UNDER GRADUATE
COURSE CATALOGUE
2025

CHAUDHARY CHARAN SINGH HARYANA AGRICULTURAL UNIVERSITY HISAR-125004

(A+ Grade NAEAB-ICAR ACCREDITED)

Foreword

It gives me immense pleasure to present the Undergraduate Academic Catalogue of Chaudhary Charan Singh Haryana Agricultural University, Hisar, developed in adherence to the academic guidelines laid down by the Indian Council of Agricultural Research (ICAR) and the holistic vision of the National Education Policy 2020 (NEP 2020).

This catalogue encompasses a wide array of undergraduate programmes-B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Tech. (Agricultural Engineering), B.Tech. (Biotechnology), B.Sc. (Hons.) Community Science and B.F.Sc. reflecting our institution's comprehensive and forward-looking approach to agricultural education.

Rooted in academic excellence and enriched with hands-on learning, the curriculum is crafted to develop skilled, innovative and socially responsible professionals. The NEP 2020's emphasis on multidisciplinary education, flexibility and learner-centric models is well-embedded in the structure of this catalogue. It is designed to empower students with critical thinking, entrepreneurial aptitude, ethical grounding and global awareness-traits essential for addressing the challenges and opportunities of the 21st century agri-food systems.

As we move toward a future of sustainable agriculture, climate resilience and technological integration, this academic catalogue stands as a guiding document that aligns education with employability, research with relevance and tradition with transformation.

I congratulate the all contributing faculty members, Dr. S.K. Pahuja (Dean, College of Agriculture and College of Agricultural Engineering & Technology), Dr. Beena Yadav (Dean, College of Community Science), Dr. K.D. Sharma (Dean, College of Biotechnology), Dr. Rajesh Gera (Dean, College of Basic Sciences & Humanities and College of Fisheries Science), Dr. Atul Dhingra, OSD to Vice-Chancellor and Head, Business Management and Dr. Mukesh Kumar, Associate Professor, Dept. of Genetics and Plant Breeding, College of Agriculture for their dedication, vision and hard work in preparing this catalogue. It will undoubtedly serve as a valuable academic compass for our students, educators and stakeholders.

Prof. B.R. Kamboj

Prof. B.R. Kamboj
Vice-Chancellor
CCSHAU, Hisar

Preface

I am delighted to present the Undergraduate Academic Catalogue of CCS Haryana Agricultural University, Hisar, meticulously prepared in alignment with the guidelines of the Indian Council of Agricultural Research (ICAR) and the National Education Policy 2020 (NEP 2020). This catalogue outlines the structure, curriculum and academic framework of our diverse undergraduate programs-B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Tech. Agricultural Engineering, B.Tech. Biotechnology, B.Sc. (Hons.) Community Science and B.F.Sc. The course catalogue and examination and evaluation system as per the recommendations of the Sixth Deans' Committee of ICAR and will be implemented from academic session 2025-26 of 4-year programme of all the colleges.

In tune with the vision of NEP 2020, this catalogue embodies a holistic and multi disciplinary approach, aiming to nurture critical thinking, practical skills, ethical grounding and entrepreneurial spirit among our students. The curriculum emphasizes experiential learning, skill development, and industry alignment, ensuring that our graduates are not only academically sound but also socially responsible and globally competent.

Each program has been thoughtfully designed to balance foundational knowledge with emerging scientific advancements, integrating local relevance with global perspectives. Special emphasis has been placed on internships, rural and industry exposure, interdisciplinary electives, and innovation-driven projects to foster creativity and real-world problem-solving abilities in our students.

This catalogue is a testament to our commitment to academic excellence, student-centric learning, and nation-building through quality education in agriculture and allied sciences. I sincerely hope it serves as a valuable guide for our students, faculty, and stakeholders, and contributes to shaping the next generation of agricultural professionals and leaders.

I acknowledge the dedicated efforts of Dr. Beena Yadav (Dean, College of Community Science), Dr. K.D. Sharma (Dean, College of Biotechnology), Dr. Rajesh Gera (Dean, College of Basic Sciences & Humanities and College of Fisheries Science), Dr. Atul Dhingra, OSD to Vice-Chancellor and Head, Business Management, Dr. Mukesh Kumar, Associate Professor, Dept. of Genetics and Plant Breeding, Dr. Anil Kumar, Sr. Scientist & Head, Dept. of Nematology, Dr. Subodh Aggarwal, Assistant Professor, Dept. of Business Management, Dr. Lomash Kumar, Assistant Professor, Dept. of Entomology, Dr. Neelam M. Rose, Professor & Head, Dept. of Apparel & Textile Science , Dr. Saroj Yadav, Associate Professor, Dept. of Apparel & Textile Science, Dr. Rachna Gulati, Professor, Dept. of Aquaculture & Post harvest Technology, Dr. Anupam Anand, Assistant Professor, Dept. of Fisheries Extension, Economics & Statistics, Dr. Kavita Sharma, Assistant Professor, Dept. of Fisheries Resource Management, Dr. Rajender Kumar, Assistant Professor, Dept. of Basic Engineering, Dr. Ajeev Kumar, Assistant Professor, Dept. of Agricultural Biotechnology and Dr. Kanika Rani, Assistant Professor, Dept. of Nanobiotechnology for curriculum development, revision and compilation of under graduate course curriculum of the university.

The help extended by Registrar, Dean, PGS, Directors and Officers of the university, the Head of departments and faculty members involved in the preparation of this document is gratefully acknowledged.

Dr. S. K. Pahuja

Dr. S. K. Pahuja
Dean, College of Agriculture
&
Chairperson
Committee for finalisation
of UG Course Curriculum
CCS HAU, Hisar

ACRONYMS

AAHM	Aquatic Animal Health Management
ABM	Agricultural Business Management
ABT	Agricultural Biotechnology
AE	Agricultural Engineering
AEC	Ability Enhancement Course
AEM	Aquatic Environment Management
AGRI	Agriculture
AIA	Agro-Industrial Attachment
AM	Agribusiness Management
ANBT	Animal Biotechnology
ATS	Apparel and Textile Science
AGRON	Agronomy
AG ECON	Agricultural Economics
AGM	Agricultural Meteorology
AQC	Aquaculture
BI	Bioinformatics
BIO	Biology
BIOCHEM	Biochemistry
BIOTECH	Biotechnology
CCA	Co-curricular Activity
CE	Civil Engineering
CS	Community Science
COMP	Computer Science
EE	Electronics and Electrical Engineering
EECM	Extension Education and Communication Management
ENG	English
ENT	Entomology
EXT	Extension Education
FE	Fish Engineering
FN	Foods and Nutrition
FEES	Fisheries Extension, Economics & Statistics
FMPE	Farm Machinery & Power Engineering
FOR	Forestry
FPT	Fish Processing Technology
FRM	Fisheries Resource Management
FS	Fisheries Science
GPB	Genetics & Plant Breeding
HDFS	Human Development and Family Studies
HORT	Horticulture
IBT	Industrial Biotechnology
LPM	Livestock Production Management
MATH	Mathematics

MBB	Molecular Biology & Biotechnology
MDC	Multi-Disciplinary Course
ME	Mechanical Engineering
MEB	Microbial and Environmental Biotechnology
MICRO	Microbiology
NBT	Bio-Nanotechnology
NCC	National Cadet Corps
NEMA	Nematology
NG	Non Gradial
NSS	National Service Scheme
PBT	Plant Biotechnology
PFE	Processing and Food Engineering
PL PATH	Plant Pathology
PL PHY	Plant Physiology
RAWE	Rural Agricultural Work Experience
REE	Renewable Bio-energy Engineering
RMCS	Resource Management and Consumer Science
SEC	Skill Enhancement Course
SOC	Sociology
SOILS	Soil Science
SST	Seed Science & Technology
STAT	Statistics
SWE	Soil and Water Engineering
TUT	Tutorial
VAC	Value Added Course
VSC	Vegetable Science

CONTENTS

GENERAL INFORMATION

Chaudhary Charan Singh Haryana Agricultural University, Hisar has revised Course Curriculum for undergraduate programmes in all the colleges of the University as per the recommendations of the Sixth Deans' Committee of ICAR and implemented from academic session 2025-26.

- The B.Sc. (Hons.)/ B.F.Sc./ B.Tech. programme are of 4 years duration, covering 166-174 credits of coursework. Additionally, students engage in 16 credits of non-gradial courses and 10 credits of MOOCs/online courses. The credit distributions for the different courses have been specified for individual disciplines.

General Credit Allocation Scheme of UG Programmes

Semester	Core Courses (Major+ Minor)	Multi-Disciplinary Courses (MDC)	Value Added Courses (VAC)	Ability Enhancement Courses (AEC)	Skill Enhancement Courses (SEC)	Internship/ Project/ Student READY/ RAWE & AIA	Total Credits	Non-Gradial	Online Courses/ MOOC
I	12	3(2)	-	2(3) + 2(4)	4	-	23	3(1+1a)	10
II	10	3(5)	3(6)	2(3) + 2(7)	4	-	24	2(1a+8a)	
Post-II semester	-	-	-	-	-	10(12)	-	-	
III	16	-	-	2(8)	2	-	20	3(3+1a)	
IV	12	3(9)	3(10)	-	2	-	20	2(1a+8a)	
Post-IV semester	-	-	-	-	-	10(13)	-	-	
V	21	-	-	-	-	-	21	5(3+1a+11)	
VI	21	-	-	-	-	-	21	1(1a)	
VII	20	-	-	-	-	-	20	-	
VIII	-	-	-	-	-	20	20	-	
Total	**112**	**9**	**6**	**10**	**12**	**20**	**169**	**16**	**10**

(1) Deeksharambh (Induction-cum-Foundation Course) of 2 credits (2 weeks duration)
(1a) Tutorial
(2) Farming based Livelihood systems
(3) NCC/NSS
(4) Communication Skills
(5) Entrepreneurship Development and Business Management
(6) Environmental Studies and Disaster Management
(7) Personality Development
(8) Physical Education, First Aid, Yoga Practices and Cultural Activities
(8a) Co-curricular Activity
(9) Agriculture Marketing and Trade
(10) Agriculture Informatics and Artificial Intelligence
(11) Educational Tour (10-14 days)
(12) Only for those opting for an exit with UG-Certificate
(13) Only for those opting for an exit with UG-Diploma

One multidisciplinary course in Agricultural Engineering discipline is different from the above common courses keeping in view the discipline specific requirement.

UNDERGRADUATE PROGRAMMES COLLEGE-WISE

Programme	Core Courses (Major+ Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship/ Project/ Student READY/ RAWE & AIA	Total Credits	Non-Gradial	Online Courses/ MOOC
B.Sc. (Hons.) Agriculture	112	9	6	10	12	20	169	17	10
B.Sc. (Hons.) Agribusiness Management	112	9	6	8	12	20	167	17	10
B.Tech. (Agricultural Engineering)	125	10	6	10	8	15	174	18	6
B.Tech. (Biotechnology)	112	9	6	8	12	20	167	16	10
B.Sc. (Hons.) Community Science	112	9	6	10	12	20	169	16	10
B.F.Sc.	117	9	6	8	12	20	172	16	10

- After the admission in the University, the students will register for *Deeksharambh* (0+2) (Non-gradial) the Foundation course of 2 weeks' duration in the 1st semester of the degree programme. It will include discussions on operational framework of academic process in the college and the university. There will be sessions with alumni, business leaders, University academic and research personnel on instilling social awareness, ethics and values, cultural heritage, folk art and craft, Indian Constitution etc. It will help to identify the strength and weakness of students, diverse potentialities and to enhance cultural integration of students from different backgrounds. It will also create a platform for students to learn from each other's life experiences.
- The first year of the degree programme comprises skill development courses/ modules along with other fundamental courses. After satisfactory completion of courses in two semesters of 1st year and subsequent satisfactory completion of 10 credits (10 weeks) of industry/ institute training/ internship, the student will become eligible for the award of UG-Certificate in admitted programme on exit. The students continuing the study further, would not have to attend the internship after 1st year.
- The second year has been designed with the skill development courses as well as fundamental courses related to degree programme with adequate theory and practical components, enabling the student to get acquainted with the basic principles and applications of agricultural sciences. After satisfactory completion of the courses during first two years and subsequent satisfactory completion of 10 credits (10 weeks) of internship/industry/institute training, the student will become eligible for the award of UG-Diploma in the admitted programme on exit. The students continuing the further study, need not to attend the internship after 2nd year. However, the students of B.Tech (Agricultural Engineering) are being offered 4 weeks In-Plant training as partial credits

after 4th Semester during break for completing the degree requirement with splitting in two slots (4 weeks each).

- The courses in the third year have been designed to impart in-depth knowledge of the subject to the students. There will not be an exit after 3rd year. During 5th semester, the students will have an educational tour of 10-12 days duration, which will be counted as 2 credits (Non-gradial).
- The fourth year of degree programmehas been meticulously designed not only to impart specialized knowledge to the students in the selected major disciplines but also to prepare the students to take up employment or entrepreneurship as their future career.
- During the 7th semester, the students will adequately select 20 credits from a basket of elective courses, each course giving an opportunity to gain advanced knowledge in frontier areas of science. The objective is to enable the student to acquire deeper understanding in any particular field.
- In the 8th semester of the degree programme, Student READY programme: Rural Agricultural Work Experience (RAWE), Experiential Learning, Hands-on Training, In-plant Training/ Industrial Aattachment/Internship and Project Work of 20 credits will be offered.
- In B.Tech (Agricultural Engineering) final year, the student will have the liberty to choose any three elective subjects, preferably from one or related disciplines. The objective is to enable the student to acquire deeper understanding in a particular field. In the final year, the Project-I (3 credits in 7th semester) and Project-II (4 credits in 8th semester) are meant for advanced skill development for research, employment and entrepreneurship. Under these courses, the student will have the option to take up a research project (R & D based/field study based) for developing research skills in form of project or take up incubation/ experiential learning-based activity for entrepreneurship development. The Project-I and II can also be taken up in collaboration with any organization/ industry.
- The students have to take a minimum of 10 credits of online courses (6 credits for B.Tech Agricultural Engineering) during four years as a partial requirement for the B.Sc. (Hons)/ B.F.Sc./B.Tech. programme. The online courses can be from any field such as Agriculture and allied sciences, Basic Sciences, Humanities, Psychology, Anthropology, Economics, Business Management, Languages including foreign language, Communication skills/ Music, etc. and can be taken from NPTEL, Mook IT, edX, Coursera, SWAYAM or any other such reputed portal accepted by the University. The objective is to allow the students to groom their passion or strengthen their knowledge and competency in any field beyond prescribed courses. These online courses will be non-gradial and separate certificates would be issued by institute/organization offering the courses. The student must submit the list of online courses along with the content he/she intends to undertake to the Dean/Assoc. Dean/Principal of the college for a permission and records.

Entry and Exit Options

The entry and exit options for the UG programme is shown in the figure below.

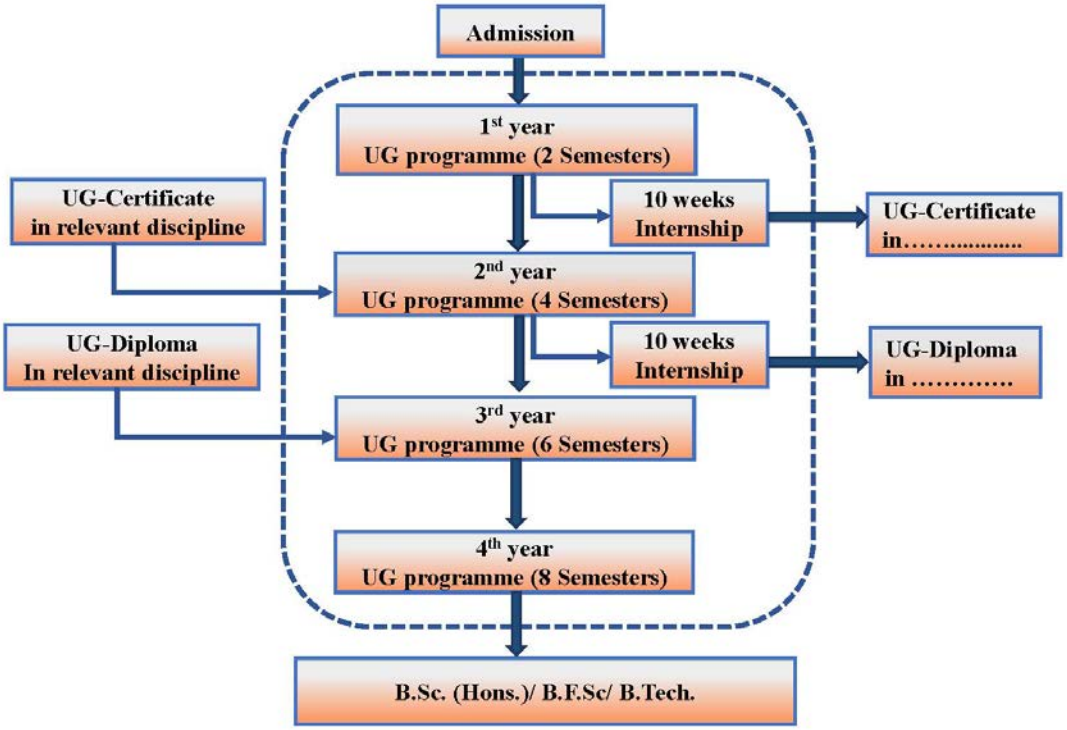

Figure 1: Entry and Exit Options for the UG Programmes

Entry Options: Students with UG-Certificate and UG-Diploma can take admission in 2nd and 3rd year, respectively of B.Sc.(Hons.)/ B.F.Sc./ B.Tech. degree programme.

Exit options

i. **UG-Certificate:** Exit after satisfactory completion of first year and 10 weeks' internship.

ii. **UG-Diploma:** Exit after satisfactory completion of second year and 10 weeks' internship.

iii. **B.Sc. (Hons.)/B.F.Sc./B.Tech.:** On successful completion of four-year degree requirements.

Examination and Evaluation System

Examination and evaluation system of under graduate programme of the University has been given below:

- External pattern of examination shall be followed only for the final theory portion to be conducted at the end of the semester for regular courses.
- External theory exam will be 50% and internal theory + practical- 50%.
- There will be mid-term examination for internal theory and evaluation will be internal.

- The question papers for non-credit courses will be set at the level of Dean/HOD concerned.
- The mid-term, practical and final-term examination shall be conducted during examination dates prescribed in the academic calendar.
- The date sheet will be provided by the Dean of the respective colleges.
- For a course with practical only, practical examination will be conducted twice during mid-term and final term.

Distribution of Marks for Various Examinations

Nature of courses Credit Hours (Theory + Practical)	**Internal (100)**				**External (100)**
	Mid-term Theory	**Assignment**	**Mid-term Practical**	**Final Practical**	
Courses with theory and practical					
1+1	30	20	NA	50	100
1+2	20	20	NA	60	100
2+1	40	20	NA	40	100
2+2	30	20	NA	50	100
3+1	50	20	NA	30	100
Courses with only theory	70	30	NA	NA	100
Courses with only practical	NA	30	70	100	NA

- 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.
- The evaluation of the skill enhancement courses will be done as courses with practical only.
- Usually for any subject, there will be two assignment/quizzes within the semester, one before the midterm and one after midterm examination.
- The evaluation of internship will be done by the parent institute. The student shall submit a report to the parent institute and present the learnings before the other students and faculty after the internship programme.
- The online/MOOC courses, successfully completed by the student, will be indicated in the transcript with 'Satisfactory' grade.
- When students take deficiency course(s), they will be assessed as 'Satisfactory' or Unsatisfactory' without any grade points.

The course catalogue and examination & evaluation system as per the recommendations of Sixth Deans' committee implemented with effect from academic year 2025-26, starting from 1st year 4-year programme of all the colleges. In rest of the existing classes (2nd to 4th year 4-year programme) of all the colleges, the old course catalogue and examination system shall be followed.

