetables; principles of food preservation; food poisoning and food borne infections: microbial toxins, indicator organisms; rapid methods for detection of microorganisms.

Practical

Microscopic examination of bacteria, yeast and molds; preparation of media; methods of sterilization, isolation, purification and maintenance of microorganisms; microbiological examination of milk, grains, fruit and vegetables.

Suggested Readings:

1. Banawart, G.J. (1989). Basic food microbiology (2nd Ed.). AVI Publ.
2. Frazie,r J. and Westhoff, D.C. (1988). Food microbiology (4th Ed.) McGraw Hill.
3. Garbutt, J. (1997). Essentials of food microbiology. Arnold Heinemann.
4. Jay, J.M., Loessner, M.J. and Golden, D.A. (2005). Modern food microbiology (7th Ed.) Springer.
5. Ray, B. (2004). Fundamentals of food microbiology (3rd Ed.). CRC.
6. Robinson, R.K. (Ed.). (1983). Dairy microbiology. Applied Science.
7. Steinkraus, K.S. (1996). Handbook of Indigenous Fermented Foods. Marcel Dekker.

MICRO 102	AGRICULTURAL MICROBIOLOGY	2 (1+1)	SEM II/VI

Theory

Introduction, history of microbiology; contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall, Winogradsky, Beijernick; microbial world: prokaryotic and eukaryotic microbes; bacteria: cell structure, classification of bacteria on the basis of nutritional attributes; microbial

growth; bacterial genetics: genetic recombination- transformation, conjugation and transduction, plasmids; role of microbes in soil fertility and crop production: carbon, nitrogen, phosphorus and sulphur cycles; biological nitrogen fixation- symbiotic, associative and aysmbiotic; mycorrhiza; rhizosphere and phyllosphere; biofertilizers and biopesticides.

Practical

Introduction to microbiology laboratory and its equipments; bright field microscope- parts and principles, resolving power and numerical aperture; staining: simple staining, gram staining and negative staining; media preparation and sterilization; methods of isolation and purification of microbial cultures using pour, spread and streak plate methods; demonstration of ubiquitous nature of microorganisms; enumeration of bacteria and fungi in soil.

Suggested Readings:

1. Pathak, D.V., Tikoo, A. and Goyal, S. (2016). Introductory Microbiology. Daya Publishing House, Astral International Pvt. Ltd., New Delhi.
2. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
3. Rangaswami, G. and Bagyaraj, D.J. (1992). Agricultural Microbiology. Asia Publishing House, New Delhi.
4. Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
5. Tauro, P., Kapoor, K.K. and Yadav, K.S. (1991). An Introduction to Microbiology. New Age Internaional Pvt. Ltd, New Delhi.

MICRO 204/ SOILS 204/ AGRON 206	AGRICULTURAL WASTE MANAGEMENT	2 (1+1)	SEM IV/VIII

Theory

Introduction to agricultural waste management; nature and characteristics of agricultural waste and their impact on the environment; kinds of wastes; classification, role of soil and plants in waste management, sources of waste, impact of waste on soil and plant quality; biological processes of waste management, utilization and recycling of agricultural waste, potential of recyclable crop residues and its management, in-situ management of agriculture waste, composting and vermicomposting for bio-conservation of biodegradable waste, biogas technology, agricultural waste and water, air and animal resources, impacts of waste on human, animal health and environment; management of bedding & litter, waste feed, run-off from feed lots and holding areas and waste water form dairy parlors, agro-waste recycling through farming system, waste management machineries, environmental benefit of waste management.

Practical

Collection and preparation agricultural waste sample; determination of pH, EC, CEC, heavy metals, BOD, COD, TSS, TDS, NH_4, total P, and dissolved reactive P; nutrient status (N, P, K, secondary and micronutrients), analysis of agricultural waste; waste management equipment operation, maintenance and safety hazards, computer software and models; survey of different agri- wastes from live stock, dairy, poultry, food processing, fruit & vegetable and agri-chemicals, preparation of compost, vermicomposting, biogas and analysis of compost.