COLLEGE OF AGRICULTURE


तिरंगा मार्च
राष्ट्रीय सेवा योजना
कृषि महाविद्यालय
चौ. चरण सिंह हरियाणा कृषि विश्वविद्यालय, हिसार
राष्ट्रीय सेवा योजना
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तिरंगा यात्रा
कृषि महाविद्यालय
चौ. चरण सिंह हरियाणा कृषि विश्वविद्यालय, हिसार

COLLEGE OF AGRICULTURE

B. SC. (HONS.) AGRICULTURE, 4-YEAR PROGRAMME
COURSES: SEMESTER-WISE

Course No.	Course Title	Credits
I Semester		
AGRI 100	*Deeksharambh* (Induction cum Foundation course of 2 weeks)	2 (0+2) NG
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)
AGRON 103	Fundamentals of Agronomy	3 (2+1)
HORT 101	Fundamentals of Horticulture	3 (2+1)
SOILS 101	Fundamentals of Soil Science	3 (2+1)
SEC I	Skill Enhancement Course I*	2 (0+2)
SEC II	Skill Enhancement Course II*	2 (0+2)
ENG 101 (AEC)	Communication Skills	2 (1+1)
MATH 101/ BIO 101	Introductory Mathematics/Introductory Biology (Need Based)	1 (1+0) NG
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)
TUT	Tutorial	1(1+0) NG
	Total Credits	**22 (11+11)**
II Semester		
EXT 102 (AEC)	Personality Development	2 (1+1)
ENT 102	Fundamentals of Entomology	3 (2+1)
LPM 102	Livestock and Poultry Management	2 (1+1)
PL PATH 102	Fundamentals of Plant Pathology	3 (2+1)
SOILS 102 (VAC)	Environmental Studies and Disaster Management (To be taught jointly by Dept. of Soil Science, Agricultural Meteorology, Forestry and Microbiology)	3 (2+1)
SOILS 104	Soil Fertility Management	3 (2+1)
SEC III	Skill Enhancement Course III*	2 (0+2)
SEC IV	Skill Enhancement Course IV*	2 (0+2)
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)
CCA 102	Co-curricular Activity	1 (0+1) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**22 (10+12)**
AGRI 200	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (10 weeks) Compulsory for students opting for an exit with UG-Certificate after 1st Year	10 (0+10)
III Semester		
AGRON 201	Crop Production Technology I (*Kharif* Crops)	3 (1+2)
AGRON 203	Principles and Practices of Natural Farming	2 (1+1)

EXT 201	Fundamentals of Extension Education	2 (1+1)
GPB 201	Principles of Genetics	3 (2+1)
NEMA 201	Fundamentals of Nematology	2 (1+1)
VSC 201	Production Technology of Vegetables and Spices	2 (1+1)
SEC V	Skill Enhancement Course V*	2 (0+2)
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)
NCC III/ NSS III (AEC)	National Cadet Corps III/ National Service Scheme III	2 (0+2) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**21 (9+12)**
IV Semester		
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)
AG ECON 202	Principles of Agricultural Economics and Farm Management	2 (2+0)
AGRON 202	Crop Production Technology-II (*Rabi* Crops)	3 (1+2)
AGRON 204	Water Management	2 (1+1)
GPB 202	Basics of Plant Breeding	3 (2+1)
HORT 202	Production Technology of Fruit and Plantation Crops	2 (1+1)
SOILS 202	Problematic Soils and their Management	2 (1+1)
SEC VI	Skill Enhancement Course VI*	2 (0+2)
FMPE 204	Farm Machinery and Power	2 (1+1)
CCA 202	Co-curricular Activity	1 (0+1) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**21 (11+10)**
AGRI 300	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (10 weeks) Compulsory for students opting for an exit with UG-Diploma after 2nd Year	10 (0+10)
V Semester		
AG ECON 301 (MDC)	Agricultural Marketing and Trade	3 (2+1)
AGRON 301	Weed Management	2 (1+1)
AGM 301	Introduction to Agro-meteorology	2 (1+1)
ENT 301	Pest Management in Crops and Stored Grains	3 (2+1)
GPB 301	Crop Improvement (*Kharif* Crops) I	2 (1+1)
HORT 301	Ornamental Crops, MAPs and Landscaping (To be taught jointly by Dept. of Horticulture and Agronomy)	2 (1+1)
PL PATH 301	Diseases of Field and Horticultural Crops and their Management	3 (2+1)
PL PHY 201	Fundamentals of Crop Physiology	3 (2+1)

REE 301	Renewable Energy in Agriculture and Allied Sector	2 (1+1)
AGRI 351	Educational Tour	2 (0+2) NG
NCC IV/ NSS IV (AEC)	National Cadet Corps IV/ National Service Scheme IV	2 (0+2) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**22 (13+9)**
VI Semester		
AG ECON 302	Agricultural Finance and Cooperation	2 (1+1)
AGRON 302	Dryland Agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)
FOR 302	Introductory Agro Forestry	2 (1+1)
GPB 302	Crop Improvement (*Rabi* Crops) II	2 (1+1)
SST 302	Fundamentals of Seed Science and Technology	2 (1+1)
BIOCHEM 302	Essentials of Plant Biochemistry	3 (2+1)
MICRO 302	Agricultural Microbiology and Phyto-remediation	2 (1+1)
STAT 302	Basic and Applied Agril Statistics	3 (2+1)
ABT 304	Fundamentals of Agri Biotechnology	3 (2+1)
TUT	Tutorial	1 (1+0) NG
	Total Credits	**21(12+9)**
VII Semester		
Elective Courses: A student has to get register five Elective Courses (Major or Minor) each of 4 (3+1) credits **		20 (15+5)
	Total Credits	**20(15+5)**
VIII Semester		
Student READY: RAWE/ Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship		
AGRI 499	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (20 weeks) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)	20
	Total Credits	**20**
Online Courses (MOOC)***		10
	Grand Total	**169+ 10 (MOOC)+ 17 NG**

* From the bouquet of Skill Enhancement Course (SEC) modules

** From the bouquet of Elective Courses

*** From SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera or any other portal under intimation to the Dean

B.SC. (HONS.) AGRICULTURE, 4 YEAR PROGRAMME
FOUNDATION AND COMMON COURSES

Course No.	Course Title	Credits	Semester
FOUNDATION COURSES			
AGRI 100	*Deeksharambh* (Induction cum Foundation Course of 2 weeks)	2 (0+2) NG	I
AGRI 351	Educational Tour	2 (0+2) NG	V
	Total Credits	**4 (0+4) NG**	
COMMON COURSES			
Multidisciplinary Courses (MDC)			
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)	I
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)	IV
AG ECON 301(MDC)	Agricultural Marketing and Trade	3 (2+1)	V
	Total Credits	**9 (6+3)**	
Value Added Courses (VAC)			
SOILS 102 (VAC)	Environmental Studies and Disaster Management	3 (2+1)	II
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)	III
	Total Credits	**6 (4+2)**	
Ability Enhancement Courses (AEC)			
ENG 101 (AEC)	Communication Skills	2 (1+1)	I
EXT 102 (AEC)	Personality Development	2 (1+1)	II
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)	I
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)	II
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)	III
	Total Credits	**10 (2+8)**	

B. SC. (HONS.) AGRICULTURE, 4-YEAR PROGRAMME
CORE COURSES: DEPARTMENT-WISE

Course No.	Course Title	Credits	Semester
Agricultural Economics			
AG ECON 202	Principles of Agricultural Economics and Farm Management	2 (2+0)	IV
AG ECON 301 (MDC)	Agricultural Marketing and Trade	3 (2+1)	V
AG ECON 302	Agricultural Finance and Cooperation	2 (1+1)	VI
	Total Credits	**7 (5+2)**	
Agricultural Extension Education			
EXT 102 (AEC)	Personality Development	2 (1+1)	II
EXT 201	Fundamentals of Extension Education	2 (1+1)	III
	Total Credits	**4 (2+2)**	
Agricultural Meteorology			
AGM 301	Introduction to Agro-meteorology	2 (1+1)	V
	Total Credits	**2 (1+1)**	
Agronomy			
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)	I
AGRON 103	Fundamentals of Agronomy	3 (2+1)	I
AGRON 201	Crop Production Technology I (*Kharif* Crops)	3 (1+2)	III
AGRON 203	Principles and Practices of Natural Farming	2 (1+1)	III
AGRON 202	Crop Production Technology II (*Rabi* Crops)	3 (1+2)	IV
AGRON 204	Water Management	2 (1+1)	IV
AGRON 301	Weed Management	2 (1+1)	V
AGRON 302	Dryland Agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)	VI
	Total Credits	**20 (10+10)**	
Business Management			
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)	IV
	Total Credits	**3 (2+1)**	
Entomology			
ENT 102	Fundamentals of Entomology	3 (2+1)	II
ENT 301	Pest Management in Crops and Stored Grains	3 (2+1)	V
	Total Credits	**6 (4+2)**	
Forestry			
FOR 302	Introductory Agro Forestry	2 (1+1)	VI
	Total Credits	**2 (1+1)**	
Genetics and Plant Breeding			
GPB 201	Principles of Genetics	3 (2+1)	III
GPB 202	Basics of Plant Breeding	3 (2+1)	IV
GPB 301	Crop Improvement (*Kharif* Crops) I	2 (1+1)	V

GPB 302	Crop Improvement (*Rabi* Crops) II	2 (1+1)	VI
	Total Credits	**10 (6+4)**	
Horticulture			
HORT 101	Fundamentals of Horticulture	3 (2+1)	I
HORT 202	Production Technology of Fruit and Plantation Crops	2 (1+1)	IV
HORT 301	Ornamental Crops, MAPs and Landscaping (To be taught jointly by Dept. of Horticulture and Agronomy)	2 (1+1)	V
	Total Credits	**7 (4+3)**	
Nematology			
NEMA 201	Fundamentals of Nematology	2 (1+1)	III
	Total Credits	**2 (1+1)**	
Plant Pathology			
PL PATH 102	Fundamentals of Plant Pathology	3 (2+1)	II
PL PATH 301	Diseases of Field and Horticultural Crops and their Management	3 (2+1)	V
	Total Credits	**6 (4+2)**	
Seed Science and Technology			
SST 302	Fundamentals of Seed Science and Technology	2 (1+1)	VI
	Total Credits	**2 (1+1)**	
Soil Science			
SOILS 101	Fundamentals of Soil Science	3 (2+1)	I
SOILS 102 (VAC)	Environmental Studies and Disaster Management (To be taught jointly by Dept. of Soil Science, Agricultural Meteorology, Forestry and Microbiology)	3 (2+1)	II
SOILS 104	Soil Fertility Management	3 (2+1)	II
SOILS 202	Problematic Soils and their Management	2 (1+1)	IV
	Total Credits	**11 (7+4)**	
Vegetable Science			
VSC 201	Production Technology of Vegetables and Spices	2 (1+1)	III
	Total Credits	**2 (1+1)**	

SKILL ENHANCEMENT COURSES*

Course No.	Course Title	Credits	Semester
AGRON 001	Vermicompost Production Technology	2 (0+2)	I, II
AGRON 002	Herbicides Spray Technologies	2 (0+2)	I, II
ABM 003	Development of Agribusiness Proposal	2 (0+2)	I, II
ENT 004	Apiculture	2 (0+2)	I, II
ENT 005	Production of Biocontrol Agents	2 (0+2)	I, II
GPB 006	Crossing Techniques and Handling of Different Field Crops	2 (0+2)	III, IV
GPB 007	Molecular Techniques for Agriculturist (To be taught jointly by Dept. of Genetics & Plant Breeding, Plant Pathology and Nematology)	2 (0+2)	III, IV
HORT 008	Value Addition of Fruits and Vegetables (To be taught jointly by Dept. of Horticulture and Vegetable Science)	2 (0+2)	I, II
HORT 009	Nursery Raising of Horticultural and Forest Plants (To be taught jointly by Dept. of Horticulture and Forestry)	2 (0+2)	I, II
PL PATH 010	Mushroom Cultivation	2 (0+2)	I, II
SST 011	Quality Seed Production Techniques	2 (0+2)	I, II
SST 012	Seed Testing and Quality Control	2 (0+2)	I, II
SOILS 013	Soil and Water Testing Services	2 (0+2)	I, II
VSC 014	Nursery Management in Vegetable Crops	2 (0+2)	I, II
LPM 015	Poultry Production Technology	2 (0+2)	I, II

ELECTIVE COURSES**

Course No.	Course Title	Credits	Semester
AG ECON 401	International Trade in Agriculture	4 (3+1)	VII
AG ECON 402	Agricultural Project Formulation Evaluation and Monitoring	4 (3+1)	VII
AGM 401	System Simulation and Agroadvisory	4 (3+1)	VII
AGM 402	Geoinformatics and Remote Sensing, Precision Farming (To be taught jointly by Agronomy, Soil Science, Agricultural Meteorology and Farm Machinery & Power Engineering)	4 (3+1)	VII
AGRON 401	Management of Natural Resources (To be taught jointly by Agronomy, Soil Science and Soil Water Engineering)	4 (3+1)	VII
AGRON 402	Agrochemicals (To be taught jointly by Agronomy, Soil Science, Entomology and Plant Pathology)	4 (3+1)	VII
AGRON 403	Climate Resilient Agriculture (To be taught jointly by Agronomy, Agricultural Meteorology and Genetics & Plant Breeding)	4 (3+1)	VII

AGRON 404	Principles and Practices of Organic Farming and Conservation Agriculture	4 (3+1)	VII
ENT 401	Management of Beneficial Insects	4 (3+1)	VII
ENT 402	Pesticides and Plant Protection Equipment	4 (3+1)	VII
EXT 401	Entrepreneurship Development and Management	4 (3+1)	VII
EXT 402	Extension Approaches and Agricultural Journalism	4 (3+1)	VII
FOR 401	Wood Technology and Forest Utilization	4 (3+1)	VII
FST 401	Food Safety and Standards	4 (3+1)	VII
FST 402	Food Science and Nutrition	4 (3+1)	VII
GPB 401	Crop Improvement	4 (3+1)	VII
GPB 402	Biotechnology of Crop Improvement	4 (3+1)	VII
HORT 401	Landscaping	4 (3+1)	VII
HORT 402	Hi-tech Horticulture	4 (3+1)	VII
HORT 403	Protected Cultivation	4 (3+1)	VII
NEMA 401	Nematode Pests of Crops and their Management	4 (3+1)	VII
PL PATH 401	Applied Plant Pathology	4 (3+1)	VII
PL PATH 402	Biocontrol Agents and Biopesticides	4 (3+1)	VII
SST 401	Commercial Seed Production	4 (3+1)	VII
SOILS 401	Soil Mineralogy, Genesis, Classification and Survey	4 (3+1)	VII
SOILS 402	Soil Management	4 (3+1)	VII
VSC 401	Post Harvest Technology and Value Addition (To be taught jointly by Dept. of Horticulture and Vegetable Science)	4 (3+1)	VII
VSC 402	Commercial Vegetable Production	4 (3+1)	VII

RAWE AND AIA FOR UG CERTIFICATE AFTER 1ST YEAR AND UG DIPLOMA AFTER 2ND YEAR

Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)			
Sr. No.	**Activities**	**No. of weeks**	**Credits**
1.	General orientation and on campus training by different faculties	1	5
2.	RAWE (Rural Agricultural Work Experience) – Village Attachment	4	
3.	Plant Clinic	1	1
4.	Agro-Industrial Attachment	3	3
5.	Project Report Preparation, Presentation and Evaluation	1	1
	Total	**10**	**10**

RAWE AND AIA FOR B.SC. (HONS.) AGRICULTURE, 4-YEAR PROGRAMME

Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)			
Sr. No.	**Activities**	**No. of weeks**	**Credits**
1.	General orientation and on campus training by different faculties	1	10
2.	RAWE (Rural Agricultural Work Experience) – Village Attachment	9	
3.	Plant clinic	2	02
4.	Agro-Industrial Attachment	6	06
5.	Project Report Preparation, Presentation and Evaluation	2	02
	Total	**20**	**20**

NON-GRADIAL COURSES

Course No.	Course Title	Credits	Semester
AGRI 100	*Deeksharambh* (Induction cum Foundation course of 2 weeks)	2 (0+2)	I
AGRI 351	Educational Tour	2 (0+2)	V
TUT	Tutorial	1 (1+0)	I to VI
	Total Credits	**10 (6+4)**	

SUPPORTING COURSES: DEPARTMENT-WISE

COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

Course No.	Course Title	Credits	Semester
Farm Machinery and Power Engineering			
FMPE 204	Farm Machinery and Power	2 (1+1)	IV
	Total Credits	**2 (1+1)**	
Renewable and Bio-energy Engineering			
REE 301	Renewable Energy in Agriculture and Allied Sector	2 (1+1)	V
	Total Credits	**2 (1+1)**	

COLLEGE OF BASIC SCIENCES AND HUMANITIES

Course No.	Course Title	Credits	Semester
Biochemistry			
BIOCHEM 302	Essentials of Plant Biochemistry	3 (2+1)	VI
	Total Credits	**3 (2+1)**	
Botany and Plant Physiology			
BIO 101	Introductory Biology (Need based)	1 (1+0) NG	I
PL PHY 201	Fundamentals of Crop Physiology	3 (2+1)	V
	Total Credits	**3 (2+1)**	
Computer Section			
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)	III
	Total Credits	**3 (2+1)**	
Languages and Haryanavi Culture			
ENG 101(AEC)	Communication Skills	2 (1+1)	I
	Total Credits	**2 (1+1)**	
Mathematics and Statistics			
MATH 101	Introductory Mathematics (Need based)	1 (1+0) NG	I
STAT 302	Basic and Applied Agril Statistics	3 (2+1)	VI
	Total Credits	**3 (2+1)**	
Microbiology			
MICRO 302	Agricultural Microbiology and Phyto-remediation	2 (1+1)	VI
	Total Credits	**2 (1+1)**	
Sociology			
SOC 101	Rural Sociology and Educational Psychology	2 (2+0)	I
	Total Credits	**2 (2+0)**	

COLLEGE OF BIOTECHNOLOGY

Agricultural Bio-technology			
Course No.	**Course Title**	**Credits**	**Semester**
ABT 304	Fundamentals of Agri Biotechnology	3 (2+1)	VI
	Total Credits	**3 (2+1)**	

OTHER SUPPORTING COURSE

Animal Science			
Course No.	**Course Title**	**Credits**	**Semester**
LPM 102	Livestock and Poultry Management	2 (1+1)	II
	Total Credits	**2 (1+1)**	

DIRECTORATE OF STUDENTS' WELFARE

Course No.	**Course Title**	**Credits**	**Semester**
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)	I
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)	II
CCA 102	Co-curricular Activity	1 (0+1) NG	II
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)	III
NCC III/ NSS III	National Cadet Corps III/ National Service Scheme III	1 (0+1) NG	III
CCA 202	Co-curricular Activity	1 (0+1) NG	IV
NCC IV/ NSS IV	National Cadet Corps IV/ National Service Scheme IV	2 (0+2) NG	V
	Total Credits	**6 (0+6)**	

COURSE CONTENTS: DEPARTMENT-WISE

FOUNDATION COURSES

Course No.	Course Title	Credits	Semester
AGRI 100	*Deeksharambh* (Induction cum Foundation course of 2 weeks)	2 (0+2) NG	I
AGRI 351	Educational Tour	2 (0+2) NG	V
	Total Credits	**4 (0+4)**	

AGRI 100	***DEEKSHARAMBH* (Induction Cum Foundation Course of Two Weeks)**	2 (0+2) NG	SEM I

Objectives

- Help for cultural integration of students from different backgrounds,
- Know about the operational framework of academic process in the University/ College/ Institute
- Instilling life and social skills,
- Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
- Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.
- Identify strength and weakness of the students in different core areas of the discipline.

Activities

i. Discussions on operational framework of academic process in the University, as well as interactions with academic and research managers of the University
ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
iii. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
iv. Activities to enhance cultural Integration of students from different backgrounds.
v. Field visits to related fields/ establishments
vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

AGRI 351	EDUCATIONAL TOUR	2 (0+2) NG	SEM V

To be conducted for 10-12 days after 5th Semester.
The students will visit industries/ institutions, preferably outside the state, so that, in addition to visiting the organizations/ industries (related to the profession), they will also be exposed to the geographical variability of different places/ states and the social and cultural differences existing in the country.
After the visit, the students will submit a report/ make a presentation.

AGRICULTURAL ECONOMICS

Course No.	Course Title	Credits	Semester
Core Courses			
AG ECON 101	Fundamentals of Agricultural Economics (For B.Sc. (Hons.) Agribusiness Management)	2 (2+0)	I
AG ECON 102	Farm Management, Production and Resource Economics (For B.Sc. (Hons.) Agribusiness Management)	3 (2+1)	II
AG ECON 202	Principles of Agricultural Economics and Farm Management	2 (2+0)	IV
AG ECON 206	International Trade and Policy in Agriculture (For B.Sc. (Hons.) Agribusiness Management)	2 (2+0)	IV
AG ECON 301 (MDC)	Agricultural Marketing and Trade (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science and B.Tech. Biotechnology)	3 (2+1)	Agri.: V AM: V CS: IV Biotech: IV
AG ECON 302	Agricultural Finance and Cooperation	2 (1+1)	VI
AG ECON 303	Introduction to Managerial Economics (For B.Sc. (Hons.) Agribusiness Management)	3 (2+1)	V
AG ECON 304	Grading Standardization and Quality Management in Agri-food products (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	VI
	Total Credits	**22(16+6)**	
Elective Courses			
AG ECON 401	International Trade in Agriculture	4 (3+1)	VII
AG ECON 402	Agricultural Project Formulation Evaluation and Monitoring	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**30(22+8)**	

AG ECON 101	**FUNDAMENTALS OF AGRICULTURAL ECONOMICS (For B.Sc. (Hons.) Agribusiness Management)**	**2 (2+0)**	**SEM I**

Objectives

1. To understand the fundamental principles of economics as they apply to agriculture;
2. To analyze the economic factors influencing agricultural production, distribution, and consumption.
3. To explore the role of government policies and international trade in shaping the agricultural economy.
4. To develop critical thinking skills to evaluate and address economic challenges and opportunities in agriculture.

Theory

Agricultural Economics: Meaning, definition, characteristics of agriculture, Nature and scope of agricultural economics, Distinction between agriculture and industry, Role of agriculture in economic development, Role of government interventions in agricultural development. Planning and Agricultural Development: Meaning and objectives, economic planning, benefits of planning, Agricultural development during different Five-year Plans in India, Measures of reorganization of agriculture and NITI Aayog. Factors of production: Meaning of land and its characteristics, Labour concept, Characteristics of labour and efficiency of labour, Capital concept and its characteristics, Forms of capital in agriculture and process of capital formation, Organization of business firms, Forms of business organizations and their characteristics. Land reforms: Land reforms and Land tenure systems, Concepts of agricultural land holdings in India. Theory of production: Meaning, definition, types of production functions, Laws of Diminishing Marginal Returns and Elasticity of production. Scale of production: Meaning, classification and economies of scale. Theory of costs: Meaning, definitions and different types of costs and their measurement. Revenue concept: Total revenue, average revenue and marginal revenue and profit maximization.

Suggested Readings

1. Agriculture economics by Shubha Reddy
2. Finance by Shubha Reddy
3. Economic of farm production and management by VT Raju, VS Rao
4. Agricultural marketing in India by S S Acharya, NL Aggarwal
5. Modern microeconomics by Koutsoyiannis

AG ECON 102	**FARM MANAGEMENT, PRODUCLTION AND RESOURCE ECONOMICS (For B.Sc. (Hons.) Agribusiness Management)**	**3 (2+1)**	**SEM II**

Objectives

1. To understand the principles of farm management and resource allocation in agriculture
2. To analyze production economics to optimize resource use and maximize profitability on farms
3. To learn about farm-level decision-making processes, including crop selection, input use, and technology adoption
4. To explore the economic aspects of resource management, including land, labor, capital, and risk, in agricultural enterprises

Theory

Farm management: meaning, definitions and concepts; Nature and scope, objectives and relationship with other sciences; Decisions making process; Meaning and definition of farms sizes based on holding and ownership; Types of farming and their

characteristics; factors determining types and size of farms; production economics and farm management principles; Meaning definition of production economics, concept of production function and its types, use of production function in decision making on a farm, factor-product, factor-factor and product-product relationship. Law of equi-marginal returns or principles of opportunity cost and law of comparative advantage; Cost principle: meaning and concept of costs, types of costs-seven costs and applied cost concepts, and their interrelationship, importance of cost in managing farm business; Farm records: types and importance of farm records and accounts in managing a farm; Farm planning and budgeting: meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting, linear programming; Risk and uncertainty: concept of risk and uncertainty in agriculture production, types/sources of risks and their management strategies. Crop/livestock/machinery insurance: Weather based crop insurance (WBCIS) and *Pradan Mantri Fasal Bhima Yojana* (PMFBY), their features; Resource economics: Meaning of resource economics difference between NRE and agricultural economics, unique properties of natural resources, positive and negative externalities in agriculture, inefficiency and welfare loss, solutions, management of common property resources of land, water, pasture, fishery and forest resource.

Practical

Basic concepts in production economics and farm management; study and visit to different farm layouts and appraisals of farm resources; Analysis of costs and revenue concepts; Computation of depreciation cost of farm assets; Determination of most profitable level of input use in a farm production process; Determination of least cost combination of inputs; Selection of most profitable enterprise combination; Application of equi-marginal returns/opportunity cost principle in allocation of farm resources; Application of the principle of comparative advantage; Estimation of cost and returns using CACP cost concepts for crop, horticulture and livestock enterprises; Farm inventory analysis; Preparation of optimum farm plan using budgeting technique using partial and complete budgeting; visit to farms to study farm records and accounts; preparation of profit and loss accounts compensation for crop loss; Collection and analysis of data on various resources in India; Practical Examination.

Suggested Readings

1. Chinna, S.S., Agricultural Economics and Indian Agriculture.
2. Heady, E.O. and Dhillon, J.L., Agricultural Production Functions.
3. Jhon, P. Doll and Frank. Orezen, Production Economics: Theory with Applications.
4. Johl, S.S. and Kapoor, T.R., Fundamentals of Farm Business Management.
5. Memoria, C.B., Agricultural Problems of India.
6. Raju, V.T. and Vishwashankar Rao, Economics of Farm Production and Management.
7. Sadhu and Singh, Fundamentals of Agricultural Economics.
8. Sankhyan, P.L., Introduction to Economics of Agricultural Production.
9. Spinger, Natural Resource Management and Policy.
10. Subba Reddy *et al.*, Agricultural Economics.

AG ECON 202	PRINCIPLES OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT	2 (2+0)	SEM IV

Objectives

1. To aware the students about broad areas covered under agricultural Economics and farm management
2. To impart knowledge on judicious use of resources for optimum production

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, equimarginal 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, Farms and farm management, decisions taken on a farm etc. Principles of farm management and their application in decision making on a farm. Farm business analysis and farm efficiency measures. 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. 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. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on Indian economy.

Suggested Readings

1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers
2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd

AG ECON 206	INTERNATIONAL TRADE AND POLICY IN AGRICULTURE (For B.Sc. (Hons.) Agribusiness Management)	2 (2+0)	SEM IV

Objectives

1. Understand the principles and mechanisms of international trade in agricultural commodities
2. Learn about agricultural trade policies, agreements, and their impacts on global markets
3. Explore strategies for market access, trade negotiations, and resolving trade disputes in agriculture
4. Develop skills to analyze international trade trends, assess market opportunities, and navigate regulatory frameworks to facilitate agricultural exports and imports

Theory

International Trade - meaning, definition, nature and scope. Salient features of international trade, differences between internal trade and international trade, advantages and disadvantages of international trade.

Theories of international trade - mercantilism, theory of absolute cost advantage, theory of comparative cost advantage and modern theory of international trade. Terms of trade - meaning and types. Free trade - meaning, advantages and disadvantages, free trade agreements.

Protectionism - meaning, advantages and disadvantages of protectionism, types of protection-tariffs, quotas, subsidies, dumping, cartels and commodity agreements. Balance of Trade (BoT) and Balance of Payments (BoP) - meaning, differences between BoT and BoP, India's BoT and BoP position. Foreign exchange – meaning, foreign exchange rate, types of foreign exchange rate, mechanisms of determining foreign exchange rate. Foreign exchange market – meaning and functions, instruments of international payments, foreign exchange control and foreign exchange reserves.

WTO – origin, structure, objectives and functions. Agreement on Agriculture - domestic support, market access and export subsidies. FAO / WHO Codex Alimentarious and SPS measures.

Export procedures and documentations, types of export - direct export and indirect export, export houses – objectives and types. Agricultural export promotion organizations - APEDA, MPEDA, Commodity Boards and State Export Promoting Agencies. India's agricultural exports and imports – composition and trading countries. India's foreign trade policy – meaning and objectives.

Suggested Readings

1. Ajami, Riad A. - International Business- Theory and Practices.
2. Cherunilam and Dominick Salvatore - International Economics.
3. Cherunilam, Prancis - International Trade and Export Management.
4. Haberler, G. - Theory of International Trade.

5. Jain, Arun Kumar - International Business.
6. Jhingan, M.L. - International Economics.
7. Justin Paul - International Business.
8. Mithani, D.M. - Money, Banking, International Trade and Public Finance.
9. Tappa, Ashwa - International Business.
10. Vaish, M.C. and Singh, Sudham– International Economics.
11. Venkateshwaran, N. - International Business Management.

AG ECON 301 (MDC)	**AGRICULTURAL MARKETING AND TRADE (FOR B.SC. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM Agri.: V AM: V CS: IV Biotech: IV**

Objectives

1. To understand the fundamentals of agricultural marketing and trade
2. To analyze the factors influencing supply and demand in agricultural markets
3. To explore different marketing channels and strategies in agriculture
4. To examine the role of government policies and regulations in agricultural markets

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 producers surplus of agri commodities: nature and determinants of demand and supply of farm products, producers surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and 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 labelling (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 and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for

innovations in 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; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present-day context.

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. 2006. Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3. Dominic Salvatore, Micro Economic Theory
4. Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
5. Kotler and Armstrong, 2005. Principles of Marketing, Pearson Prentice-Hall.
6. Lekhi, R. K. and Joginder Singh. 2006. Agricultural Economics. Kalyani Publishers, Delhi.
7. Memoria, C.B., Joshi, R.L. and Mulla, N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
8. Pandey Mukesh and Tewari, Deepali. 2004. Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
9. Sharma, R. 2005. Export Management, Laxmi Narain Agarwal, Agra.

AG ECON 302	AGRICULTURAL FINANCE AND COOPERATION	2 (1+1)	SEM VI

Objectives

To impart knowledge on issues related to lending to priority sector credit management and financial risk management

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 noninstitutional 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, NAFED. Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Practical

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 first-hand 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. Different types of repayment plans.

Suggested Readings

1. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects**.** The Johns Hopkins Univ. Press.
2. Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH.

AG ECON 303	**INTRODUCTION TO MANAGERIAL ECONOMICS (For B.Sc. (Hons.) Agribusiness Management)**	**3 (2+1)**	**SEM V**

Objectives

1. Understand the application of economic principles in managerial decision-making
2. Learn how to analyze market conditions, demand, and cost structures to optimize business strategies
3. Explore the role of managerial economics in pricing, production, and resource

allocation within firms

4. Develop skills to make informed decisions that maximize profitability and efficiency in various business contexts

Theory

Managerial Economics: Definition, scope and significance of managerial economics, Basic economic concepts and principles – firm, industry and economy. Demand estimation: Demand forecasting – meaning, importance and techniques. Production analysis: Cobb-Douglas and CES production functions. Modern Firms: Changing objectives of modern firms and their cost curves, Leaning curve, Meaning, uses and types of cost control, revenue concepts and break-even analysis. Monopoly: Monopoly types, characteristics and degrees of price discrimination under monopoly. Monopolistic Competition: Types, characteristics and pricing and output determination, Pricing strategies of modern firms. Macro-economic equilibrium: Money concept, functions, demand for and supply of money. Inflation: Meaning and types of inflation, price indices, causes, effects and control of business cycles using monetary and fiscal policies.

Practical

Computation of different types of demand function. Computation of elasticity of demand-price, income, cross and promotional. Computation of total, average and marginal revenue under different market conditions. Demand estimation through regression analysis. Demand forecasting using non-quantitative and quantitative techniques - trend method, regression method, leading indicator method, simultaneous equations method. Analysis of important demand forecasting methods. Computation of average product, marginal product and elasticity of output with respect to one variable input. Analysis of optimal factor combination using C-D production function. Computation of elasticity of substitution using C-D and CES production functions. Calculation of optimal output combination of multi-product firms. Derivation of cost functions from production functions and break-even analysis. Determination of market price, market price and normal price. Price determination in perfect competition. Computation of break-even point, learning curve and economies of scope. Calculation of equilibrium price and output under conditions of monopoly and oligopoly. Calculation of market concentration under oligopoly. Price and output determination. Computation of macro-economic equilibrium models.

Suggested Readings

1. Ahuja, H.L. (2008). Managerial Economics – Analysis of Managerial Decision Making. S. Chand and Company Ltd.
2. Chaturvedi, D.D. and S.L. Gupta. (2012). Business Economics Theory and Application. International Book House.
3. Dewett, K.K. 2002. Modern Economic Theory. Syamlal Charitable Trust, New Delhi.
4. Seth, M.L. (2000). Principles of Economics. Lakshmi Narain Agarwal Co., New Delhi.

AG ECON 304	**GRADING STANDARDIZATION AND QUALITY MANAGEMENT IN AGRI-FOOD PRODUCTS (For B.Sc. (Hons.) Agribusiness Management)**	**2 (1+1)**	**SEM VI**

Objectives

1. Understand the principles and methods of grading and standardization for agri-food products
2. Learn techniques to ensure product quality and consistency in the agricultural supply chain
3. Explore quality management systems and certifications applicable to agri-food products
4. Develop skills to implement grading, standardization, and quality management practices to meet market requirements and consumer expectations

Theory

Evolution of markets- meaning of market, marketing, Agril. Marketing. Concept of marketing – old concept, new concept and modern concept. Significance / need of Agril. Marketing, creation of utilities. Classification of markets. Marketing functions- Physical functions, exchange functions and facilitative functions. Grading and standardization Meaning-Significance of grading and standardization. Types of grading- fixed grading/mandatory grading, permissive/variable grading, centralized grading/decentralized grading and Grading at producers' level. Criteria for grade standards and advantages of grading. Role of grading in Agril. Products. The agricultural produce (Grading and Marketing) Act, 1937. Quality control of Agril. Products, AGMARK standards, the role of DMI in grading of Agril. Produce, Inspection and quality control, labelling in Agril. Products. Grading of food grains- grading of Rice commercial classification, based on physical characteristics, cooking quality of rice, Rice grading by AGMARK. Special characteristics, general characteristics, safety parameters, determination of quality of rice. Impurities refractions of food grains foreign matter- organic and inorganic, admixtures, damaged and discolored grains, slightly damaged grains and immature and shriveled grains, Chalky, weevils, broken, fragments, other foodgrains, non-food grains, Smutty grains, whole grains. Inherent and acquired characteristics of food grains. Wheat- quality characteristics of wheat varieties, Wheat- strong wheat flour, medium and medium flour, kinds of wheat. AGMARK quality specifications for wheat, safety parameters and determination of quality of wheat. FAQ standards for Rice, Wheat, Ragi, Maize. Grading of Pulses, AGMARK standards for Green gram (moong), Red gram (tur dal), Bengal gram, Black gram urad dal), Rajma, Peas, Masoor (lentils), Matki (moth). Grading of oil seeds: Groundnut, Sunflower. AGMARK standards of oil seeds. Commercial classification of Groundnut- Coramandal, Bold, Red natal and Peanuts. Grading of pods and kernels of groundnut. AGMARK grade designation of quality of edible oil. Grading of commercial crops- special and general characteristics of Areca nut, copra, Tobacco and Cotton, chilli. Classification and grading of vegetables: Cole, Tuber, Pod, Salad, Root and Bulb vegetables. Grading of fruits- Tropical fruits, Mango,

Banana, Citrus, Grapes, Sapota and Pomegranate. Temperate fruits: Apple, Pears, Plums, Apricots and Peaches. Quality control of manufactured products Indian Standards Institution (ISI): aims and objectives of ISI, granting licenses for ISI, Bureau of Indian Standards (BIS), management systems certification. Spot exchange grade requirements, Mark to identify vegetarian/non vegetarian food, Eco mark. Mark of FPO and ISO standards. Quality control in food- food hygiene, food adulteration and food poisoning. Good Agril. Practices, good manufacturing practices. EUREPGAP Quality management in food: FSS Act 2006, Hazard Analysis and Critical Control Point (HACCP), Codex Alimentarius commission (CODEX), Fair Average Quality (FAQ), General Characteristics and grade designations of processed food- Jaggery, instant food, fruits and vegetables products.

Practical

Study of laboratory equipment, Sampling equipment, scientific grading, instruments and other apparatus, Visit to vegetable and fruit markets, Jaggery market and other food processing units. Visit to Bureau of Indian Standards. Presentations and Group discussions for the above topics.

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L., 2000, Agricultural Marketing in India.
2. Chakravarty, A. and De, D.S., 1981, Post harvest technology of cereals and pulses, Oxford and IBH, Calcutta.
3. Jambunathan, L.R., 1984, Grading of cotton for quality: A scoring system of instrumental evaluation for Cotton Hybrid-4.
4. Mamoria, C.B., 1976, Agricultural Problems of India, Kitab Mahal, Allahabad.
5. Manual on Grading and Standardization, Directorate of Marketing and Inspection (DMI), Nagpur.
6. Manual on Standards, Bureau of Indian Standards (BIS), New Delhi.
7. Wader, L.K. and C., Murthy, 2003, Textbook of agricultural marketing and cooperation, ICAR, New Delhi.

AG ECON 401	INTERNATIONAL TRADE IN AGRICULTURE	4 (3+1)	SEM VII

Objectives

1. To introduce basic concepts and policies of international trade in agriculture.
2. To understand the impact of globalization and WTO agreements on Indian agriculture.
3. To develop skills in export-import data collection, analysis, and reporting.

Theory

Basic concept/terms in international trade, Theory of International Trade, Process of Liberalization, Privatization and Globalization (LPG), Balance of payments, Advantages of International Trade, Principal of Comparative Advantage-Trade Barriers-Tariff Rate quotas(TRQ)- Tariffication, Policy of International Trade in India- An Over View of Agricultural Exports and Imports in India-Major Constraints

in agricultural exports, Agro-Export Zones (AEZs) and Special Economic Zone (SEZ)- Export Promotion Council(EPC)- Agricultural Processed Food Export Development Agency(APEDA)- Marine Product Export Development Agency(MPEDA)

Emerging trade Problems in the New Economic Regime, WTO Agreement on agriculture and its Implications to Indian Agriculture, Sanitary and Phyto-Sanitary Measures (SPS)-Technical Barriers to Trade (TBT)- Pre- Shipment Inspection-Hazard Analysis Critical Control Point (HACCP). International Marketing Channels-International prices (f.o.b and c i f)- Export Risk Insurance, Market Intelligence in International trade, existing and potential export markets

Practical

Visit to Export units, Regional Export Promotion council and APEDA, Preparation of visit report, Presentation of visit report, Collection of Exports, Imports and Prices data, Analysis of collected data, Report and presentation on EPC and NPC Export-Import (Exim) policy of the government, group discussion on Exim policy and BOP, BOP-data collection over a period, Visit to a food processing enterprise, Preparation of visit report, Presentation of visit report, Revision and discussion on all exercises

Suggested Readings

1. WTO and Indian Economy by G.K. Chadha
2. Agricultural Economics by S. Subba Reddy, P. Raghu Ram et al.
3. Indian Economy by Ruddar Dutt and K.P.M. Sundharam
4. Trade Liberalization, WTO and Indian Agriculture by Ramesh Chand
5. WTO and New International Trade Regime by A.K. Vashisht and Alka Singh
6. Agricultural Statistics at a Glance 2013 by Ministry of Agriculture (Government of India)

AG ECON 402	AGRICULTURAL PROJECT FORMULATION EVALUATION AND MONITORING	4 (3+1)	SEM VII

Objectives

1. To understand the process of agricultural project development, including the roles of NABARD and key project management steps.
2. To apply project appraisal techniques like NPV, IRR, and BC Ratio to evaluate agricultural projects.
3. To develop practical skills in preparing project reports, analyzing financial statements, and estimating project feasibility.

Theory

Project: Meaning, Project Development – Need and Scope of Project Development in Agriculture and rural development, Role of NABARD in project Development, Management and Implementation, Development of Project Related to Agriculture, Project Cycle and Various steps involved in Project Management, Project Appraisal Techniques, Discounting and undiscounted technique, computation of NPV, Internal Rate of Return (IRR), BC Ratio & Profitability Index, Programme Evaluation Review

Technique and Critical Path Method (PERT and CPM) , Monitoring and Evaluation of projects, Project Evaluation Approaches : Pre-post, Ex-Ante and Ex-Post, With and Without- Situations and Justification, Preparation of Project Report

Practical

Identification of Agro based projects and their study, Balance sheet and various ratios based on it, Preparation of income statement of typical farm and various ratios based on it, Collection of data for cash flow map and working out cash flow for dairy and poultry etc, Visit of RRB & HGB and presentation on various financial aspects, Visit of PAC's and DCCB's and presentation thereof on various financial aspects, Visit to LDB and presentation thereof on various financial aspects, Preparation of Agricultural Rural Development Projects and their presentation on multimedia , Estimation of NPV, IRR, BC ratio and profitability index for different Agril. Projects and reporting writing

Suggested Readings

1. Economic Analysis of Agricultural Projects by Gittinger, J.P.
2. Project Appraisal and Planning for Developing Countries by Little, I.M.D. and Mirrlees, J.A.
3. Investment Projects in Agriculture by Donald Mc. and Benjamin, P.C.
4. Project Planning, Financing, Implementation and Evaluation by Srivastava, U.K.
5. Agro Industrial Project Analysis by James Austin
6. Guidelines for Project Evaluation by the United Nations
7. Indian Economy by Rudder K.P.M. Sundharam
8. Agricultural Finance and Management by S. Subba Reddy and C.P. Raghu Ram

AGRICULTURAL EXTENSION EDUCATION

Course No.	Course Title	Credits	Semester
Core Courses			
EXT 102 (AEC)	Personality Development (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribuisness Management and B.Tech. Biotechnology)	2 (1+1)	II
EXT 201	Fundamentals of Extension Education	2 (1+1)	III
	Total Credits	**4 (2+2)**	
Elective Courses			
EXT 401	Entrepreneurship Development and Management	4 (3+1)	VII
EXT 402	Extension Approaches and Agricultural Journalism	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**12(8+4)**	

EXT 102 (AEC)	PERSONALITY DEVELOPMENT **For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribuisness Management and B.Tech. Biotechnology)**	2 (1+1)	SEM II

Objectives

To make students realize their potential strengths, cultivate their inter-personal skills and improve employability.

Theory

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.

Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

Suggested Readings

1. Andrews, Sudhir. 1988. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw- Hill.
2. Heller, Robert. 2002. Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim. 2003. Reducing Stress. Essential Manager series. Dk Publishing.
4. Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5. Mile, D.J. 2004. Power of Positive Thinking. Delhi. Rohan Book Company.
6. Pravesh Kumar. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House.
7. Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
8. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.

EXT 201	FUNDAMENTALS OF EXTENSION EDUCATION	2 (1+1)	SEM III

Objectives

1. State the importance of extension education in agriculture
2. Familiarize with the different types of agriculture and rural development programs launched by govt. of India
3. Classify the types of extension teaching methods
4. Elaborate the importance and different models of communication
5. Explain the process and stages of adoption along with adopters'categories

Theory

Education: Meaning, definition and 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.); Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc. New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc., Attributes of Innovation, DWCRA, Commodity Interest Groups (CIGs)., Farmers Producer Group (FPG).

Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader. Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs;

transfer of technology: concept and models, capacity building of extension personnel; extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (News and social media), media mix strategies; communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; Identification of rural leaders in village situation; 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; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO 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. Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi press, Bapatla.
2. Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
3. Jalihal, K. A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.
4. MuthaiahManoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.
6. Rathore, O. S. et al. 2012. Handbook of Extension Education, Agrotech Publishing Academy, Udaipur.
7. Dudhani, C.M., Hirevenkatgoudar, L.V., Manjunath, L. Hanchinal, S.N. and Patil, S.L. 2004. Extension Teaching Methods and Communication Technology, UAS, Dharwad.
8. Sandhu, A.S. 1993. Text book on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Pvt. Ltd, New Delhi.
9. Singh, A.K., Lakhan Singh, R. and Roy Burman. 2006. Dimensions of Agricultural Extension. Aman Publishing House, Meerut

EXT 401	ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT	4 (3+1)	SEM VII

Objectives

The first part of the course is intended to provide overall picture of planning and development of enterprises for extending sustainable livelihoods for rural people. The second part of the course is structured to help the students to gain knowledge and skills in different concepts and techniques of management in extension organizations.

Theory

Entrepreneurship–Concept, characteristics, Approaches, Theories, Need for enterprises development. Agri – entrepreneurship – Concept, characteristics, Nature and importance for sustainable Livelihoods. Traits of entrepreneurs – Risk taking, Leadership, Decision making, Planning, Organizing, Coordinating and Marketing, Types of Entrepreneurs. Stages of establishing enterprise – Identification of sound enterprise, steps to be considered in setting up an enterprise, feasibility report, product selection, risk and market analysis, legal requirements. Project Management and Appraisal – Market, Technical, Financial, Social Appraisal of Projects Micro enterprises – Profitable Agri enterprises in India – Agro Processing, KVIC industries. Micro financing – meaning, Sources of Finance, Banks, Small scale industries development organizations. Marketing for enterprises – Concept, planning for marketing, target marketing, Competition, market survey and strategies, Product sales and promotion. Gender issues in entrepreneurship development – Understanding gender and subordination of women, Gender as a development tool, Policy approaches for women entrepreneurship development. Success and Failure stories for enterprises – Issues relating to success and failure of enterprises – Personal, Production, Finance, Social, Marketing. Management – Meaning, concept, nature and importance, Approaches to management, Levels of management, Qualities and skills of a manager. Extension Management – Meaning, Concept, Importance, Principles of management, Classification of Functions of Management. Planning – Concept, Nature, Importance, Types, Making planning effective. Change Management – factors, process and procedures. Decision making – Concept, Types of decisions, Styles and techniques of decision making, Steps in DM Process, Guidelines for making effective decisions. Organizing – Meaning of Organization, Concept, Principles, Organizational Structure, Span of Management, Departmentalization, Authority and responsibility, Delegation and decentralization, line and staff relations.

Practical

Field visit to Successful enterprises-Study of Characteristics of Successful entrepreneurs Development of Project Proposal -Case Studies of Success / Failure enterprises-Exercise on Market Survey-Field visit to Financial institutions- Simulated exercise to understand management process-Field visit to extension organizations to understand the functions of management -Group exercise on development of short

term and long term plan-Simulated exercise on techniques of decision making-Designing organizational structure –Group activity on leadership development skills.

Suggested Readings

1. Gupta CB. 2001. Management Theory and Practice. S. Chand & Sons.
2. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
3. Khanka SS. 1999. Entrepreneurial Development. S. Chand & Co.
4. Singh D. 1995. Effective Managerial Leadership. Deep & Deep Publ.
5. Tripathi PC & Reddy PN. 1991. Principles of Management. Tata McGraw Hill.
6. Shravan M Haldar, P.T. Sharma, Indira Sarangthem, S. Basanta Singh (2023) Entrepreneurship Opportunities in Agriculture. Bhavya Books.
7. R. R. Chole, P. S. Kapse & P.R. deshmukh. (2022) Entrepreneurship development and communication Skills. Scientific Publishers.

EXT 402	EXTENSION APPROACHES AND AGRICULTURAL JOURNALISM	4 (3+1)	SEM VII

Objectives

In this course, students will learn about the concept, meaning and process of various extension approaches and their methods of evaluation and various methods and modern media of agricultural journalism. Besides, the students will also learn the journalistic writing of various information materials and study their readability.

Theory

Participatory extension approaches RRA, PRA and PLA: meaning, features, principles, techniques; demand driven extension: meaning, features, model; reorganized extension system; broad based extension: meaning, concept; farmer led extension: meaning, features, scope and importance; farming systems approach and farming situation based extension: concept, characters, activities and scope; strategic research and extension plan: meaning and importance; group led extension: meaning, concepts, procedures, advantages and limitations; market led extension: meaning, problems in agricultural marketing, characteristics, approaches and strategies; privatization of agriculture extension services and public private partnership: meaning, problems in public extension, reasons for privatization, approaches, possibilities; voluntary organizations in agricultural extension-scope and importance, limitations. Journalism: meaning, nature, scope and importance; agricultural journalism: meaning, concept, nature, history, scope and importance; journalist: meaning, roles, qualities, types; print media: concept, role, trends, principles, laws, ethics; readership analysis: meaning, importance, methods; writing new stories, feature articles and success stories: planning and writing; agricultural information materials: planning, preparation and evaluation of information materials – leaflet, pamphlet, folder, bulletin; electronic media: concept, types, trends, principles, ethics; listeners/viewers analysis: meaning, importance, methods; report writing: gathering of news, forms of reporting, principles for creative writing, editing and proof reading;

radio: scope and importance, script writing for radio, treatment, recording and broad casting; television: scope and importance, script writing for TV, planning, recording and telecasting; photo journalism: concept, scope and importance, principles, selection and editing of photographs, writing photo features and captions; video production technology: concepts, types of cameras and parts, different formats, techniques of planning, production and editing, types of shots, audio and video mixing; public relations: meaning, concept, scope and dimensions, scenario in organizations.

Practical

Analyzing the roles of change agents in state department of agriculture; visit to a village to observe the extension activities at the field level; visit to a ATMA district; identification of technological needs of farmers through participatory approach; identification of suitable alternative extension approaches for solving extension problems in a specific farming situation; preparation of research and extension plan using PRA, FSR/E and FSBE; analyzing the functions of a selected; V.O. studying role of farm women and rural youth in agriculture in a selected village; studying SHGS in a selected village. Designing of layout and preparation of agricultural information materials; testing the readability of prepared agricultural information materials; gathering of news by using different methods; exercise on writing of different forms of news reports in print media; editing process in print media; testing the readability of printed literature; visit to a newspaper office; visit to All India Radio Station/TV Studio; script writing for radio; rehearsal recording, editing and evaluation of radio program; preparation of story board for TV; method of holding and exposing a still camera; writing captions for photographs; writing photo features for photographs; studying various parts of video camera and handling of video camera; audio and video mixing.

Suggested Readings

1. Dahama, O.P. & Bhatnagar, O.P. (2005). Education and Communication for Development.
2. Jana BL & Mitra KP. 2005. Farm Journalism. Agrotech Publ. Academy. Ray GL. 2006. Extension Communication and Management. Kalyani Publ.
3. Ray, G.L. (2006). Extension Communication and Management.
4. Debasmita Nayak & Mita Meher (2024). Agricultural Journalism. New India Publishing Agency. New Delhi.
5. Kandpal, Arpita. (2023) Agricultural Journalism. Narendera Publishing House Delhi.
6. A. K. Singh. (2022). Agricultural Extension And Farm Journalism
7. Priyanka Rana. (2022) Textbook of Agricultural Journalism. Agrotech Publishing Academy. Udaipur (Rajasthan)
8. Shubonam Panda & Ankita Kakaty (2025). Agricultural Journalism in digital Age. Scientific publisher.

AGRICULTURAL METEOROLOGY

Course No.	Course Title	Credits	Semester
	Core Course		
AGM 301	Introduction to Agro-meteorology	2 (1+1)	V
	Total Credits	**2 (1+1)**	
	Elective Courses		
AGM 401	System Simulation and Agroadvisory	4 (3+1)	VII
AGM 402	Geoinformatics and Remote Sensing, Precision Farming (To be taught jointly by Dept. of Agronomy, Soil Science, Agricultural Meteorology and Farm Machinery & Power Engineering)	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**10(7+3)**	

AGM 301	INTRODUCTION TO AGRO-METEOROLOGY	2 (1+1)	SEM V

Objectives

1. To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere
2. To impart the theoretical and practical knowledge of instruments/ equipment used for measurement of different weather variables in an agro-meteorological observatory
3. To study the meteorological aspects of climate change in agriculture and allied activities

Theory

Meaning and scope of agricultural meteorology; 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, Application of Thermal time concept and Crop/ Pest weather calendar; Energy balance of earth; Atmospheric humidity, concept of saturation, vapour 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 normal 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 Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave 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, Use of synoptic charts, weather reports, weather forecasting-types and methods, crop weather calendar.

Suggested Readings

1. Agricultural Meteorology by G.S.L.H.V. Prasado Rao
2. Fundamentals of Agrometeorology and Climate Change by G. S. Mahi and P. K. Kingra
3. Introduction to Agrometeorology and Climate Change by Alok Kumar Patra
4. Introduction to Agrometeorology by H. S. Mavi
5. Text Book of Agricultural Meteorology by M. C. Varshneya and P.B. Pillai

AGM 401	SYSTEM SIMULATION AND AGROADVISORY	4 (3+1)	SEM VII

Objectives

1. To impart the knowledge of statistical and simulation modelling in crop yield estimation
2. To get acquainted with different weather forecasting techniques and their usability analysis
3. To study about the preparation and dissemination of agro-advisory bulletin

Theory

System approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models, concepts and techniques, types of crop models, data requirements, relational diagrams. Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production- concept and modelling, techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance. Weather forecasting, types methods, tools and techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop-Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro- advisory and its effective dissemination.

Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential and achievable production; yield forecasting, insect and disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro- advisory.

Suggested Readings

1. Introduction to Agrometeorology by H. S. Mavi.
2. Agricultural Meteorology by G.S.L.H.V. Prasado Rao.
3. Advances in Plant Atmospheric Interactions (Eds. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B), Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.
4. Text Book of Agricultural Meteorology by M.C. Varshneya and P.B. Pillai. ICAR.
5. Principles of Agricultural Meteorology by OP Bishnoi.

AGM 402	**GEOINFORMATICS AND REMOTE SENSING, PRECISION FARMING (To be taught jointly by Dept. of Agronomy, Soil Science, Agro-Meteorology and Farm Machinery & Power Engineering)**	**4 (3+1)**	**SEM VII**

Objectives

1. Enabling students acquire knowledge on basics of remote sensing technique for precision farming applications
2. To provide a comprehensive knowledge of remote sensing, precision farming and its benefits in improving crop production and soil health management

Theory

Introduction and history of remote sensing; sources, Principles of remote sensing propagation of radiations in atmosphere; Interaction with matter, Application of remote sensing techniques land use soil surveys, crop stress and yield forecasting, Advantages and disadvantages of remote sensing, Remote sensing institutes in India, Basic Concepts about geoinformatics. What is artificial intelligence; History of artificial intelligence, Fundamentals of big data & machine learning (ML), Use of artificial intelligence in autonomous systems: agricultural robots and drone monitoring systems, driverless tractors, automated sprinklers and self-harvesting machines etc.; Use of AI in crop analysis: monitoring soil quality, promoting organic crops, monitoring weeds, precision agriculture, using drones for crop analysis; Role of AI for sustainability and climate change, yield and demand forecasting, food tech/wider value chain including impact of blockchain, AI use for in the emerging

markets; Technology deployment like sensors , AI and agricultural technologies and How to scale AI for agricultural technologies applications, Responsible AI in agriculture, Data sharing; Expert System: Introduction to expert system, Characteristics and features of expert system, Applications of Expert System, Importance of Expert system, Rule based system architecture; Software Agents

Practical

Familiarization with different remote sensing equipments and data products, Interpretation of aerial photographs and satellite data for mapping of land resources, Global positioning system (GPS), Basics of Geographic Information System (GIS), Georeferencing of toposheets, Live examples and case study of AI use in Agriculture, Search and Control strategies: Blind search, Breadth - first search, Depth First search, Hill climbing method, Best First search, Branch and Bound search, Programming in Prolog Syntax and meaning of Prolog Programs. Using Data Structures. Controlling Back- tracking. Input and Output. Built-in Predicates, Using Prolog Grammar Rules. Higher level assignments/exercises for implementation using Prolog.

Suggested Readings

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor (s): Rabinarayan Satpathy, Tanupriya Choudhury, Suneeta Satpathy, Sachi Nandan
2. Machine Learning Approaches to Bioinformatics by Zheng Rong Yang
3. Text Book of Remote Sensing and Geographical Information Systems by M. Anji Reddy
4. Precision Agriculture Technologies for Food Security and Sustainability by A El-Kader, M Sherine, M El-Basioni, M Basma.
5. Principles and Theory of Geoinformatics P.K. Garg Khanna Publishers,2019, 296
6. Advances in Geoinformatics Remote Sensing and GIS by Bhunia, Gouri Sankar & Uday Chatterjee & Gopal Krishna Panda, BIO GREEN
7. Artificial Intelligence: Machine Learning, Deep Learning and Automation Processes, John Adamssen,2020, Efalon Acies
8. Remote Sensing and Image Interpretation, 6ed (WSE) Paperback – 1 January 2011, Willey Student Edition
9. Remote Sensing and Geographic Information: A.M. Chandra and S.K. Ghosh, Narosa

AGRONOMY

Course No.	Course Title	Credits	Semester
Core Courses			
AGRON 101 (MDC)	Farming Based Livelihood Systems (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribuisness Management, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech (Agricultural Engineering) and B.Tech. Biotechnology)	3 (2+1)	I
AGRON 103	Fundamentals of Agronomy	3 (2+1)	I
AGRON 105 (MDC)	Crop Production and Protection Technologies (For B. Tech. (Agricultural Engineering)	4 (3+1)	I
AGRON 107	Introduction to Agronomy and Crop Production Technology (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	I
AGRON 201	Crop Production Technology I (*Kharif* Crops)	3 (1+2)	III
AGRON 202	Crop Production Technology II (*Rabi* Crops)	3 (1+2)	IV
AGRON 203	Principles and Practices of Natural Farming	2 (1+1)	III
AGRON 204	Water Management	2 (1+1)	IV
AGRON 301	Weed Management	2 (1+1)	V
AGRON 302	Dryland Agriculture/ Rainfed Agriculture and Watershed Management	2 (1+1)	VI
AGRON 303	Sustainable Farming System and Precision Agriculture (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	V
	Total Credits	**28 (15+13)**	
Skill Enhancement Courses			
AGRON 001	Vermicompost Production Technology	2 (0+2)	I, II
AGRON 002	Herbicides Spray Technologies	2 (0+2)	I, II
	Total Credits	**4 (0+4)**	
Elective Courses			
AGRON 401	Management of Natural Resources (To be taught jointly by Dept. of Agronomy, Soil Science and Soil Water Engineering)	4 (3+1)	VII
AGRON 402	Agrochemicals (To be taught jointly by Dept. of Agronomy, Soil Science, Entomology and Plant Pathology)	4 (3+1)	VII
AGRON 403	Climate Resilient Agriculture (To be taught jointly by Dept. of Agronomy, Agricultural Meteorology and Genetics & Plant Breeding)	4 (3+1)	VII
AGRON 404	Principles and Practices of Organic Farming and Conservation Agriculture	4 (3+1)	VII
	Total Credits	**16 (12+4)**	
	Grand Total	**48 (27+21)**	

AGRON 101 (MDC)	**FARMING BASED LIVELIHOOD SYSTEMS** (**For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribuisness Management, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech (Agricultural Engineering) and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM I**

Objectives

1. To make the students aware about farming-based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro-forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

Practical

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming-based livelihood models/ systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming-based livelihood models, Field visit of innovative farming system models. Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in agri-sectors.

Suggested Readings

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7.
2. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Centre for Science and Environment, New Delhi, India
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmer Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey, Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar
7. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
10. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

AGRON 103	FUNDAMENTALS OF AGRONOMY	3 (2+1)	SEM I

Objectives

To impart the basic and fundamental knowledge of Agronomy

Theory

Agronomy and its scope: Definition, meaning and scope of Agronomy; art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, fields crops and classification, importance, ecology and ecosystem. Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.

Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /uncombined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures)

and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.

Water management: Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.

Weeds: Definition, Importance and basics of classification of weeds and their control. Agroclimatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy: Meaning and importance in crop production, Growth and development of crops: Definition, Meaning and factors affecting growth and development.

Practical

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers.

Suggested Readings

1. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
2. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
4. William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.
5. Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.

AGRON 105 (MDC)	**CROP PRODUCTION AND PROTECTION TECHNOLOGIES** **(For B. Tech. Agricultural Engineering)**	**4 (3+1)**	**SEM I**

Objective

To enable the students to have basic idea on crop production and protection practices to understand the domain of agricultural sciences and to have an idea of the different types of machineries/ equipment that can be adopted for these operations

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; Time and method of sowing of major field crops, seed rate for important crops; Methods and time of application of manures and fertilizers, fertigation; Basic principles of natural farming, organic farming and sustainable agriculture.

Soil-water-plant relationship, crop coefficients, water requirement of crops and critical stages for irrigation; Weeds and their management in crops; Crop rotation, cropping systems, cropping scheme, relay cropping, mixed cropping and intercropping.

Soil forming processes; Classification and composition of soil, 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 – 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; Gypsum requirement for reclamation of sodic soils and neutralizing RSC; Liquid fertilizers and their solubility and compatibility.

Types of horticultural crops; Sowing and planting times and methods; Seed rate and seed treatment for vegetable crops; Macro and micro propagation methods; Types of plant growing structures; Pruning and training; Water requirements and critical stages; Management of orchard; Major pests and diseases of horticultural crops and their management.

Practical

Identification of crops and their varieties, seeds and weeds; Study of different fertilizer application methods and weed control methods; Judging the maturity time for harvesting of crop; Study of seed viability and germination test; Identification of rocks and minerals; Examination of soil profile in the field; Determination of bulk density; particle density and porosity of soil; Determination of organic carbon of soil; Identification of nutrient deficiency symptoms of crops in the field; Determination of gypsum requirement of sodic soils; Identification and description of important fruits, flowers and vegetables crops; Study of different garden tools; Preparation of nursery bed; Practices of pruning and training in some important fruit crops; Study of cultural operations for vegetable crops (sowing, fertilizer application, mulching, irrigation and weed control); Seed extraction techniques; Visit to commercial greenhouse/ polyhouse.

Suggested Readings

1. Ahamad S, Anwar Ali and Sharma P K (Eds). 2018. Plant Disease Management in Horticultural Crops. Daya Publishing House, Delhi.
2. Biswas T D and Mukharjee S K. 1987. A Text Book of Soil Science. Tata McGraw-Hill publishing Co. Ltd.
3. Brady N C and Ray R Weill. 2002. The Nature and Properties of Soil. Pearson Education Inc. New Delhi.
4. Chadha K L. 2003. Handbook of Horticulture. ICAR Publication, New Delhi.

5. Das D K. 2020. Introductory to Soil Science. Kalyani publication, Ludhiana.
6. Dey G C. 2013. Fundamentals of Agronomy. Jain Book Depot.
7. Ghildyal B P and Tripathy R P. 1987. Soil Physics. Wiley Eastern Ltd., New Delhi.
8. Hillel D. 1982. Introduction to Soil Physics. Academic Press, New York.
9. Indian Society of soil science. 2002. Fundamentals of Soil Science. ISSC, IARI, New Delhi.
10. Janick J. 1979. Horticultural Science. Surjeet Publications, Delhi.
11. Kumar N. 2017. Introduction to Horticulture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Muthukrishnan N, Ganapathy N, Nalini R and Rajendran R. 2005. Pest Management in Horticultural Crops. New Madura Publishers, Madurai, Tamil Nadu.
13. Reddy S R. 2020. Principles of Agronomy. Kalyani Publisher.
14. Reddy Yellamanda T and Reddy Shankar G H. 1995. Principles of Agronomy. Kalyani Publishers Ludhiana.
15. Sehgal J L. 1996. Soil Pedology. Kalyani publication, Ludhiana.
16. Singh Jitendra. 2018. Fundamentals of Horticulture. Kalyani Publishers, Ludhiana.
17. Singh S S and Singh R. 2013. Principles and practices of Agronomy. Kalyani Publisher.
18. Sudheer K P and Indira V. 2016. Post harvest Technology of Horticultural Crops. New India Publishing Agency, New Delhi.

AGRON 107	**INTRODUCTION TO AGRONOMY AND CROP PRODUCTION TECHNOLOGY (For B.Sc. (Hons.) Agribusiness Management)**	**2 (1+1)**	**SEM I**

Objectives

1. To understand the principles of agronomy and crop production technology.
2. To learn about crop growth and development, including factors influencing yield and quality.
3. To explore sustainable and efficient farming practices to enhance crop productivity while minimizing environmental impact.
4. To gain practical knowledge of crop management techniques, including soil fertility, pest control, and irrigation.

Theory

Agriculture**,** Agronomy and their scope, tillage and tilth, crop density and geometry, factors affecting growth and development, crops and cropping systems, crop rotation and its principles, manures and fertilizers, irrigation, water resources, crop water requirement, water-use efficiency, irrigation-scheduling criteria and methods, quality of irrigation water, drainage. Weeds- importance, classification, crop weed competition, concepts of weed management-principles and methods, herbicides. Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops, namely, rice, maize, sorghum, minor millets, pigeon pea, mung bean, groundnut and soybean. *Rabi*

crops, namely, sorghum, wheat, chickpea, rapeseed and mustard, sunflower, sugarcane, cotton, tobacco and chilli.