Suggested Readings:

1. Chongrak, P. (1996). Organic Wastes Reclying, John Wiley and Sons.

2. Kapoor, K. K., Sharma, P. K., Dudeja, S. S. and Kundu, B. S. (2005). Management of Organic Wastes for Crop Production, Proceedings of the National Symposium on Management of Organic Wastes for Crop Production.
3. Raymond, C. L. (2012). Agricultural Waste Management: Problems, Processes and Approaches, Academic Press, New York.
4. Sannigrahi, A.K. (2011). Agriculture And Waste Management For sustainable Future, New India Publishing Agency, Pitam Pura New Delhi.
5. Srivastav, M. L. (2007). Waste Management, Shree Publications and Distributors, New Delhi.

Module 8	**BIOAGENTS AND BIOFERTILIZERS PRODUCTION**	**10 (0+10)**	**SEM VIII/XII**
Weekly activities			
Week	**Activites**		
1	Handling of BOD incubator, shaker, UV-VIS spectrophotometer, autoclave, microscope and hot air oven		
2	Measuring techniques including pipetting, use of measuring cylinders and weighing of media components		
3	Preparation of different culture media, sterilization of media and petri plates, and pouring of media in plates		
4	Isolation of *Azotobacter* from soil samples, purification of colonies and its maintenance		
5	Isolation of *Rhizobium* from nodule samples, purification of colonies and its maintenance		
6	Isolation of phosphate solubilizing bacteria from soil samples, purification of colonies and its maintenance		
7	Isolation of *Azospirillum* from soil samples, purification of colonies and its maintenance		
8	Isolation of *Gluconoacetobacter* from soil samples, purification of colonies and its maintenance		
9	Characterization of isolated bacteria on the basis of IAA production, ammonium excretion, phosphate solubilization, zinc solubilization and potash solubilization		
10	Isolation of antifungal PGPRs, purification of isolates and their storage		
11	Characterization of PGPRs for various traits like antifungal, insecticidal, etc.		
12-14	Inoculum development and mass scale production of *Azotobacter*, *Azospirillum*, *Rhizobium* and *Glucanoacetobacter*, filling and packing of liquid biofertilizers (Mass scale production, activities will be repeated).		
15-16	Periodically maintenance and quality control of isolates including rechecking for IAA production, ammonium excretion, phosphate solubilization, zinc solubilization, potash solubilization, quality control will ensure the minimum viable counts of each produced biofertilizers alongwith its main characters		

MOLECULAR BIOLOGY, BIOTECHNOLOGY AND BIOINFORMATICS

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Supporting Course for B. Sc. (Hons.) Agriculture			
MBB 101/ BIOCHEM 101	Fundamentals of Plant Biochemistry and Biotechnology (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics	3 (2+1)	I/V
	Total Credits	**3 (2+1)**	

MBB 101/ BIOCHEM 101	FUNDAMENTALS OF PLANT BIOCHEMISTRY AND BIOTECHNOLOGY (To be taught jointly by Chemistry and Biochemistry and Molecular Biology, Biotechnology and Bioinformatics)	3 (2+1)	SEM I/V

Theory

Importance of biochemistry; carbohydrate: importance and classification; structures of monosaccharides, reducing and oxidizing properties of monosaccharides, mutarotation; structure of disaccharides and polysaccharides; lipid: importance and classification; structures and properties of fatty acids; storage lipids and membrane lipids; proteins: importance of proteins and classification; structures and zwitterions nature of amino acids; structural organization of proteins; enzymes: general properties; classification; mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; nucleic acids: importance and classification; structure of nucleotides, B-DNA; RNA: types and secondary & tertiary structure; metabolism of carbohydrates: glycolysis, TCA cycle, Glyoxylate cycle, electron transport chain; metabolism of lipids: beta oxidation.

Concepts and applications of plant biotechnology: scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; micro-propagation methods; organogenesis and embryogenesis, synthetic seeds and their significance; embryo rescue and its significance; somatic hybridization and cybrids; somaclonal variation and its use in crop improvement; cryo-preservation; introduction to recombinant DNA technology: methods of gene transfer physical (gene gun method), chemical (PEG mediated) and agrobacterium mediated gene transfer methods; transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; marker assisted breeding in crop improvement; biotechnology regulations.