Practical

Identification of crops, seeds, fertilizers, herbicides, tillage andsowing implements, Identification of weeds in crops, Methods of herbicide and fertilizer application, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Methods of irrigation. Methods of sowing of different crops. Nutrient functions and deficiencies, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of important crops, Visit to research centers of related crops.

Suggested Readings

1. Principles of Agronomy by T.Y. Reddy and G.H. Sankara Reddi
2. Fundamentals of Crop Production by Stephen R. Kaffka and Larry L. Strand
3. Introduction to Agricultural Engineering Technology: A Problem Solving Approach by Harry L. Field and John B. Solie
4. Crop Production: Evolution, History, and Technology by C. Wayne Smith and Julian R. Betters

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

Objectives

1. To impart basic and fundamental knowledge on principles and practices of kharif crop production
2. To impart knowledge and skill on scientific crop production and management

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops. Cereals- rice, maize, sorghum, pearl millet, finger millet and other minor millets, pulses- pigeonpea, mungbean and urdbean; oilseeds, groundnut, soybean, sesame, castor; fibre crops- cotton and jute; forage crops- sorghum, cowpea, cluster bean, maize, guinea and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mungbean, maize, groundnut and cotton, effect of seed size on germination and seedling vigour of *Kharif* crops, effect of sowing depth on germination of *Kharif* crops, identification of weeds in *Kharif* crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of *Kharif* crops, study of crop varieties and important agronomic experiments at experiential farm, recording biometric observations, Study of forage experiments, morphological description of *Kharif* crops, silage and hay making, visit to research centres of related crops.

*__Practical Crop Production- One (1) credit from practical of the course is allotted for Practical Crop Production of selected *kharif* crops covered under this course.__

Suggested Readings

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
6. UAS, Bangalore. 2011. Package of Practice. UAS, Bangalore.
7. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production. South Asian Publishers, New Delhi.

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

Objectives

1. To impart basic and fundamental knowledge on principles and practices of *rabi* crop production.
2. To impart knowledge and skill on scientific crop production and management.

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. *Rabi* redgram and, rajmash. Oilseed- rapeseed, mustard, sunflower, safflower; and linseed. Sugar crops-sugarcane and sugar beet. Medicinal and aromatic crops- mentha, lemon grass and citronella. Forage crops – barseem, lucerne and oat; potato, quinoa, tobacco.

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; oil extraction of medicinal crops; visit to research stations of related crops.

*** Practical Crop Production-One (1) credit from practical of the course is allotted for Practical Crop Production of selected *rabi* crops covered under this course.**

Suggested Readings

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidda Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.
5. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
6. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.
7. Rajendra Prasad. 2002. Text Book of Field Crops Production, ICAR, New Delhi.
8. Reddy, S.R. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.
9. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South Asian Publishers, New Delhi.
10. UAS, Bangalore. 2011. Package of Practice. UAS, Bengaluru.

AGRON 203	PRINCIPLES AND PRACTICES OF NATURAL FARMING	2 (1+1)	SEM III

Objectives

1. To provide comprehensive understanding and knowledge to students about natural farming.
2. To teach students the concept, need and principles of native ecology-based production under natural farming.
3. To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

Theory

Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs), Concept of natural farming; Definition of natural farming; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/schools of natural farming. Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming, Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming;

Mechanization in natural farming, Processing, labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

Practical

Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm; Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring in-situ and green leaf manuring, Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural farming; Techniques of Indigenous seed production- storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; farming; Evaluation of ecosystem services in natural farming (Crop, Field and System).

Suggested Readings

1. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
5. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
6. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system.https://www.fao.org/3/i9037en/ i9037en.pdf Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985.
7. Fukuoka, M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp
8. Fukuoka, M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
9. Hill S.B and Ott. P. (Eeds.). 1982. Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.

10. Hill, S.B. and Ott, P. (Eeds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.
11. HLPE. 2019. Agroeeological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High-Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security, Rome. https://fao.org/3/ea5602en/ea5602en.pdf.
12. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
13. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
14. Malhotra R. and S.D. Babaji. 2020. Sanskrit Non-Translatable- The importance of Sanskritizing English. Amaryllis, New Delhi India.
15. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telengana), India. 94pp.
16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
17. Nalini, S. 2011. Upavana Vinoda (Woodland Garden for Enjoyment) by Sarangdhara (13th century CE): AAHF Classic Bulletin 8. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 64p
18. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
19. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021) 20. Plenty for All: Natural Farming A to Z Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)
21. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
22. Shamasastry, R. 1915. Kautilya's Arthashastra.
23. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)
24. U. K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.
25. कमलागतप्राकृततककृतिः आचार्यदेवव्रत, , pp 1-166.

AGRON 204	WATER MANAGEMENT	2 (1+1)	SEM IV

Objectives

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
2. To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

Theory

Irrigation: definition and objectives; Importance: Function of water for plant growth, water resources and irrigation development for different crops in India; Soil plant water relationships; Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler. Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers' field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Visit to irrigation research centre/ station and visit to command area.

Suggested Readings

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Academy, Udaipur.
2. Dilipkumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt. Ltd.,
3. S.V. Patil &Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial publishing House, Delhi.
4. Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge University Press.
5. Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.

AGRON 301	WEED MANAGEMENT	2 (1+1)	SEM V

Objectives

1. To teach students about principles of weed science
2. To impart practical knowledge of weed management in field and horticultural crops

Theory

Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds, crop-weed completion, factors of competition, factors affecting growth and development. Studies on weed seed bank, weed shifts. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management. Implements for weed control, robotic weed control, weed management in organic/ natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; Mode of action of herbicides and selectivity phenomenon. Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.

Practical

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide application equipment their parts, use, maintenance and calibration. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides, Weed management in fallow lands, Management of problem and parasitic weeds.

Suggested Readings

1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.
3. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
4. Naidu, V.S.G.R. Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.
5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur.
6. Ramamoorthy, K. and Subbian, P. Predominant Weed flora in hill –ecosystems. Agrobios (India), Jodhpur.
7. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.

8. Subramanian, S., Mohammed Ali, A. and Jayakumar, R. 1991. All About Weed Control. Kalyani Publishers, Ludhiana.
9. Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras.
10. Thakur, C. 1977. Weed Science. Metropolitan Book Co. Pvt. Ltd., New Delhi.

AGRON 302	DRYLAND AGRICULTURE/ RAINFED AGRICULTURE AND WATERSHED MANAGEMENT	2 (1+1)	SEM VI

Objectives

1. To learn about characteristics and conditions of dryland/rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management

Theory

Dryland/Rainfed agriculture: Introduction, types and characteristics; History of dry land/ rainfed agriculture in India; Problems and prospects of dry land/rainfed agriculture in India; Soil and climatic conditions prevalent in dry land/rainfed areas; Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques; Drought: types, effect of water deficit on physio- morphological characteristics of the plants; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices; Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas; Contingent crop planning for aberrant weather conditions; Concept, history, objective, principles and components of watershed management, factors affecting watershed management. Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA) Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed 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 for mitigating moisture stress including mechanical and agronomic measure. Soil moisture determination under different land situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of model watershed. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops Field demonstration on soil and moisture conservation measures. Field

demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Suggested Readings

1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
2. D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. G.S.L.H.V. Prasad Rao. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
5. H.S. Mavi. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. H.V. Nanjappa and B.K. Ramachandrappa. 2007. Manual on Practical Agricultural Meteorology. Agrobios India. Jodhpur.
7. S.R. Reddy. 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
8. T. Yellamanda Reddy and G.H. Sankara Reddi. 2010. Principles of Agronomy. Kalyani Publishers, New Delhi.

AGRON 303	SUSTAINABLE FARMING SYSTEM AND PRECISION AGRICULTURE (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM V

Objectives

1. Understand the principles and practices of sustainable farming systems aimed at environmental stewardship and resource conservation
2. Learn about precision agriculture technologies and their applications for optimizing inputs, minimizing waste, and increasing farm efficiency
3. Explore strategies to integrate sustainable practices and precision agriculture techniques for improved crop productivity, profitability, and environmental sustainability
4. Develop skills to implement and manage sustainable farming systems and precision agriculture technologies to address challenges such as climate change, soil degradation, and water scarcity in agriculture

Theory

Farming System-scope, importance, concept and types. Farming systems components, Indicators of Sustainability, adaptation and mitigation, determining production and efficiencies in cropping and farming systems; Sustainable agriculture-problems and its impact on agriculture. Evaluation indices for cropping system. Integrated Farming System- historical background, objectives and characteristics, components of IFS and its advantages, resource use efficiency and optimization techniques. Operational structure of NPOP. Organic certification process and economic considerations. Marketing export potential of organic products.

Precision agriculture: components, concepts and principles, techniques, their issues and concern for Indian agriculture. Global Positioning System (GPS) and Geographical Information System (GIS), Site Specific Nutrient Management (SSNM) for nutrient and irrigation management practices. Comparative yield, quality and farm profits under SSNM practices v/s Variable Rate Technology (VRT) practices. Yield monitoring and mapping.

Practical

Tools for determining production and efficiencies in cropping and farming system, Visit cropping systems and IFS models. Evaluation indices for cropping system. Organic farming guidelines and alternative philosophies. Organic nutrient resources and their fortification, Restrictions on nutrient use, enriched compost, vermi-compost, liquid organic manures, green manuring, crop residue management, biofertilizers/bio inoculants and their quality. ITKs in organic farming. NPOP: certification process and standards of organic farming; processing, labelling, marketing and export of organic products. Economic of Organic production systems. Visit to organic farmer's fields.

Use of GPS for agricultural survey and recording the observations with GPS. Area estimation, navigation and recording elevation points. Conversion of GPS readings, Study of maps, top sheets, cartography, GPS software's, Spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. VRT, Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Use of UAV in agriculture.

Suggested Readings

1. Joshi M and Prabhakarashetty TK. 2005. Sustainability through Organic Farming, Kalyani Publishers.
2. Palaniappan SP and Anandurai K. 1999. Organic Farming - Theory and Practice, Scientific Publishers.
3. Panda SC, 2014, Cropping and Farming System. Agrobios (India) Publishers.
4. Reddy, S. R., 2017. Geoinformatics and Nanotechnology for Precision Farming. Kalyani Publishers. pp.140.
5. Thomas Lillesand, Ralph W. Kiefer and Jonathan Chipman. 2015. Remote Sensing and Image Interpretation, 7th Edition, Wiley Publications. Pp 736.
6. Wright, Richard T. and Bernard J. Nebel Environmental science: toward a sustainable agriculture.

AGRON 001	VERMICOMPOST PRODUCTION TECHNOLOGY	2 (0+2)	SEM I, II

Objectives

1. Focusing on Recycling solid waste and organic matter into fertile soil
2. Making students aware with decomposing process in limited space
3. Making students with employable by developing skill in vermicompost technology

4. Improving soil quality by promoting bio fertilizer
5. To aware the students about entrepreneurship opportunities

Theory

Introduction and importance of vermicompost: Introduction, history, scope of vermicompost, Objective of vermicomposting, Requirement for vermicomposting unit. Biology of earthworms: Identification, types and classification of earthworms, Role of earthworms in maintaining crop production and soil fertility.

Production technology of vermicompost: Identify appropriate site and prepare a bed for vermicomposting, Aerobic and Anaerobic method, Establishment of vermicomposting unit, watering the vermibeds, Inoculate earthworms in the vermibed and manage the vermicomposting process, Pest and diseases of earthworms, Precautions while vermicomposting, Harvesting and post-harvest handling of vermicompost, Preparation of vermiwash.

Marketing of vermicompost: Packaging and storage of vermicompost, Marketing of vermicompost, Problems and prospectus in India. Vermicompost schemes, Entrepreneurial opportunities in vermicomposting, Nutritive value of vermicompost

Suggested Readings

1. Keshav Singh, 2014. Text book of Vermicompost: Vermiwash and Biopesticides Publisher: Blotech Books.
2. Somani L L., 2019 Vermicomposting and Vermiwash by Agrotech Publishing Academy.
3. Latika Vyas, 2012.Vermiculture Technology Agrotech Books.
4. Pradip Jabde, 2008. Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, agricultural pests and their controls, Publisher; Discovery publishing house.
5. Peter Bogdanov, 1998. Commercial Vermiculture: How to Build a Thriving Business in Redworms: Petros Publishing Company; 1st edition (1 January 1998)
6. Brian Grant, 2014. Worm Farming: Setup A Sustainable Vermiculture Earthworm Composting Ranch Publisher: Sparrow Publications
7. S.R. Sharma 2013-14. Operation Manual for production of Vermicompost- rural agricultural work experience programme Department of soil science and Agriculture chemistry, SKN Agricultural university JOBNER, Rajasthan.
8. Yaday, A.K. 2015. Organic Agriculture (Concept, Scenario, Principals and Practices), National Centre of Organic Farming Department agriculture and Cooperation, Ministry of Agriculture, Govt of India, CGO-II, Kamla Nehru Nagar, Ghaziabad, 201 001, Uttar Pradesh
9. Yawalkar KS, Agrawal JP & Bokde S. 2000. Manures and Fertilizers. Agri-Horti Publ.

AGRON 002	HERBICIDES SPRAY TECHNOLOGIES	2 (0+2)	SEM I, II

Objectives

1. To apprise the students with useful information on practical use of herbicides, their application techniques, calibration of the spray pumps.
2. To acquaint the students regarding spray technology for achieving herbicide efficacy.

Identification of important weeds infield crops, Different types of herbicides and their formulation, Introduction to spray techniques, Type of sprayers, Herbicides application techniques, Calibration of spray equipment and preparation of herbicide spray, Calculation of herbicide dose, Maintenance of spray pump, Safety precautions, Role of drones in weed management

Adjuvants and surfactants, compatibility of herbicides with other agrochemicals and surfactants, herbicides registration and label information, assessment of different weed control methods, weed survey and surveillance, herbicide bioassay, phyto-toxicity of important herbicides on crops, crop weed competition

Suggested Readings

1. Weed Management by U.S. Walia. Kalyani Publishers (2014).
2. Weed Management--Principles and Practices by OP Gupta. Agrobios publications (2011).
3. Principles of weed Science by V.S. Rao. CBS Publishers (2000).
4. Weed Science- Basics and Applications by T. K. Das Jain Publishers
5. Fundamentals of Weed Science by Robert Zimdahl

AGRON 401	MANAGEMENT OF NATURAL RESOURCES (To be taught jointly by Dept. of Agronomy, Soil Science and Soil Water Engineering)	4 (3+1)	SEM VII

Objectives

1. To enlighten students about available natural resources and their relationship with crop production.
2. To impart the knowledge of principles and practices of natural resource management.

Theory

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources, Factors influencing resource availability, distribution and uses, Interrelationships among different types of natural resources, Concern on productivity issues, Ecological, social and economic dimension of resource management, Land resources: Land as a resource, Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification, Landscape impact analysis,

wetland ecology & management, Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Water ecology and management, Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources, Resource Management Paradigms: Resource management the evolution and history of resource management paradigms, Resource conflicts: Resource extraction, access and control system, Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches: integrated resource management strategies, Introduction to soil and water conservation and causes of soil erosion, Definition and agents of soil erosion, Water erosion: Forms of water erosion, gully classification and control measures, Soil loss estimation by universal soil loss equation: Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping, Contour bund: Graded bund and bench terracing, Wind erosion: Mechanics of wind erosion, types of soil movement, Principles of wind erosion control and its control measures, Water harvesting techniques: Lining of ponds, tanks and canal systems.

Practical

Identifying natural resources and their utility, Practicing survey: Principles and educating to use pacing technique for measurement, Area calculations through chain survey: GPS demo for tracking and area measurement, Estimation of soil loss and calculation of erosion index, Leveling concepts and practical utility in agriculture, Preparation of contour maps, Concept of vegetative water ways and design of grassed water ways, Wind erosion and estimation process, Different irrigation pumps and their constructional differences, Farm pond construction and its design aspects, Visit to nearby farm pond, Visit to an erosion site, Exposure to strip cropping/contour bunding.

Suggested Readings

1. Management of Natural Resource for Sustainable Development by Vijay Singh Rathore and B S Rathor, Daya Publishing House.
2. Sustainable Natural Resource Management by Danill R. Lynch.

AGRON 402	**AGROCHEMICALS (To be taught jointly by Dept. of Agronomy, Soil Science, Entomology and Plant Pathology)**	**4 (3+1)**	**SEM VII**

Objectives

To impart knowledge on different classes of agrochemicals

Theory

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.

Herbicides -Major classes, properties and important herbicides. Fate of herbicides.
Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper, Mode of action- Bordeaux mixture and copper oxychloride.
Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb.
Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals, Insecticide Act and rules, Insecticides banned, withdrawn and restricted use, fate of insecticides in soil &plant.IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.
Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility-preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistic and marketing.
Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content

Suggested Readings

1. Buchel KH (Ed.) 1992. Chemistry of pesticides. John Wiley & Sons
2. Panda H. 2022.The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details 2nd Revised Edition. NPCS
3. Biswas D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
4. Singh, A., 2022 Basics of Agrochemical Formulations: Brillion Publishing, 176p.
5. Larramendy, M.L 2017Toxicity and Hazard of Agrochemicals: INTECH, 170p.

AGRON 403	CLIMATE RESILIENT AGRICULTURE (To be taught jointly by Dept. of Agronomy, Agricultural Meteorology and Genetics & Plant Breeding)	4 (3+1)	SEM VII

Objectives

1. To impart the concept of climate resilient agriculture under the present context of climate change
2. To study the integrated role of different sectors in building resilience to climate change in agriculture

Theory

Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc.

Basics of adaption and mitigation in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio- economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather & climatic information, agro-advisories, ICTs and simulation models; climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro- irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling; use of renewable sources of energy; climate resilient pest-disease management strategies.

Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events.

Practical

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agroadvisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing ‘climate smart village’ model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

Suggested Readings

1. Climate Resilient Animal Agriculture by GSLHV Prasada Rao (New India Publishing Agency)
2. Climate Resilient Agriculture Adaptation and Mitigation Strategies by Bhan Manish, New India Publishing Agency
3. Climate-Smart Agriculture Sourcebook, FAO (2013).
4. Implications for Climate Smart Agriculture, Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari, Biotech Books, 357p.
5. Climate Resilient Agriculture, Adaptation and Mitigation Strategies, Manish Bhan, 2018, New India Publishing Agency, 294p.
6. Climate Change & Agriculture Over India by Prasad Rao ,2010, PHI Learning, 352p.
7. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood Security by Prakash M.2022, Satish Serial Publishing House, 178p.

AGRON 404	PRINCIPLES AND PRACTICES OF ORGANIC FARMING AND CONSERVATION AGRICULTURE	4 (3+1)	SEM VII

Objectives

1. To teach students the principles of crop production under organic and conservation agriculture situation
2. To impart practical knowledge of organic and conservation agriculture practices

Theory

Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming; Nutrient management in organic farming and their sources, Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture. Conservation agriculture: definition, origin, principles, advantages, challenges, primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate smart Agriculture.

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management; Studies in green manuring in- situ and green leaf manuring, Studies on different type of botanicals for insect-pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture

Suggested Readings

1. A.C. Gaur. Handbook of Organic farming and biofertilizers.
2. A.K. Dahama. Organic farming for sustainable agriculture. Agrobios (India), Jodhpur.
3. Arun. K. Sharma. Handbook of Organic farming. Agrobios (India), Jodhpur.
4. S.P. Palaniappan and K. Annadurai. Organic farming – Theory and Practice. Scientific Publishers. Jodhpur.
5. U. Thapa and P. Tripathy. Organic farming in India- Problems and Prospects. Agrotech publishing Ag. Udaipur.
6. G.K. Veeresh. Organic farming. Foundation Books. New Delhi.
7. Purshit, S.S. Trends in Organic Farming in India. AgrosBios (INDIA), Jodhpur.
8. Thampan, P.K. Organic Agriculture. Peckay tree Crops Development Foundation, Cochin, Kerala.
9. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
10. Abhinandan Singh Pankaj Kumar Ojha & Rahul Kumar, 2018. Conservation Agriculture Technologies, Biotech Books
11. Acharya Sankar Kr, Sreemoyee Bera, Cornea Saha, Prabhat Kumar, Monirul Haque, Riti Chatterjee and Anwesha Mandal, 2022Conservation Agriculture Approach and Application, Scholars World,292p.

BUSINESS MANAGEMENT

Course No.	Course Title	Credits	Semester
	Core Course		
ABM 208 (MDC)	Entrepreneurship Development and Business Management (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.Tech (Agricultural Engineering) and B.Tech. Biotechnology)	3 (2+1)	Agri.: IV AM: IV CS: II Biotech: II
	Total Credits	**3 (2+1)**	
	Skill Enhancement Course		
ABM 003	Development of Agribusiness Proposal	2 (0+2)	I, II
	Total Credits	**2 (0+2)**	
	Grand Total	**5 (2+3)**	

ABM 208 (MDC)	**ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.Tech (Agricultural Engineering) and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM Agri.: IV AM: IV CS: II Biotech: II**

Objectives

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Theory

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for 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. Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of environment identification of product / service: 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, Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing, inventory control. 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, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agricentrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
4. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.
6. Mehra, P. 2016, Business Communication for Managers. Pearson India, New Delhi.
7. Pandey, M. and Tewari, D. 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
8. Singh, D. 1995. Effective Managerial Leadership. Deep & Deep Publ.
9. Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.
10. Tripathi, P.C. and Reddy, P.N. 1991. Principles of Management. Tata McGraw Hill.
11. Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House.

ABM 003	DEVELOPMENT OF AGRIBUSINESS PROPOSAL	2 (0+2)	SEM I, II

Objectives

1. Learn to identify viable agribusiness opportunities and formulate innovative project proposals.
2. Understand the components and structure of a comprehensive agribusiness proposal, including market analysis, financial projections, and risk assessment.
3. Develop skills to effectively communicate business ideas, secure funding, and implement successful agribusiness ventures.
4. Gain practical experience in preparing and presenting agribusiness proposals that meet the needs of stakeholders and investors.

Practical

Project Planning, Monitoring and Evaluation: Orientation. Hands on experience on preparation of project proposals for horticulture crops, dairy, poultry and agro-processing units. Interaction with staff/experts for midterm corrections and submission of interim report. Hands on experience on preparation of project proposal for bio-fertilizer and bio-pesticides units, irrigation, equipments and machineries, forest plantations, fishery and land development activities. Interaction with staff/ experts for midterm corrections and submission of interim report. Hands on experience on ex- ante, concurrent and ex-post appraisal. Hands on experience on discounting procedures like NPV, IRR and BCR, preparation of techno-economic feasibility reports of project. Report writing and examination.

Marketing Management: Orientation. Hands on experience on conducting market survey to gain experience on working out consumer profile, competitors, substitutes and their price and features. Designing market strategy. Interaction with staff/experts for midterm corrections and submission of interim report. Hands on experience on forecasting market demand. Pricing methods, creating and organizing an advertising campaign. Various packaging materials used for agro-based products. Product distribution network, marketing cost, marketing planning process. Interaction with staff/ expert for midterm corrections and submission of interim report. Hands on experience on marketing research and information system for new product development and options for extending product life cycle. Spot and online marketing. Export- import policies for agriculture sector. Report writing and examination.

Financial Management: Orientation. Estimation of funds required – capital investment and operational expenses. Share of owned and borrowed funds in the business. Sources of borrowed funds, terms and conditions of borrowings, repayment schedule, cash inflow and cash outflows of business. Interaction with staff/ experts for midterm corrections and submission of interim report. Hands on experience on accounting methods and procedures. Commonly used account systems, the single and double entry system, recording transactions, journals, figures, trial balance, assets and liabilities. Revenue cost of sales and net profit operating and incidental expenses and inventory. Interaction with staff / experts for midterm corrections and submission of interim report. Preparation of financial statements like balance sheet, income statement, profit and loss statement for the business. Exercise on financial ratio analysis. Report writing and examination.

Suggested Readings

1. David D. Van Fleet and George J. Seperich. 2013. Agribusiness: Principles of Management. Delmar, New York.
2. Elizabeth Yeager, Frank J. Dooley, Freddie L. Barnard, Jay T. Akridge and John Charles Foltz. 2012. Agribusiness Management. Routledge, London.
3. Hegde P. 2012. Agribusiness Management. Discovery Publishing House, New Delhi.
4. Karthikeyan M. and Nakkiran S. 2012. Co-operatives and Agri-Business. Discovery Publishing House, New Delhi.
5. Walter David Downey. 1987. Agribusiness Management. Tata McGraw-Hill, New Delhi

ENTOMOLOGY

Course No.	Course Title	Credits	Semester
	Core Courses		
ENT 101	Management of Insect Pest of Crops and Stored Grains (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	I
ENT 102	Fundamentals of Entomology	3 (2+1)	II
ENT 201	Fundamentals of Crop Protection (For B.Tech. Biotechnology, to be taught jointly by Dept. of Entomology, Nematology and Plant Pathology)	3 (2+1)	III
ENT 301	Pest Management in Crops and Stored Grains	3 (2+1)	V
	Total Credits	**11 (7+4)**	
	Skill Enhancement Courses		
ENT 004	Apiculture	2 (0+2)	I, II
ENT 005	Production of Biocontrol Agents	2 (0+2)	I, II
	Total Credits	**4 (0+4)**	
	Elective Courses		
ENT 401	Management of Beneficial Insects	4 (3+1)	VII
ENT 402	Pesticides and Plant Protection Equipment	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**23 (13+10)**	

ENT 101	MANAGEMENT OF INSECT PEST OF CROPS AND STORED GRAINS (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM I

Objectives

1. To understand the biology, ecology, and behavior of insect pests affecting crops and stored grains.
2. To learn effective strategies for monitoring, prevention, and control of insect pests in agricultural settings.
3. To explore integrated pest management (IPM) approaches, including biological, cultural, and chemical control methods.
4. To develop skills to assess and minimize economic losses caused by insect pests while promoting sustainable agriculture practices.

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 of various field and horticulture crops. Factors affecting losses of stored grain. Insect pests, mites, rodents and birds 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 of various insect pests attacking different crops. Identification of insect pests 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 grains in store / godown. Identification of rodents and rodent control operations. Identification of birds and bird control operations. Methods of grain sampling under storage condition. Visit to nearest FCI godowns and ware houses.

Suggested Readings

1. Bhargava and Kumawati. Pest of stored grains and their management.
2. Dhaliwal G. S. and Koul Opender. Bio pesticides and pest management.
3. Dhaliwal G.S. and Arora Ramesh. 1998. Principles of insect pest management. Kalyani Publisher, 297p.
4. Dhaliwal G.S. and Heinrichs E. A. 1998. Critical issues in pest management. Common Wealth Publisher, New Delhi, 287p.
5. Hameed S. F. and Singh S. P. Handbook of pest management.
6. Marwaha K. K., Siddiqui K. H. and Singh J. P. Hand. book of crop pest control.
7. Panwar V. P. S. Agricultural insect pests of crops and their management.
8. Ranjith A. M. Identification and management of horticultural pest.
9. Sharma Ramnivas. Identification and management of horticulture pest.
10. Srivastav K. P. and Ahlawat Y. S. Pest management in citrus.

ENT 102	FUNDAMENTALS OF ENTOMOLOGY	3 (2+1)	SEM II

Objectives

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class insecta and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects
4. To study the characteristics of commonly observed insect orders and their economically important families

Theory

History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to 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. 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. Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic

factors. Categories of pests. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, 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); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

Suggested Readings

1. Chapman, RF. 1998. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge.
2. Chu, HF. 1992. How to Know Immature Insects. William Brown Publication, Iowa.
3. Dhaliwal GS and Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
4. Duntson PA. 2004. The Insects: Structure, Function and Biodiversity. Kalyani Publ., New Delhi.
5. Evans, JW. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi.
6. Fundamentals of Ecology - Eugene. P. Odum and Gray W. Barrett
7. Gillott, C. 1995. Entomology, 2nd Ed. Plenum Press, New York, London.
8. Gullan, P.J. and Cranston, P.S. 2000. The Insects, An Outline of Entomology, 2nd Ed. Blackwell Science, U.K.
9. Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies
10. Introduction to the study of Insects –D. J. Borror and DeLong's
11. Kerkut GA and Gilbert LI. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. IXIII. Pergamon Press, New York.
12. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Pearson Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
13. Price PW. 1997. Insect Ecology. 3rd Ed. John Wiley, New York.

14. Richards OW and Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Vol. 1. Structure,
15. Snodgross, RE. 1993. Principles of Insect Morphology. Cornell Univ. Press, Ithaca.
16. Stehr, FW. 1998. Immature Insects. Vols. I, II. Kendall Hunt Publication, Iowa.
17. Tembhore, D.B. 2000. Modern Entomology, Himalaya Publishing House, Mumbai.
18. Wigglesworth VB.1984. Insect Physiology. 8th Ed. Chapman and Hall, New York.

ENT 201	**FUNDAMENTALS OF CROP PROTECTION (For B.Tech. Biotechnology, to be taught jointly by Dept. of Entomology, Nematology and Plant Pathology)**	**3 (2+1)**	**SEM III**

Objectives

1. To study insects, their classification, structure and incidences
2. To study pathogens, their classification, pathogenesis and disease development
3. To study the best practices of insect and disease management

Theory

Insects – their general body structure. Importance of insects in agriculture. Life cycle of insects. Insects' classification. Feeding stages of insects and kinds (modifications) of mouthparts. Concepts in population build-up of insects – GEP, DB, EIL, ETL and pest status.

Causes of insect-pest outbreaks, general symptoms of insect-pest damage, principles and methods of insect-pest management, and the Integrated Pest Management concept. Importance and scope of plant pathology. Concept of disease in plants. Nature and classification of plant diseases. Importance and general characteristics of fungi, bacteria, fastidious bacteria, nematodes, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites.

Pathogenesis due to obligate and facultative parasites. Variability in plant pathogens. Conditions necessary for the development of disease epidemics. Survival and dispersal of plant pathogens. Management of key diseases and nematodes of major crops.

Practical

Familiarisation with the generalised insect's body structure and appendages. Life stages. Acquaintance with insect diversity. Identification of important insect pests of cereals, cotton, oilseeds, pulses, sugarcane, fruit and vegetable crops and stored grains, and their symptoms of damage. Acquaintance with useful insects: predators, parasitoids, pollinators, honeybees and silkworms. Acquaintance with various pesticidal formulations. Principles and working of common plant protection appliances. Calculation for preparing spray material.

Acquaintance with plant pathology laboratory equipment. Preparation of culture media for fungi and bacteria. Demonstration of Koch's postulates. Study of different groups of fungicides and antibiotics and methods of their evaluation. Diagnosis and

identification of important diseases of cereals, cotton, oilseeds, pulses, sugarcane, fruit and vegetable crops and their characteristic symptoms.

Suggested Reading

1. Agrios, GN, 2010, Plant Pathology. Acad. Press.
2. Atwal AS and Dhaliwal GS, 2002, Agricultural Pests of South Asia and Their Management, Kalyani Publishers.
3. Dhaliwal GS and Arora R, 1996, Principles of Insect Pest Management, National Agriculture Technology Information Centre.
4. Dhaliwal GS, Singh R and Chhillar BS, 2006, Essentials of Agricultural Entomology, Kalyani Publishers.
5. Kumar S, 2021, Fundamentals of Plant Pathology, SBN9789390591206, NIPA.
6. Mehrotra RS and Aggarwal A, 2007, Plant Pathology, 7th Ed, Tata McGraw-Hill Publ. Co. Ltd.
7. Sehgal PK, 2017, Fundamentals of Agricultural Entomology, Unknown Binding, Kalyani Publishers.
8. Singh H, 1984, Household and Kitchen Garden Pests – Principles and Practices, Kalyani Publishers.
9. Singh RS, 2008, Plant Diseases, 8th Ed, Oxford and IBH. Pub. Co.
10. Singh RS, 2013, Introduction to Principles of Plant Pathology, Oxford and IBH Pub. Co.
11. Stakman EC and Harrar JG, 1957, Principles of Plant Pathology, Ronald Press, USA.
12. Tarr SAJ, 1964, The Principles of Plant Pathology, McMillan, London.

ENT 301	PEST MANAGEMENT IN CROPS AND STORED GRAINS	3 (2+1)	SEM V

Objectives

Diagnosis and management of major insect and non- insect pests of crops in field and storage

Theory

General description on nature and type of damage by different arthropod pests; Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of various field crops, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments. Structural entomology and important household pests, their nature of damage and management. Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management. Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non insect pest of mites, snails and slugs, Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management,

Practical

Field visit, identification of major insect pests and their damage symptoms. Collection and preservation of major insect pests; collection of damage samples, their identification and herbarium preparation. Methods of monitoring of pest incidence *in situ*. Management strategies of insect pests of different crops. Study on structural entomology and household pests. Storage structures and methods of grain storage. Spraying techniques for selected field and horticultural crops. Vertebrate pest management, Mass multiplication of NPV and entomopathogenic nematodes.

Suggested Readings

1. Askary TH, 2022. Pest Management: Methods, Applications and Challenges. Nova Science Publishers, USA. p389
2. Atwal AS. 1976. "Agricultural Pests of India and South East Asia," Kalyani Publishers, Ludhiana, p. 502.
3. David, BV and Ramamurthy, VV. 2001. Elements of Economic Entomology. Popular Book Depot, Chennai.
4. Dhaliwal GS, Singh R and Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publ., New Delhi.
5. Dhaliwal GS. and Arora R. 2022. Integrated Pest Management (Concept and Approaches), 2nd Ed. Kalyani Publishers. p 479
6. Dunston AP. 2007. The Insects: Beneficial and Harmful Aspects. Kalyani Publ., New Delhi
7. Prakash I and Mathur RP. 1987. Management of Rodent Pests. ICAR, New Delhi.
8. Prakash Rambhat Thalya and Ravi Chandra, 2022. Essentials of Pest Management: Key Information on Pest Identification and its Management. Wings Publication International Private Limited. p.277
9. Saxena RC and Srivastava RC. 2007. Entomology at a Glance. Agrotech Publ. Academy, Udaipur.
10. Somnath, Sen and Mohd. Sameer, S. 2021. A Textbook of Insect Pest and Disease Management, Kataria & Sons publish.
11. Srivastava, K.P and Dhaliwal, G.S 2010. A textbook of applied entomology, 3rd ed., Kalyani Publishers, Ludhiana, 439p.

ENT 004	APICULTURE	2 (0+2)	SEM I, II

Objectives

1. To impart the knowledge about the honey bees, and their behaviour and activities.
2. Students have to be efficient towards bee husbandry and bee multiplication.
3. To orient the students about bee enemies and diseases and their management; hive products, apitherapy; and managed bee pollination of crops.

Practical

Morphological characteristics of honey bee, Identification of honeybee species and castes. Hive and other apicultural appliances. Examination of honeybee colonies. Recording of colony performance. Bee pasturage. Migratory routes and migration of colonies. Seasonal management of honeybee colonies. Swarming, absconding,

queenlessness and laying workers menaces, etc. & their remedies. Selection of honeybee colonies for improving bee health and colony productivity. Formulation of artificial diets and their feeding Mass queen bee rearing techniques. Identification of bee enemies and diseases and their management. Foraging and communication behaviour in honeybees. Honey extraction, processing and packaging. Collection of other hive products. Value addition of hive products.

Suggested Readings

1. Abrol DP. 2010. Beekeeping: A Compressive Guide to Bees and Beekeeping. Scientific Publishers, India.
2. Abrol DP. 2010. Bees and Beekeeping in India. Kalyani Publishers, New Delhi, India.
3. Atwal AS 2001. World of Honey Bees. Kalyani Publishers, New Delhi-Ludhiana, India.
4. Atwal AS. 2000. Essentials of Beekeeping and Pollination. Kalyani Publishers, New Delhi-Ludhiana, India.
5. Bailey L & Ball BV. 1991. Honey Bee Pathology. Academic Press, London
6. Grahm Joe M. 1992. Hive and the Honey Bee. Dadant & Sons, Hamilton, Illinois, USA.
7. Morse AA. 1978. Honey Bee Pests, Predators and Diseases. Cornell University Press, Ithaca and London.
8. Rahman, A. 2017. Apiculture in India, ICAR, New Delhi

ENT 005	PRODUCTION OF BIOCONTROL AGENTS	2 (0+2)	SEM I, II

Objectives

To train the students with hands on training on mass production techniques and field evaluation of various biological control agents like parasitoids, predators, various entomopathogenic microorganisms.

Practical

Principles and scope of biological control; principles of classical biological control importation, augmentation and conservation. Identification, biology, adaptation, host seeking behaviour of common predatory and parasitic groups of insects. Identification and role of insect pathogenic microbes, nematodes and their mode of action. Biological control of weeds using insects. Establishment of a biocontrol unit. Hands-on training on mass production of *Corcyra cephalonica, Phenacoccus solenopsis*, Mass production of parasitoids viz., *Trichogramma* sp., *Aenasius arizonensis*, Mass production of predators viz., *Chrysoperla* sp., Rearing of host insects viz., *Helicoverpa armigera* and *Spodoptera litura.* Hands-on training in culturing, formulations, field applications of common insect pathogens. viz. *Metarhizium anisopliae, Beauveria bassiana* and *Verticillium lecanii, Trichoderma* sp. Entomopathogenic nematodes viz., *Steinernema* and *Heterorhabditis.* Visits (only where logistically feasible) to bio-control laboratories to learn rearing. Quality control and registration standards for biocontrol agents.

Suggested Readings

1. De Bach P. 1964. Biological Control of Insect Pests and Weeds.
2. Chapman & Hall. Huffaker CB & Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press.
3. Saxena AB. 2003. Biological Control of Insect Pests. Anmol Publ.
4. Campbell R. 1989. Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge. Cook RJ & Baker KF. 1983. Nature and Practice of Biological Control of Plant Pathogens. APS, St. Paul, Mennisota.
5. Gaugler R & Kaya HK. 1990. Entomopathogenic Nematodes in Biological Control. CRC Press
6. Woodring JL & Kaya HK. 1988. Steinernematid and Heterorhabditid Nematodes: A Handbook of Techniques. Southern Coop. Bull., Ark. Ag. Ext. Sta.
7. Zuckerman BM. (Ed.). 1980. Nematodes as Biological Models. Vols. I, II. Academic Press. www2.oardc.ohio-state.edu/nematodes

ENT 401	MANAGEMENT OF BENEFICIAL INSECTS	4 (3+1)	SEM VII

Objectives

Student should know the rearing of beneficial insects commercially along with its use in pest control.

Theory

Importance of beneficial Insects, Beekeeping and pollinators, 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. Role of pollinators in cross pollinated plants. 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 silkworms, 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. Identification and techniques for mass multiplication of natural enemies.

Suggested Readings

1. Abrol D.P. 2009. Bees and Beekeeping in India, Kalyani publishers, New Delhi 705p.
2. Atwal AS 2001. World of Honey Bees. Kalyani Publishers, New Delhi-Ludhiana, India.
3. Dandin, S.B. and K. Giridhar. 2014. Hand book of Sericulture Technologies. Central Silk Board, Bangalore, 423p.
4. David, B. V. and Ramamurthy, V. V. 2011. Elements of Economic Entomology, 6th Edition, Namrutha Publications, Chennai.
5. Ghorai, N. 1995. Lac cultivation in India, International Books & Periodicals Supply Service, New Delhi, 167p.
6. Govindaiah., G, V.P., Sharma, D.D., Rajadurai, S. and V. NishitaNaik. 2005. A text book on mulberry crop protection. Central Silk Board, Bangalore.450 p.
7. Ignacimuthu SS and Jayaraj S. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi.
8. Krishnaswami, S. 1960. Lac cultivation in India. Ministry of Food and Agriculture, New Delhi. Farm Bulletin No. 60, 36p.
9. M. Madan Mohan Rao 1998. A Text Book of Sericulture. BS Publications, Sultan Nagar, Hyderabad. 201p.
10. Mishra, R.C. 1998. Perspectives in Indian Apiculture, Agro Botanica. Bikaner, 303p.
11. Saxena AB. 2003. Biological Control of Insect Pests. Anmol Publ., New Delhi.
12. Sharma, K.K. and Ramani, S. 2010. Recent advances in lac culture. ICAR – IINRG, Ranchi.
13. Tribhuvan Singh and Saratchandra, B. 2004. Principles and Techniques of silkworm seed production. Discovery publishing House, New Delhi, 360 pp.

ENT 402	PESTICIDES AND PLANT PROTECTION EQUIPMENT	4 (3+1)	SEM VII

Objectives

To orient the students with classification, properties, entry and mode of action of pesticides, belonging to different groups; Plant protection organizational set up in India and pest control equipment's and their remedies; Pesticides calculations, working out their doses and concentrations.

Theory

Pesticides: classification, properties, entry and mode of action; formulation and toxicity of pesticides; factors affecting toxicity of pesticides; antidotes; problems associated with the use of pesticides. Principles of insecticide toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation, antagonism, stickers, spreaders and other adjuvants. Factors affecting toxicity of insecticides; Insecticide compatibility, selectivity and phytotoxicity. Bioassay definition, objectives, criteria, factors, problems and solutions. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds/new insecticide molecules. Plant

Protection: Directorate of Plant Protection, Quarantine and Storage– A brief account of its organizational set up and functions. Pest control equipments: history of development, classification, constructional features, principles of working, operation, maintenance and selection;

Practical

Familiarization with different formulations of pesticides, their preparation and use. Toxicity to insects and plant. Demonstration on use of various types of pest control equipment. Study of factors affecting efficacy of pesticide spray. Calibration of plant protection equipments; Common troubles in the use of pest control equipment and their remedies. Pesticides calculations; working out doses and concentrations of pesticides.

Suggested Readings

1. Chattopadhyay SB. 1985. Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi.
2. Dhaliwal GS, Singh R & Chhillar BS. 2014. Essentials of Agricultural Entomology. Kalyani Publishers.
3. Gupta HCL.1999. Insecticides: Toxicology and uses. Agrotech Publ., Udaipur.
4. Ishaaya I and Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.
5. Krieger, R. I. 2001. Handbook of Pesticide Toxicology. Vol-II. Academic Press. Orlando Florida.
6. Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.
7. Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.
8. Prakash A and Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publication, New York.
9. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Pearson Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
10. Dovener, R.A. Mueninghoff, J.C. and Volgar, G.C. 2002. Pesticides formulation and delivery systems: meeting the challenges of the current crop protection industry. ASTM, USA
11. Dodia, D.A. Petel, I.S. and Petal, G.M. 2008. Botanical Pesticides for Pest Management. Scientific Publisher (India), Jodhpur.
12. Ishaaya, I. and Degheele, D. 1998. Insecticides with Novel Modes of Action: Mechanism and Application. Norosa Publishing House, New Delhi.
13. Mathews G.A. 2002. Pesticide Application Methods. 4th Ed. Intercept. UK.
14. Otto, D. and Weber, B. 1991. Insecticides: Mechanism of Action and Resistance. Intercept Ltd., U.K.
15. Roy, N.K. 2006. Chemistry of Pesticides. Asia Printograph Shahdara Delhi.