Practical

Preparation of solution, pH & buffers; qualitative tests of carbohydrates and amino acids; quantitative estimation of glucose/ proteins; effect of pH, temperature and substrate concentration on enzyme action, paper chromatography/TLC demonstration for separation of amino acids/ monosaccharides; sterilization techniques; composition of various tissue culture media and preparation of stock solutions for MS nutrient medium; callus induction from various explants; micro-propagation, hardening and acclimatization; demonstration on isolation of DNA; demonstration of gel electrophoresis techniques and DNA finger printing.

Suggested Readings:

1. Conn, Eric E. and Stumpf, P. K. (2009). Outlines of Biochemistry, Wiley and Sons.
2. Gupta, P.K. (2004). Biotechnology and Genomics, Rastogi Publishing.
3. Jain, J.L. (2004). Fundamentals of Biochemistry, S. Chand Publishing.
4. Nelson, David L. and Cox, Michael M. (2012). Principles of biochemistry, Lehninger, Freeman & Company.
5. Singh, B.D. (2010). Biotechnology: Expanding Horizon, Kalyani Publishing.

SOCIOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Supporting Course for B. Sc. (Hons.) Agriculture			
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)	I/V
	Total Credits	**2 (2+0)**	
Supporting Course for B. Sc. (Hons.) Community Science			
SOC 102	Introduction to Rural Sociology	2 (2+0)	I
	Total Credits	**2 (2+0)**	

SOC 101	RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY	2 (2+0)	SEM I/V

Theory

Sociology and rural sociology: definition and scope, its significance in agriculture extension; rural and urban community; social group; social stratification; culture- concept, social institution; social change; educational psychology: meaning & its importance in agriculture extension; behavior: cognitive, affective, psychomotor domain; personality; learning; motivation, theories of motivation; intelligence.

Suggested Readings:

1. Bhatia, M.R. (1992). General Psychology. Oxford & IBH Pub. Co Pvt Ltd, New Delhi.
2. Bhushan, Vidya and Sachdeva, D.R. (2001). An Introduction to Sociology. Kitab Mahal, Allahabad.
3. Chitambar, J.B. (1997). Introductory Rural Sociology. John Wiley and Sons, New York.
4. Desai, A.R. (1978). Rural Sociology in India. Bombay, Popular Prakashan, 5th Revised ed. Bombay.
5. Dhama, O.P. and Bhatanagar, O.P. (1998). Education and Communication for Development. Oxford and IBH publishing Co, New Delhi.

SOC 102	INTRODUCTION TO RURAL SOCIOLOGY	2 (2+0)	SEM I

Theory

Sociology: meaning, nature and significance; rural sociology: meaning, scope and significance; difference and characteristics of rural and urban societies; Indian rural social stratification : Castes- basic notions, changes and its role in economy and policy, difference between caste and class; rural social groups – definition, types and importance; Indian rural institutions : social – family and marriage (Nature, forms and changes); Rural poverty: its manifestations and causes; social-religious, functional significance of beliefs, values, traditions and customs; rural social changes; processes and factors of transformation; status of women in rural India and their role in rural and agricultural development; social control : meaning, definition, need and means (formal and informal).

Suggested Readings:

1. Chitambar, J.B. (1973). Introductory rural sociology. John Wiley and Sons, New York.
2. Desai, A.R. (1978). Rural sociology in India (5th Ed.). Popular Prakashan, Bombay.
3. Doshi, S.L. (2007). Rural sociology. Rawat Publishers, Delhi.
4. Jayapalan, N. (2002). Rural sociology. Altanic Publishers, New Delhi.
5. Sharma, K.L. (1997). Rural society in India. Rawat Publishers, Delhi.

ZOOLOGY

Course No.	Course Title	Cred	Semester (4-yr/6-yr)
Bridge Courses for B. Sc. (Hons.) Agriculture, 6-Year Programme			
BIO 1	Biology-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	I
BIO 2	Biology-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	II
BIO 21	Biology-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5(4+1)	III
BIO 22	Biology-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	IV
	Total Credits	**20 (16+4)**	
Supporting Course for B. Sc. (Hons.) Agriculture			
ZOO 101/ BOT 101	Introductory Biology (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	I/V
	Total Credits	**2 (1+1)**	
Supporting Courses for B. Sc. (Hons.) Community Science			
ZOO 100	Elementary Zoology (For students from Arts and Math streams)	2 (1+1)NC	I
ZOO 102	Elementary Human Physiology	3 (2+1)	I
	Total Credits	**5 (3+2)**	

BIO 1	BIOLOGY-I (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM I

Theory

Living organisms: diversity and classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom); systematics and binomial system of nomenclature; plant diversity: salient features of plants (major groups); classification of angiosperms up to subclass, botanical gardens, herbaria; animal diversity: salient features of animals (non-chordates up to phylum level and chordates up to class level); zoological parks and museums; tissues in animals; morphology, anatomy and functions of different systems of earthworm, cockroach and frog; human physiology: digestion and absorption, breathing and respiration, body fluids and circulation, excretory products and elimination, locomotion and movement, control and coordination.

Practical

To study the parts of a dissecting and compound microscope; study of specimens and identification with reasons: bacteria, *Oscillatoria, Spirogyra, Rhizopus,* mushroom, yeast, liverwort, moss, fern, pines, one monocotyledon and one dicotyledon and one Lichen; diversity in shape and size of cells in

different plant and animal tissues *(e.g.* parenchyma, palisade, collenchyma, sclerenchyma, xylem, phloem, squamous epithelium, muscle fibres and mammalian blood smear through temporary/permanent slides); study of specimens and identification: *Amoeba, Hydra, Liverfluke, Ascaris,* leech, earthworm, prawn, silkworm, honey bee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit; observation of the following spots: human skeleton and different types of joints; morphology of earthworm, cockroach and frog through models/preserved specimens.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 2	BIOLOGY-II (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM II

Theory

Plant kingdom: morphology and functions of different parts of flowering plants- root, stem, leaf, inflorescence, flower, fruit and seed; plant anatomy: tissue, tissue systems and anatomy of root, stem and leaf of dicotyledonous plants and comparison with monocotyledonous plants; plant physiology: plants and water relations, movement of water, food, nutrients and gases; mineral nutrition, respiration, photosynthesis; plant growth and development; structural organization in animals, cell as a unit of life: discovery of the cell, origin of prokaryotic and eukaryotic cells, cell theory, animal cell structure - cell wall, cell membrane; brief outline of structure and function of cell organelles: mitochondria, nucleus, ER, golgi apparatus, dictyosomes, plastids, lysosomes, ribosomes, vacuoles, centrioles, cytoskeleton, chromosomes, microbodies and nuclear organization; cell division: mitosis, meiosis, cell cycle; biomolecules: basic chemical constituents of living bodies, structure and functions of carbohydrates, proteins, lipids and nucleic acids; enzymes: types, properties and function.

Practical

Study and description of locally available common flowering plants one each from (Solanaceae, Fabaceae and Liliaceae); types of root (tap or adventitious), stem (herbaceous/woody), leaf arrangement/shapes/ venation, simple or compound; preparation and study of T.S. of dicot and monocot root and stem (primary); study of osmosis by potato osmometer; plasmolysis in epidermal peels *(e.g., rhoeo* leaves); study of distribution of stomata in the upper and lower surface of leaves, stomatal index; comparative study of the rates of transpiration in the upper and lower surface of leave; test for the presence of sugar, starch, proteins and fats in suitable plant and animal materials *(e.g.,* wheat, potato, groundnut, milk or other such suitable material); separation of chlorophyll pigments through paper chromatography; study of rate of respiration in flower buds and germinating seed; effect of salivary amylase on starch; testing the presence of urea, sugar, albumin and bile salts in urine sample (simulated sampled may be used); observation of the following spots -study of mitosis in onion root tip cells, different modifications in root, stem and leaves; identification and comments on different types of inflorescences; imbibition in seeds/raisins; observations and comments on the experimental set up on: anaerobic respiration, phototropism, apical bud removal, suction due to transpiration.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 21	BIOLOGY-III (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM III