FORESTRY

Course No.	Course Title	Credits	Semester
Core Course			
FOR 302	Introductory Agro Forestry	2 (1+1)	VI
	Total Credits	**2 (1+1)**	
Elective Course			
FOR 401	Wood Technology and Forest Utilization	4 (3+1)	VII
	Total Credits	**4 (3+1)**	
	Grand Total	**6 (4+2)**	

FOR 302	INTRODUCTORY AGRO FORESTRY	2 (1+1)	SEM VI

Objectives

1. To study Agro forestry as an alternate system of land use
2. To study different types of Agro forestry for soil and water conservation.
3. To study the characteristics of Agro forestry in terms its potential for soil moisture conservation practices

Theory

Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India; MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India, Ecological aspects of Agroforestry system, tree - crop interaction– competition, nutrient recycling; Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India. Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt– definition, objectives.; Socio- economic aspects of Agroforestry system; Design and Diagnostic study of agroforetry system; Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock; Management of tree species; Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.

Practical

Identification of tree species in agro-forestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed treatment, Preparation of nursery bed exercise, practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding etc. Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agroforestry system,

Evaluation of agro-forestry system in different agro climatic zones, Exposure Visit to prevailing agroforestry systems of the state and related important institutions, Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

Suggested Readings

1. Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
2. Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing,
3. Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
4. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi

FOR 401	WOOD TECHNOLOGY AND FOREST UTILIZATION	4 (3+1)	SEM VII

Objectives

To develop an understanding on the timber and non-timber forest products and their harvesting; 2. To understand the efficient utilization of wood and wood products for new generation

Theory

Uses and nature of wood. Physical and mechanical properties of woods. Wood as raw material for pulp, paper, rayon, composite woods. Wood suitability indices. Logging-felling rules and harvesting methods. Primary conversion: Sawing techniques - plain and quarter sawing.

Wood seasoning - air, kiln, chemical and solar seasoning. Wood preservation - type of preservatives, preservation methods. Composite wood products - manufacturing and its application, properties of plywood, particle board, sandwich board, core board and fibre board. Wood defects and abnormalities. Wood working joints. Wood finishing. Wood modification: its need and scope, manufacturing process, uses and properties.

Minor forest products - utilization, processing and marketing of gums, resins, essential oils, dyes and tannins, Medicinal plants, Fibres, bamboos and canes etc

Practical

Identification of wood specimens and medicinal plants. Assessment of wood properties. Demonstration of sawing methods. Methods of wood seasoning and preservation. Manufacturing processes of composite wood. Identification of wood defects and wood working joints. NTFPs - collection and harvesting processes of gum, resin, etc. Visit to forest-based industries.

Suggested Readings

1. Mehta T. 2008. A Handbook of Forest Utilization. International Book Distributor, Dehradun, India. ISBN: 978-8170893158.
2. Negi SS. 1997. Wood Science and Technology. International Book Distributor, Dehradun, India. ISBN: 817089247.

GENETICS AND PLANT BREEDING

Course No.	Course Title	Credits	Semester
	Core Courses		
GPB 104	Introduction to Genetics and Plant Breeding (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	II
GPB 201	Principles of Genetics	3 (2+1)	III
GPB 202	Basics of Plant Breeding (For B.Sc. (Hons.) Agriculture and B.Tech. Biotechnology)	3 (2+1)	Agri.: IV Biotech: II
GPB 301	Crop Improvement (*Kharif* Crops) I	2 (1+1)	V
GPB 302	Crop Improvement (*Rabi* Crops) II	2 (1+1)	VI
	Total Credits	**12 (7+5)**	
	Skill Enhancement Courses		
GPB 006	Crossing Techniques and Handling of Different Field Crops	2 (0+2)	III, IV
GPB 007	Molecular Techniques for Agriculturist (To be taught jointly by Dept. of Genetics & Plant Breeding, Plant Pathology and Nematology)	2 (0+2)	III, IV
	Total Credits	**4 (0+4)**	
	Elective Courses		
GPB 401	Crop Improvement	4 (3+1)	VII
GPB 402	Biotechnology of Crop Improvement	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**24 (13+11)**	

GPB 104	INTRODUCTION TO GENETICS AND PLANT BREEDING (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM II

Objectives

1. To understand the principles of genetics and their application in plant breeding
2. To learn about breeding techniques used to improve crop traits such as yield, disease resistance, and quality
3. To explore the importance of genetic diversity and its role in crop improvement and adaptation to changing environments
4. To develop skills to evaluate and select superior plant genotypes for breeding programs aimed at enhancing agricultural productivity and sustainability

Theory

History of Genetics and Plant Breeding, Study of Chromosome- Structure, functions, cell division. Mendel's laws of inheritance, Mode of inheritance- monogenic, polygenic, cytoplasmic. Modes of reproduction in plants: sexual and asexual,

differences between self- and cross-pollinated crops. Male sterility and their significance in plant breeding. Breeding for self-pollinated (Mass, pure line, pedigree and bulk methods), cross-pollinated (Ear to row, Backcross, Development of synthetics, composites and hybrids), vegetatively propagated crops (Clonal selection).

Practical

Mendelian ratios- Problems related to segregation and independent assortment and polygenic inheritance. Study of linkage, crossing over percentage, map distance. Study of floral structure and biology of important cereals, pulses, oilseeds and commercial crops. Study of plant breeder's kits, selfing and crossing techniques. Male sterility: A, B and R lines and their utility. Pollen fertility study and its importance. Layout of field experiments, principles, data recording and elementary statistics and analysis of data. Visit to different crop breeding schemes.

Suggested Readings

1. An Introduction to Genetic Analysis by Suzuki *et al.*
2. Breeding Field Crops by JM Poehlman.
3. Genetics by Strickberger.
4. Plant Breeding: Principles and Practices by JR Sharma.
5. Principles of Plant Breeding (1st and 2nd Edition) by RW Allard.

GPB 201	PRINCIPLES OF GENETICS	3 (2+1)	SEM III

Objectives

To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.

Theory

Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Study of model organisms (Drosophila, Arabidopsis, Garden pea, *E. coli*, and mice), Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probabilit and Chi-square. Types of DNA and RNA, Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation.

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 mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications, Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance, Nature, structure and replication of genetic material, Protein

synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

Practical

Study of microscope, Study of cell structure, Mitosis and Meiosis cell division, 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 data), Study on sex linked inheritance in Drosophila. Study on models on DNA and RNA structures.

Suggested Readings

1. Fundamentals of Genetics: B. D. Singh
2. Genetics: M. W. Strickberger.
3. Principles of Genetics: Gardner, Simmons and Snustad.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky

GPB 202	**BASICS OF PLANT BREEDING (For B.Sc. (Hons.) Agriculture and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM Agri.: IV Biotech: II**

Objectives

To acquaint with different techniques ranging from simply selecting plants with desirable characteristics for propagation, to more complex molecular techniques for breeding new varieties, which are higher yielding, resistant to biotic and abiotic stresses for ensuring food security.

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, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/ diversity, Components of Genetic variation. Heritability and genetic advance. Pre-breeding and Universal Plant Breeder's equation. 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. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. 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. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

Practical

Plant Breeder's kit, Study of germplasm of various crops, Study of floral structures of self-pollinated and cross-pollinated crops, Emasculation and hybridization techniques in self and cross pollinated crops, Consequences of inbreeding on genetic structure of resulting populations, Study of male sterility system, Handling of segregating populations, Methods of calculating mean, range, variance, standard deviation, heritability, Designs used in plant breeding experiments, 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, Maintenance of breeding records and data collection, Screening tests for biotic and abiotic stresses.

Suggested Readings

1. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard.
2. Plant Breeding: Principles & Practices by JR Sharma.
3. Plant Breeding- B.D. Singh.
4. Principles and Procedures of Plant Breeding - Biotechnical and Conventional Approaches by GS Chahal and SS Gosal.
5. Principles of Plant Genetics and Breeding by George Acquaah.

GPB 301	**CROP IMPROVEMENT (*KHARIF* CROPS) I**	**2 (1+1)**	**SEM V**

Objectives

1. To provide knowledge about Self-pollinated and cross pollinated *Kharif* crops
2. To learn about origin and distribution of *Kharif* crops
3. To design breeding objectives of major *Kharif* crops
4. To impart information on different crop varieties for *Kharif* season

Theory

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops of *kharif* season; Plant genetic resources, its utilization and conservation, 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); Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeonpea etc. Ideotype concept, climate resilient crop varieties for future.

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, maize, sorghum, pearl millet, pigeonpea, urdbean, mungbean, groundnut, sesame, castor, cotton, cowpea, brinjal and okra. 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 seed 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 breeding plots of different crops.

Suggested Readings

1. Breeding field crops -I by V.L. Chopra
2. Genetic improvement of field crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable breeding – Principles and Practices by Hari Har Ram
5. Breeding field crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –theory and practice by S.K. Gupta
7. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur
8. Practical manuals on Crop Improvement I (*Kharif* crops) by Rajendra Kumar Yadav

GPB 302	CROP IMPROVEMENT (*RABI* CROPS) II	2 (1+1)	SEM VI

Objectives

1. To provide knowledge about self-pollinated and cross-pollinated *rabi* crops
2. To learn about origin and distribution of *rabi* crops
3. To design breeding objectives of major *rabi* crops
4. To impart information on different crop varieties for *rabi* season

Theory

Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; Plant genetic resources, its utilization and conservation, 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); Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc. Ideotype concept, climate resilient crop varieties for future.

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard, pulses, sugarcane etc. Study of field techniques for seed production and hybrid seed production in rabi crops; Estimation of heterosis, inbreeding depression and heritability; Study of

quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Suggested Readings

1. Breeding Field Crops -I by V.L. Chopra
2. Genetic Improvement of Field Crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable Breeding – Principles and Practices by Hari Har Ram
5. Breeding Field Crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –Theory and practice by S.K. Gupta
7. Breeding Asian field Crops by J.M. Poehlman and D.N. Barthakur
8. Practical Manuals on Crop Improvement I (*Rabi* crops) by Rajendra Kumar Yadav

GPB 006	**CROSSING TECHNIQUES AND HANDLING OF DIFFERENT FIELD CROPS**	**2 (0+2)**	**SEM III, IV**

Objective

To provide basic understanding of different crops, their handling to raise healthy crop and hand on crossing techniques in various field crops.

Practical

Emasculation and hybridization techniques in different crop species; viz., Rice, Maize, Sorghum, Pearl Millet, Pigeonpea, Urdbean, Mungbean, clusterbean, Seasame, Cotton and Cowpea. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods; Study of field techniques for seed production and hybrid seeds production in *Kharif* crops; Layout of field experiments; Study of quality characters, donor parents for different characters;

Emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rapeseed Mustard, Sunflower and Cowpea; Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Layout of field experiments; Study of quality characters, study of donor parents for different characters.

Suggested Readings

1. Floral Biology of crop plants (2nd ed.) by A.K. Chhabra
2. Breeding Field Crops -I by V.L. Chopra
3. Genetic Improvement of Field Crops by C.B. Singh and D. Khare
4. Breeding Field Crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –Theory and practice by S.K. Gupta
7. Breeding Asian field Crops by J.M. Poehlman and D.N. Barthakur
8. Practical Manuals on Crop Improvement I (*Rabi* crops) by Rajendra Kumar Yadav

GPB 007	MOLECULAR TECHNIQUES FOR AGRICULTURIST (To be taught jointly by Dept. of Genetics & Plant Breeding, Plant Pathology and Nematology)	2 (0+2)	SEM III, IV

Objective

To provide basic knowledge of molecular techniques for diversity, detection and characterisation studies.

Practical

Introduction to Molecular Laboratory: Overview of molecular techniques and Laboratory safety protocols.

Molecular characterisation of crop plants: Handling of plant sample, extraction of DNA, qualitative and quantitative analysis of the extracted DNA, PCR amplification, Real-time PCR (qRT-PCR) and data analysis.

Fungal and bacterial Pathogen Isolation and Characterization: Sample collection and handling, isolation and pure culture preparation, DNA extraction and PCR amplification (ITS or any conserved region, 16S rRNA gene).

Viral Pathogen Detection and Extraction: Sample preparation and sap extraction, Serological methods (ELISA and its variants), DNA/RNA extraction, PCR/ RT-PCR amplification.

Nematodes detection and characterisation: Collection of nematodes from soil and plant samples, DNA isolation from pure culture of nematodes, single worms and from soil sample, Different genetic markers utilized in nematode identification, genetic diversity assessment and DNA Barcoding for biodiversity studies.

Data Analysis and Bioinformatics: Sequence analysis using BLAST, primer designing using Primer3, Phylogenetic tree construction and Use of bioinformatics tools (e.g., MEGA, ClustalW Omega).

Suggested Readings

1. Green MR and Sambrook J, 2012, Molecular cloning: A Laboratory Manual 4th edn, Cold Spring Harbor.
2. Kreuzer H and Massey A, 2008, Molecular biology and biotechnology: a guide for students, 3rd edn, ASM Press.
3. Baxevanis AD, Ouellette BFF, 2011, Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley and Sons.
4. Lela B, 2019, Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, FA Davis Company.

GPB 401	CROP IMPROVEMENT	4 (3+1)	SEM VII

Objectives

1. To acquaint breeding methods of crop improvement
2. To introduce genetic resources

Theory

Pollination behaviour in relation to breeding methods, Sexual and asexual reproduction, Specific breeding objectives of major field crops and Mechanism promoting autogamy and allogamy; Genetic basis of breeding self and cross fertilized crops: Genetic consequences of self & cross fertilization, Genetics of Self Incompatibility, Mating system, Qualitative & quantitative traits & their behaviour in segregating generation, Component of variation: single & multiple gene concept, epistasis & gene interaction, Selection: Response to selection, selection differential intensity & realised advance, Heterosis and Inbreeding depression, Seed classification; breeder seed production; seed certification regulations, Classification of variability and Relative importance of different components of genetic variation in crop improvement

Centres of origin and Domestication, Different breeding methods for developing varieties including composites/synthetics/hybrids of major field crops: Mass selection, Pure-line selection, Pedigree selection, Bulk population, Backcrossing breeding method, multiline breeding, Recurrent selection, Composite and synthetic breeding, Inbred and hybrid development; Specific and general combining ability in crop improvement: Features, importance and uses of GCA and SCA, Importance of varietal resistance and breeding for disease resistance

Genetic resources: definitions and concepts, germplasm and gene pools: Primary, secondary and tertiary; importance of genetic resources in crop improvement, centres of origin and diversity; germplasm exploration, collection, characterization, evaluation and cataloguing; germplasm introduction and exchange- in situ and ex situ conservation of germ plasm; modules for germplasm conservation- short, medium and long term conservation, maintenance of germplasm in relation to breeding behaviour; registration of plant genetic resources.

Practical

Selection of plant progenies in relation to breeding objectives; Identification of varieties and hybrids of various crops in the field

Floral biology, emasculation, pollination and selfing techniques of cereals (Wheat, Barley, Maize, Bajra and Rice), pulses (Chickpea, Field pea, Lentil and Mungbean), forage crops (Oat, Sorghum and Berseem), medicinal crop (Jojoba & Guayule), oilseed crops (Brassica and Sunflower), cash crops (Cotton and Sugarcane), Prediction of performance of single and double crosses

Suggested Readings

1. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard.
2. Plant Breeding- B.D. Singh.
3. Principles of Plant Genetics and Breeding by George Acquaah.
4. Breeding field crops -I by V.L. Chopra
5. Practical manuals on Crop Improvement I (*Kharif* crops) by Rajendra Kumar Yadav
6. Breeding field crops by D.A. Sleper and J.M. Poehlman

7. Maxted N, Ford-Lloyd BV and Hawkes JG. 1997. Plant Genetic Conservation: The in Situ Approach. Chapman & Hall, London.
8. Chaudhury R and Malik SK .2017 Cryopreservation of Plant Species: Practical Approaches from Handling to Cryobanking. ICAR-NBPGR, New Delhi. 52 p.

GPB 402	BIOTECHNOLOGY OF CROP IMPROVEMENT	4 (3+1)	SEM VII

Objectives

1. To acquaint with biotechnological tools of crop improvement
2. To know about direct and indirect methods of gene transfer
3. To introduce about gene editing in plants
4. To provide knowledge about marker assisted breeding and genomic selection

Theory

Impact of Biotechnology on crop improvement and the perspective of society; Various biotechnological techniques available for crop improvement – Plant Tissue Culture, Genetic Engineering, Genome editing, Marker Assisted breeding and Genomic Selection. Biosafety regulations and their application in Agricultural Biotechnology. Somaclonal variation and its use in crop improvement; embryo culture; anther/pollen culture; somatic embryogenesis; artificial seeds; techniques of protoplast culture, regeneration and somatic cell hybridization, achievements and limitations, utility in the improvement of crop plants. Direct and Indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots; Direct DNA delivery methods (microinjection, particle gun method, electroporation); gene targeting; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; creation of transgenic plants; Introduction to genome editing – Various tools of genome editing; CRISPR-Cas9 with specific emphasis on Indian regulations; Applications of CRISPR/cas9 technology in crop plants. Marker Assisted Breeding and Genomic Selection: Introduction to various DNA-based markers and their use in marker-assisted breeding; Foreground Selection, Recombinant Selection and background Selection; Marker-assisted backcross breeding, marker-assisted selection – success stories; Introduction to Genomic Selection.

Practical

Aseptic manipulation of various explants, observations on the contaminants occurring in media, interpretations; Inoculation of explants, callus induction and plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures; Visit to commercial micropropagation unit; Demonstration of Agrobacterium-mediated transformation in plants – preparation of construct, transfer to binary vector, transform Agrobacterium, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing- preparation of CRISPR/CAS construct, direct transfer to plant, analysis of the targets; Planning of a MABB

programme – selection of parents, crossing strategies, marker analysis, PCR-based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship.

Suggested Readings

1. Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.
2. Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/otherweb/lzc/genetic%20engineering/courseware/b1.pdf
3. Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
4. Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.
5. Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.
6. Ram, Hari Har. 2019. Crop Breeding and Biotechnology. Kalyani Publications.
7. Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.
8. Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
9. Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology.
10. Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.

HORTICULTURE

Course No.	Course Title	Credits	Semester
Core Courses			
HORT 101	Fundamentals of Horticulture	3 (2+1)	I
HORT 201	General Horticulture (For B.Sc. (Hons.) Agribusiness Management; To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	III
HORT 202	Production Technology of Fruit and Plantation Crops	2 (1+1)	IV
HORT 204	Post-harvest Management and Value Addition of Fruits and Vegetables (For B.Sc. (Hons.) Agribusiness Management; To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	IV
HORT 301	Ornamental Crops, MAPs and Landscaping (To be taught jointly by Dept. of Horticulture and Agronomy)	2 (1+1)	V
	Total Credits	**11 (6+5)**	
Skill Enhancement Courses			
HORT 008	Value Addition of Fruits and Vegetables (To be taught jointly by Dept. of Horticulture and Vegetable Science)	2 (0+2)	I, II
HORT 009	Nursery Raising of Horticultural and Forest Plants (To be taught jointly by Dept. of Horticulture and Forestry)	2 (0+2)	I, II
	Total Credits	**4 (0+4)**	
Elective Courses			
HORT 401	Landscaping	4 (3+1)	VII
HORT 402	Hi-tech Horticulture	4 (3+1)	VII
HORT 403	Protected Cultivation	4 (3+1)	VII
	Total Credits	**12 (9+3)**	
	Grand Total	**27 (15+12)**	

HORT 101	FUNDAMENTALS OF HORTICULTURE	3 (2+1)	SEM I

Objectives

1. To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants
2. To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops
3. To provide knowledge on different physiological aspects of horticultural crops

Theory

Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops. Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.

Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops, pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops, irrigation and its methods, Fertilizer application in horticultural crops.

Practical

Identification and nomenclature of fruit, Layout of an orchard, pit making and system of planting, Nursery raising techniques of fruit crops, Understanding of plant propagation structures, Propagation through seeds and plant parts, Propagation techniques for horticultural crops, Container, potting mixture, potting and repotting, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage.

Suggested Readings

1. Prasad and Kumar, 2014. Principles of Horticulture 2nd Edn. Agrobios (India).
2. Neeraj Pratap Singh, 2005. Basic concepts of Fruit Science 1st Edn. IBDC Publishers. Gardner/Bardford/Hooker. J.R., 1957. Fundamentals of Fruit Production. Mac Graw Hill Book Co., New York.
3. Edmond, J.B, Sen, T.L, Andrews, F.S and Halfacre R.G., 1963. Fundamentals of Horticulture. Tata Mc Graw Hill Publishing Co., New Delhi.
4. Kumar, N., 1990. Introduction to Horticulture. Rajyalakshmi publications, Nagarcoil, Tamilnadu
5. Denisen E.L.,1957. Principles of Horticulture. Macmillan Publishing Co., New York. Chadha, K.L.(ICAR),2002,2001. Handbook of Horticulture. ICAR, New Delhi
6. K.V. Peter, 2009. Basics Horticulture. New India Publishing Agency
7. Kausal Kumar Misra and Rajesh Kumar, 2014. Fundamentals of Horticulture. Biotech Books.
8. D.K. Salunkhe and S.S. Kadam, 2013. A handbook of Fruit Science and Technology. CRC Press. S. Prasad and U. Kumar, 2010. A handbook of Fruit Production. Agrobios (India).
9. Jitendra Singh, 2011. Basic Horticulture. Kalyani Publications, New Delhi.