Theory

Reproduction in flowering plants: vegetative reproduction, flowers, pre fertilization structure and events, apomixis and polyembryony, development of seeds and fruit; ecology: concept of species,

population and community; ecological adaptations; pollution and deforestation, global warming, ozone layer depletion, underground water level and threat to biodiversity, conservation of biodiversity; national parks and sanctuaries; human reproduction: male reproductive system, female reproductive system, gametogenesis, menstrual cycle, fertilization and implantation, pregnancy and embryonic development, parturition and lactation; reproductive health problem and strategies, population explosion

and birth control, medical termination of pregnancy, STD, infertility; organism and environment: ecosystem - biotic and abiotic components, food chain, trophic levels, food webs, ecological pyramids, ecosystems components, types and energy flow; biotic community: intraspecific and interspecific relationships, commensalism, predation, scavenging, parasitism, symbiosis, biotic stability and biotic succession.

Practical

Dissection of flower and display of different whorls; dissection of anther and ovary to show number of chambers; study of pollen germination on a slide; collect and study of soil from at least two different sites for texture, moisture content, pH and water holding capacity; correlation with the kinds of plants found in them; collect water from two different water bodies in your locality and study the samples for pH, clarity and presence of any living organisms; study the presence of suspended particulate matter in air at the two widely different sites; plant population density by quadrat method; observations on the following spots - study of flowers adapted to pollination by different agencies (wind, insect); pollen germination on stigma through a permanent slide; study and identify stages of gamete development *i.e.,* T.S. testis and T.S. ovary through permanent slides (from any mammal); meiosis in onion bud cell or grasshopper testis and T.S. of blastula through permanent slides; study two plants and two animals found in xeric conditions and comment upon their adaptations/ morphological features; plants and animals found in aquatic conditions and comment upon their adaptations/morphological features.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

BIO 22	BIOLOGY-IV (To be taught jointly by Botany and Plant Physiology and Zoology)	5 (4+1)	SEM IV

Theory

Health, agriculture and industry: recombinant DNA technology and application in health, agriculture and industry, genetically modified (GM) organisms, bio-safety issues; plant breeding, tissue culture, food production, microbes in house hold processing, industrial production; sewage treatment and energy generation; *Bt* cotton; genetics and evolution: Mendelian inheritance, chromosome theory of inheritance, deviations from Mendelian ratio; gene interaction: epistasis, incomplete dominance, co-dominance, complementary genes, multiple alleles, sex determination in human beings; linkage and crossing over; inheritance pattern of haemophilia, blood groups in human beings; DNA and applied zoology: DNA replication, transcription, translation; genetic code, gene expression and regulation; DNA fingerprinting, recombinant DNA technology and its applications; basic concepts of immunology and vaccines: pathogens, parasites; cancer and AIDS; adolescence and drug/ alcohol abuse; animal husbandry, bee keeping and fisheries; evolution: theories and evidences.

Practical

Prepration of a temporary mount of onion root tip to study mitosis; study of effect of the different temperatures and three different pH on the activity of salivary amylase on starch; observations on the following spots: study Mendelian inheritance using seeds of different colour/size of any plant;

preparation of pedigree charts of genetic traits such as rolling of tongue, blood groups, widow's peak, colour blindness; exercise on controlled pollination -emasculation, tagging and bagging; identification of the common disease causing organisms like *Ascaris, Entamoeba, Plasmodium*, ringworm through permanent slides or specimens and symptoms of diseases caused by them.

Suggested Readings:

1. Biology – Text book for class XI, NCERT, New Delhi.
2. Biology – Text book for class XII, NCERT, New Delhi.

ZOO 100	ELEMENTARY ZOOLOGY (For B. Sc. (Hons.) Community Science students from Arts and Maths streams)	2 (1+1) NC	SEM I

Theory

Nature and scope of zoology; taxonomic classification of animal kingdom; animal life: structure and function- tissues and other body systems; applications of biology: communicable diseases, immune responses, inherited and sex linked diseases; cancer, human population growth.

Practical

Classification and general features of different animal types, microscopic structure of mammalian tissues; study of some physiological functions.

Suggested Readings:

1. Bhatia, K.N. and Tyagi, M.P. (2015). Elementary Biology, Volume- I & II. A Trueman Publications Jalandhar.
2. Biology Textbook for Class XI, XII (2017). NCERT, New Delhi.
3. Dhami, P.S., Chopra, G. and Srivastva, H.N. (2015). A Text Book of Biology, Part-I & II. Pardeep's Publication.
4. NCERT Biology (2015). New Delhi.
5. Pandey, B.D. and Rath, R.K. (2014). Zoology at a Glance, Scientific Publishers, Jodhpur, India.

ZOO 101/ BOT 101	INTRODUCTORY BIOLOGY (To be taught jointly by Botany and Plant Physiology and Zoology)	2 (1+1)	SEM I/V

Theory

Introduction to the living world, diversity and characteristics of life, origin of life, evolution and eugenics; binomial nomenclature and classification cell and cell division; morphology and anatomy of flowering plants; seed and seed germination; plant systematics viz; Brassicaceae, Fabaceae and Poaceae; role of animals in agriculture.

Practical

Morphology of flowering plants– root, stem and leaf and their modifications; inflorence, flower and fruits; cell, tissues & cell division; internal structure of root, stem and leaf; study of specimens and slides; description of plants- Brassicaceae, Fabaceae and Poaceae; study of type animals of major phyla.

Suggested Readings:

1. Bhatia, K.N. and Tyagi, M.P. (2015). Elementary Biology, volume- I & II. Trueman Publication Jalandhar.
2. Biology Textbook for Class 12 (2017). NCERT, New Delhi.
3. Dhami, P.S., Chopra, G. and Srivastva, H.N. (2015). A Text Book of Biology, Part-I & II. Pardeep's Publication.
4. NCERT Biology (2015). New Delhi.
5. Pandey, B.D. and Rath, R.K. (2014). Zoology at a Glance, Scientific Publishers, Jodhpur, India.

ZOO 102	ELEMENTARY HUMAN PHYSIOLOGY	3 (2+1)	SEM I

Theory

Physiological process, structural and functional basis of human body, skeletal system, joints and muscular system; functions of brain and spinal cord. nerve impulse reflex action and sense organs; composition and functions of blood and lymph, heart and course of blood circulation, blood pressure, pulse and heart sounds; respiratory system, mechanism of respiration, respiratory rates, volume and transport of gases; physiology of kidney, physiology of digestion, digestive enzymes and their functions, functions of liver, mechanism of absorption from the intestine; the location, secretions and function of various endocrine glands; male reproductive organs and their functions; female reproductive organs and their functions; pregnancy and milk secretion.

Practical

Skeletal system of mammal (human); hematology- R.B.C., W.B.C., T.L.C., D.L.C. and estimation of hemoglobin in mammalian blood; heart beat and heart sound, blood pressure measurement; respiratory quaotient, inspiration, expiration and measurement of O_2 and CO_2 at various partial pressure in lungs; reproductive cycle-menstruation and estrous cycles, mating behaviour and fertility test.

Suggested Readings:

1. Arthur J. V. Human physiology- The mechanisms of body function, Tata McGraw Hill Publishing Company, New Delhi.
2. Bharucha, E. (2005). Text book of environmental studies. University Grants Commission, University Press, New Delhi.
3. Guyton C. Text Book of medical physiology (5th Ed.). W.B. Saunders Company-Philadelphia, London.
4. Keele, C.A. and Neil, B. Applied physiology (10th Ed.). Oxford University Press, New York.

CENTRE FOR FOOD SCIENCE AND TECHNOLOGY

Course No.	Course Title	Credits	Semester (4-yr/6-yr)
Supporting Course for B. Sc. (Hons.) Agriculture			
FST 302	Basics of Food Science, Safety and Nutrition	4 (3+1)	VI/X
	Total Credits	**4 (3+1)**	
Student READY Module/ Experiential Learning Programme/Hands on Training			
Module 9	Food Proccessing	10 (0+10)	VIII/XII
	Total Credits	**10 (0+10)**	

FST 302	BASICS OF FOOD SCIENCE, SAFETY AND NUTRITION	4 (3 + 1)	SEM VI/X

Theory

Concepts of food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, pigments, miscellaneous bioactives compounds and important browning reactions); principles and methods of food processing and preservation (use of heat, low temperature, chemicals and radiation), production of fermented foods.

Foods and nutrition- malnutrition (over and under nutrition), nutritional disorders, RDA, food groups, energy metabolism (carbohydrate, fat, proteins), balanced/ modified diets, new trends in food science and nutrition.

Food safety– definition, importance, scope and factors affecting food safety; hazards and risks, types of hazards– biological, chemical, physical hazards, management of hazards– need and control of parameters, hygiene and sanitation, sources of contamination and their control, personnel hygiene, food safety measures, food safety management tools- basic concepts, PRPs, GHPs, GMPs, SSOPs etc. HACCP, ISO series; TQM – concept and need for quality, components of TQM, food laws and standards– Indian food regulatory regime, FSSA, global scenario codex alimentarius commission; other laws and standards related to food; recent concerns– new and emerging pathogens, packaging, products labeling and nutritional labeling; newer approaches to food safety.

Practical

Preparation of various standard solutions and buffers; physico-chemical properties of foods; determination of pH, acidity and water activity; estimation of moisture, ash, fat, proteins and fibre content in the food samples; processing and preservation of foods by dehydration, refrigeration, freezing and concentration of foods; assessment of personal hygiene; preparation of plans for implementation of food safety management system – HACCP, ISO: 22000.

Suggested Readings :

1. DeMan, J.M. (1999). Principles of Food Chemistry, Springer, Verlag.
2. Fortin, N.D. (2009). Food Regulation, John Wiley & Sons. New Jersey.
3. Gopalan, C., Rama Sastri, B.V. and Balasubramanian, S.C. (1989). Nutritive Value of Indian Foods, National Institute of Nutrition, ICMR, Hyderabad.
4. Potter, N.N. and Hotchkiss, H.H. (1997). Food Science. 5th Ed. CBS Publishers & Distributors, New Delhi.
5. Swaminathan, M. (1974). Essentials of Foods and Nutrition. Vol. II. Ganesh & Co., New Delhi.

Module 9	FOOD PROCESSING	10 (0+10)	SEM VIII/XII
Weekly activities			
Week	**Activities**		
1	Machinery/equipments for food processing, preparation of fruit juices, preparation of RTS drink and nectar		
2	Preparation of fruit squash, crush and syrup, and syrup from extracts		
3	Preparation of jam, jelly and marmalade		
4	Preparation of fruit cheese, bar, slab/leather, butter and toffee		
5	Preparation of preserve and candy		
6	Preparation of tomato products		
7	Preparation of pickles and chutneys		
8	Quality evaluation of fruits, vegetables and its products		
9	Quality evaluation of grains-physical method, chemical method, conditioning and milling of wheat		
10	Evaluation, grading and cooking quality of rice, milling, parboiling of paddy and assessment of degree of polishing		
11	Milling of other grains like corn, millets; milling and quality evaluation of pulses		
12	Preparation of biscuit, cake and bread, preparation of other bakery products, pasta and noodles		
13	Preparation of ready-to-eat snacks, value added products and products from corn and millets		
14	Preparation of products from pulses and oilseeds		
15	Quality evaluation of processed products and FSSAI standards for food products		
16	Establishment of processing unit and visit to commercial processing units		




University Foundation Day Celebrations
Seminar on
Nurturing Business, Incubation &
Entrepreneurial Approach in Agriculture
(February 02, 2018)
NABARD


ATIC
College of Agriculture
College of Agricultural Engineering & Technology
51st Annual Convention of Indian Society of Agricultural Engineers (ISAE)
Sardar Patel
Outstanding ICAR Institution
Award-2016
Foundation Stone Laying Ceremony of College of Agriculture at Bawal
College of Basic Sciences & Humanities
Nehru Library
I.C. College of Home Sciences