HORT 201	**GENERAL HORTICULTURE (For B.Sc. (Hons.) Agribusiness Management; To be taught jointly by Horticulture and Vegetable Science)**	**2 (1+1)**	**SEM III**

Objectives

1. Understand the basic principles of horticulture, including plant biology,

propagation, and cultivation

2. Learn about the cultivation techniques and management practices for various horticultural crops
3. Explore the importance of pest and disease management, as well as environmental factors affecting horticultural production
4. Develop skills to apply horticultural knowledge in the production of fruits, vegetables, ornamental plants, and herbs for both commercial and personal use

Theory

Horticulture- Definition, branches, importance and scope. Methods of plant propagation - sexual and asexual. General principles and practices of cultivation of important fruits-mango, banana, citrus, grape, guava, sapota. Importance of vegetables, kitchen garden, etc. General principles and practices involved in cultivation of important vegetables solanaceous crops, cole crops, cucurbits, peas and beans. Importance of floriculture and different components of ornamental garden and cultivation of important flower crops. Medicinal and aromatic plants: active principle, medicinal properties and aromatic principles.

Practical

Visit to orchards and gardens; Plant propagation methods; Study of varieties, cultural practices, plant protection of important fruits; Study of varieties, cultural practices, plant protection of important vegetables; Study of culture of medicinal plants; Study of culture of aromatic plants; Study of different components of ornamental garden - annuals, shrubs, trees, climbers, hedges and edges; Study of culture of flower crops.

Suggested Readings

1. ICAR. 2002. Handbook of Horticulture. ICAR.
2. Peter KV. 2008. (Ed.) Basics of Horticulture. New India Publ. Agency.
3. Pradeepkumar T, Suma B, Jyothibhaskar and Satheesan KN. 2008. Management of Horticultural Crops. New India Publ. Agency.
4. Rajan S and Baby LM. 2007. Propagation of Horticultural Crops. New India Publ. Agency.

HORT 202	PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS	2 (1+1)	SEM IV

Objectives

1. To educate about the different forms of classification of fruit crops
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops
3. To educate about the physiological disorders of fruit crops, palms and plantation crops

Theory

Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit

crops; area, production, productivity and export potential of fruit and plantation crops. Crop production techniques in tropical, sub-tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.

Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops Jackfruit, Bael, dragonfruit and minor fruits- date, ber, apple, plantation crops-coconut, arecanut, cashew, tea and coffee.

Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition

Palms: Coconut, Arecanut, Oil palm and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut,

Practical

Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate, jackfruit, preparation and application of PGR's for propagation, Micro propagation, protocol for mass multiplication and hardening of fruit crops, Identification and description of varieties, mother palm and seed nut selection, nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of Coconut, Arecanut and cocoa, Tea and coffee, Rubber and cashew, Visit to commercial orchard and plantation industries.

Suggested Readings

1. Banday, F.A. and Sharma, M.K.2010 Advances in temperate fruit production. Kalyani Publishers, Ludhiana
2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
7. Chattopadhyay. 1998. A textbook on pomology (sub-tropical fruits) vol.III. Published by M/s. Kalyani publishers, Ludhiana, New Delhi, Noida. UP.
8. Chudawat, B. S.1990. Arid fruit culture Oxford &IBH, New Delhi
9. Das, B.C. and Das S.N. Cultivation of minor fruits. Kalyani Publishers, Ludhiana

10. David Jackson and N.E. Laone, 1999. Subtropical and temperate fruit production. CABI publications
11. H.P. Singh and M.M. Mustafa 2009. Banana-new innovations Westville publishing House, New Delhi
12. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, Tamil Nadu.
13. Mitra, S.K., T.K. Bose and D.S. Rathore. 1991. Temperate fruits. Horticulture and allied Publishers, Calcutta.
14. Pal, J.S. 1997. Fruit Growing. Kalyani Publishers, New Delhi.
15. Radha, T. and Mathew, L.2007. Fruit crops. New India publishing Agency
16. Rajput, CBS and Srihari babu, R.1985. Citriculture, Kalyani Publishers, Ludhiana
17. Sadhu, M.K. and P.K. Chattopadhyay. 2001. Introductory Fruit Crops. Naya Prokash, Calcutta.
18. Singh, S.P. 2004. Commercial Fruits. Kalyani Publishers, Ludhiana
19. Symmonds. 1996. Banana, II Edn. Longman, London
20. Veeraragavathatham, D., Jawaharlal, M., Jeeva, S., Rabindran, R and Umapathy, G. 2004 (2nd edition). Scientific fruit culture. Published by M/s. Suri associates, 1362/4, Velraj Vihar Complex, Thadagam Road, Coimbatore- 2
21. W.S. Dhillon. 2013. Fruit production in India. Narendra publishing House, New Delhi
22. Kavino, M, V. Jegadeeswari, R. M. Vijayakumar and S. Balkrishnan. 2018. Production Technology of Fruits and Plantation Crops by Narendra Publishing House.
23. Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
24. Nair. 1979. Cashew, CPCRI, Kerela
25. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of Fruits and Plantation Crops. Elite Publishing House
26. Thampan, P.K.1981. Handbook of coconut palm. Oxford &IBH, New Delhi.
27. Thompson, P.K.1980. Coconut. Oxford &IBH, New Delhi
28. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C. Krishnamoorthy 2015. Fruit and Plantation Crops Narendra Publishing House.

HORT 204	**POST-HARVEST MANAGEMENT AND VALUE ADDITION OF FRUITS AND VEGETABLES (For B.Sc. (Hons.) Agribusiness Management; To be taught jointly by Horticulture and Vegetable Science)**	**2 (1+1)**	**SEM IV**

Objectives

1. Understand the principles and techniques of post-harvest management for fruits and vegetables
2. Learn about value addition processes such as sorting, grading, packaging, and processing

3. Explore methods to minimize post-harvest losses and extend the shelf life of fruits and vegetables
4. Develop skills to add value to agricultural produce, increase marketability, and enhance profitability for farmers and stakeholders

Theory

Importance of post-harvest processing of fruits and vegetables; Extent and possible causes of post-harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling; Storage (ZECC, Cold storage, CA, MA and Hypobaric); Value addition concept; Principles and methods of preservation; Minimal processing; Intermediate moisture foods- Jam, Jelly, Marmalade - Concepts and Standards; Fermented and non-fermented beverages; Drying/ Dehydration of fruits and vegetables - Concept and methods; Canning - Concepts and Standards, Packaging of products.

Practical

Containers for shelf life extension; Effect of temperature on shelf life and quality of produce; Chilling and freezing injury in vegetables and fruits; Extraction and preservation of pulps and juices; Preparation of Jam, Jelly, RTS, Nectar, Squash, Wine, Fruit bar, Candy, Tomato products; Quality evaluation of products- physico- chemical and sensory; Visit to processing unit/ industry.

Suggested Reading

1. Bhutani, R.C., 2003, Fruit and Vegetable Preservation, Biotech Books.
2. Mitra, S.K., 1997, Post Harvest Physiology and Storage of Tropical and Sub-Tropical Fruits, CABI.
3. Ranganna, S., 1997, Handbook of Analysis and Quality Control for Fruit and Vegetable Products, Tata McGraw-Hill.
4. Sudheer, K.P., and Indira, V., 2007, Post Harvest Technology of Horticultural Crops, New India Publ. Agency.
5. Willis, R., McGlassen, W.B., Graham, D. and Joyce, D., 1998, Post Harvest: An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals, CABI.

HORT 301	**ORNAMENTAL CROPS, MAPS AND LANDSCAPING (To be taught jointly by Dept. of Horticulture and Agronomy)**	**2 (1+1)**	**SEM V**

Objectives

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs
2. To educate about concept, designing principles and components of landscaping
3. To educate about the physiological disorders of commercial flowers
4. To educate about the post-harvest management and value addition in flower crops and MAP

Theory

Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum, Coleus, Glory lily, Periwinkle etc.; Production technology of plants like lemongrass, citronella, vetiver and palmarosa etc., Importance and scope of ornamental crops; Importance and scope of medicinal and aromatic plants and landscaping; Principles of landscaping; Landscape uses of trees, shrubs and climbers, Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and lilium; Production technology of chrysanthemum and carnation; Package of practices for loose flowers like marigold and jasmine under open conditions; Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc.; Processing and value addition imp ornamental crops; Processing and value addition of MAPs produce.

Practical

Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants). Propagation of MAP, Bed preparation and planting of MAP; Nursery bed preparation and sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of bougainvillea; Planting of gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

Suggested Readings

1. Floriculture in India by G.S. Randhawa and Mukopadhyay
2. Introduction to spices, plantation crops, medicinal and aromatic plants by N. Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam
3. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
4. Commercial flowers (Vol 1 and 2) by T.K. Bose.

HORT 008	**VALUE ADDITION OF FRUITS AND VEGETABLES (To be taught jointly by Dept. of Horticulture and Vegetable Science)**	**2 (0+2)**	**SEM I, II**

Objectives

1. To inculcate processing skills among students for development of fruits and vegetables products
2. To build entrepreneurship spirit and business management competence among students.

Practical

1. Identification and use of fruits processing machinery/equipment's
2. Application of different types of packaging container for shelf-life extension
3. Extraction and preservation of pulps and juices

4. Preparation of fruit juices, RTS drink and nectar
5. Preparation of fruit squash, crush and syrup, syrup from extracts
6. Preparation of jam, jelly and marmalade
7. Preparation of fruit cheese, bar, slab/leather, butter and toffee
8. Preparation of preserve and candy
9. Preparation of tomato products
10. Preparation of pickles and chutneys
11. Drying and dehydration of fruits and vegetables
12. Quality evaluation of food products
13. FSSAI standards for food products
14. Visit to commercial food processing units

Suggested Readings

1. Khander, V. (1999). Preservation of fruits and vegetables. Kalyani Publisher.
2. Lal, G., Siddappa, G.S. and Tandon, G.L. (1998). Preservation of fruits and vegetables by ICAR Publications.
3. Srivastva, R.P. and Kumar, S. (1998). Fruit and vegetable Preservation-Principles and Practices, International Book Distributing Co, Lucknow

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HORT 009	**NURSERY RAISING OF HORTICULTURAL AND FOREST PLANTS (To be taught jointly by Dept. of Horticulture and Forestry)**	**2 (0+2)**	**SEM I, II**

Objectives

To impart knowledge and develop understanding about modern nursery techniques for mass production of quality planting stock using sexual and asexual propagation techniques in horticultural and forest crops.

Practical

1. Identification of modern nursery tools & equipment in nursey.
2. Land preparation, layout and sowing of seeds in the primary nursery.
3. Preparation, mixing & sterilization of media and filling of bags, portrays and root trainers.
4. Extraction, pre sowing seed treatment for raising rootstocks and forest plants.
5. Propagation of plants through cuttings
6. Propagation of plants through layering
7. Propagation of plants through budding
8. Propagation of plants through grafting
9. Propagation of plants through special plant parts
10. Preparation and use of plants bio-regulator for rooting and growth of seedlings
11. Protection of young plants from adverse weather conditions
12. Identification of nursey insects-pest, diseases & their management.
13. Digging, lifting, packing, transportation and storage of seedling/buddlings

14. Visit to commercial nursery and maintenance of nursery record.

Suggested Readings

1. Dr. N. Kumar. 1997. Introduction to Horticulture. Rajalakshmi Publications, 28/5 – 693, Vepamoodu Junction, Nagercoil. Pp: 15.47- 15.50.
2. Manisha Thapliyal and Sanjeev Kumar (2023). Standard operating procedures For Nursery techniques. https://odishaforest.in/admin/data/documents/ publication_file_1209573378.pdf
3. Ratha Krishnan, M., et.al. (2014) Plant nursery management: Principles and practices, Central Arid Zone Research Institute (ICAR), Jodhpur, Rjasthan
4. Kumar, N., (1997) Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Kumar Mishra, K., N.K. Mishra and Satish Chand (1994) Plant Propagation, John Wiley & Sons, New Jersey

HORT 401	LANDSCAPING	4 (3+1)	SEM VII

Objectives

1. To educate the students on designing different styles and types of gardens
2. To enable the students to identify different ornamental plants and their utilization in landscaping design.
3. To enable students to design landscapes in softwares like AutoCAD, ARCHICAD etc.

Theory

Importance and scope of landscaping. Principles of landscaping, garden styles and types terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery water garden, walkpaths, bridges, other constructed features etc. gardens for special purposes Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers importance, selection, propagation, planting, Annuals: selection, propagation, planting scheme. Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning; landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions, Bonsai principles and management, lawn: establishment and maintenance. CAD application.

Practical

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software, visit to important gardens/ parks/ institutes.

Suggested Readings

1. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
2. Principles of Landscape Gardening: Y. Chandrasekhar and Hemla Naik B., 2020. ICAR,
3. Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh, 2020, Bio-Green Books.
4. Principles of Landscape Architecture: Pragnyashree Mishra and Bhimasen Naik, 2022, New India Publishing Agency.
5. Landscape Gardening: Sudhir Pradhan, 2018, Scientific Publish

HORT 402	HI-TECH HORTICULTURE	4 (3+1)	SEM VII

Objectives

1. To educate the students on the latest technology of hi-tech horticulture
2. To educate students on the concepts and prospects of hi-tech horticulture

Theory

Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods, Protected cultivation: advantages, controlled conditions, method and techniques, Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding, Components of precision farming :Remote sensing ,Geographical Information System (GIS),Differential Geo-positioning System (DGPS) ,Variable Rate Applicator(VRA), application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment's identification and application, Micro propagation, Nursery- portrays, micro-irrigation, EC, pH-based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

Suggested Readings

1. Hi-tech Horticulture by T.A. More
2. Greenhouse operation and management by Paul V. Nelson
3. Hi Tech Horticulture (Pb), S. Prasad, Dharam Singh and R'L, Bharadwaj, 2020, Agrobios
4. Instant Horticulture, S.N. Gupta, Jain Brothers,2023, 488p.
5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide, Tom Garden, Webb Eleanor

HORT 403	PROTECTED CULTIVATION	4 (3+1)	SEM VII

Objective

To educate students on the scientific and commercial cultivation of high value-horticulture crops in protected cultivation

Theory

Protected cultivation- importance and scope, status of protected cultivation in India and World, types of protected structure based on site and climate. Cladding material involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management. Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc. Cultivation of economically important medicinal and aromatic plants. Off- season production of flowers and vegetables. Insect pest and disease management.

Practical

Raising of seedlings and saplings under protected conditions, Use of portrays in quality planting material production, Bed preparation and planting of crop for production. Inter cultural operations, Soil EC and pH measurement. Regulation of irrigation and fertilizers through drip, fogging and misting.

Suggested Readings

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA,252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p.
6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

NEMATOLOGY

Course No.	Course Title	Credits	Semester
Core Course			
NEMA 201	Fundamentals of Nematology	2 (1+1)	III
	Total Credits	**2 (1+1)**	
Elective Course			
NEMA 401	Nematode Pests of Crops and their Management	4 (3+1)	VII
	Total Credits	**4 (3+1)**	
	Grand Total	**6 (4+2)**	

NEMA 201	FUNDAMENTALS OF NEMATOLOGY	2 (1+1)	SEM III

Objectives

1. To impart knowledge on history, economic importance of plant parasitic nematodes, morphology, biology, host parasitic relationship of nematodes.
2. To impart knowledge on nematode pests of different crops of national and local importance and their management.

Theory

Introduction: History of phytonematology, habitat and diversity, ecology and biology of plant parasite nematodes, economic importance of nematodes. General characteristics of plant parasitic nematodes. Nematode: definition and general morphology. Classification of nematodes on the basis of feeding/ parasitic habit. Symptomatology, role of nematodes in disease development, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses. Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee, guava, pomegranate and coconut. Different methods of nematode management: Cultural methods, physical; methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

Practical

Sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique, killing, fixing and mounting of nematodes; Picking and counting of plant parasitic nematode. Identification, symptomology, biology and management of economically important plant nematodes up to generic level with the help of description: Meloidogyne, Pratylenchus; Anguina, Aphelenchoides, Ditylenchus, Heterodera, Tylenchulus, Xiphinema, and Helicotylenchus etc. Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops etc. Methods of application of nematicides and organic amendments.

Suggested Readings

1. Economic Nematology-Edited by J.M. Webster
2. Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde

3. Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy.
4. Text book on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.
5. Nematode Pests of Crops- D. S. Bhatti and R. K. Walia.

NEMA 401	NEMATODE PESTS OF CROPS AND THEIR MANAGEMENT	4 (3+1)	SEM VII

Objectives

1. To develop a comprehensive understanding of plant-parasitic nematodes and their critical role within ecosystems.
2. To highlight the significance of plant parasitic nematodes in modern agriculture and their management.

Theory

History and growth of nematology; nematode habitats and diversity; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry; comprehensive account of crop losses caused by plant parasitic nematode; host finding, invasion and feeding in plant parasitic nematodes; life cycle patterns in different plant parasitic nematodes; types of nematodes symptoms and cellular responses to infection by important phytonematodes; nematode pests of cereals and vegetable crops; nematode pests of pulses and oilseed crops; nematode pests of fruit and plantation crops; nematode problems of mushrooms and protected cultivation; emerging nematode problems; importance of nematodes in international trade and quarantine

Nematode management: terminology, ecology as the basis for nematode management, concepts of nematode control and management technology; Cultural practices- crop rotations and cropping sequences, fallowing, flooding, soil solarisation, time of sowing, organic amendments of soil, bio- fumigation, antagonistic and trap crops, sanitation, physical methods- use of heat, hot water treatment and other methods of disinfestations of planting material; biological methods-use of predators and parasites as biological control agents for plant parasitic nematodes; genetic methods- plant resistance; legal methods- quarantine regulations; chemical methods- nematicides, their types, classification, mode of action, application methods and economizing nematicidal use; next generation nematicides; integrated nematode management; novel nematode management techniques.

Practical

Field visits, isolation and identification of nematodes associated with field, vegetable, fruits crops, mushroom and protected cultivation; study of nematode fauna in varied agro-ecological systems, community analysis of nematode populations; identification of different life cycle stages of root-knot nematodes; demonstration of nematode management technology: plastic mulching, summer solarisation, application of chemical nematicides and bio-agents.

Suggested Readings

1. Bhatti DS & Walia RK. 1992. Nematode Pests of Crops. CBS, New Delhi.
2. Bridge J. & Starr JL. 2007. Plant Nematodes of Agricultural Importance: A Colour Handbook, CRC Press
3. Chen ZX, Chen SY& Dickson DW. 2004. Nematology: Advances and Perspectives. Vol. II: Nematode Management and Utilization. CABI, Wallingford.
4. Perry RN & Moens M. 2013. Plant Nematology. 2nd Ed., CABI, Wallingford, London.
5. Sikora R, Coyne D, Hallmann J & Timper P. 2018. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture, 3rd Ed., CABI, UK.
6. Walia RK & Bajaj HK. 2003. Text Book on Introductory Plant Nematology. ICAR, New Delhi.
7. Walia RK & Khan MR. 2018. A Compendium of Nematode Diseases of Crop Plants, ICAR- AICRP (Nematodes), IARI, New Delhi

PLANT PATHOLOGY

Course No.	Course Title	Credits	Semester
Core Courses			
PL PATH 101	Management of Plant Disease (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	I
PL PATH 102	Fundamentals of Plant Pathology	3 (2+1)	II
PL PATH 301	Diseases of Field and Horticultural Crops and their Management	3 (2+1)	V
	Total Credits	**8 (5+3)**	
Skill Enhancement Course			
PL PATH 010	Mushroom Cultivation	2 (0+2)	I, II
	Total Credits	**2 (0+2)**	
Elective Courses			
PL PATH 401	Applied Plant Pathology	4 (3+1)	VII
PL PATH 402	Biocontrol Agents and Biopesticides	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**18 (11+7)**	

PL PATH 101	MANAGEMENT OF PLANT DISEASE (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM I

Objectives

1. To understand the biology, epidemiology, and ecology of plant diseases.
2. To learn effective strategies for disease prevention, diagnosis, and management in agricultural systems.
3. To explore integrated disease management approaches, including cultural, chemical, and biological control methods.
4. To develop skills to mitigate the impact of plant diseases on crop yield, quality, and sustainability.

Theory

Objectives, historical development and economic significance of post-harvest diseases and seed-borne diseases. Study of important post-harvest diseases (transport, storage and market) of perishables and grains etc. Production of mycotoxins and their effects. Diagnosis and detection of plant pathogens carried through seeds, vegetatively propagated material. Harvesting, transportation, processing and methods of storage. Seed contamination, seed-borne infections and seed transmission. Packing and packaging, requirement of packing materials. Principles of plant disease management, viz., avoidance, exclusion, eradication, protection, immunization-HPR and biological control. Pesticides, Classification of fungicides. Mode of application. Biotechnological approaches of diseases management. IPR and related issues. IDM concepts and importance. Management of post- harvest diseases. IDM module for important post-harvest diseases.

Practical

Study of post-harvest disease symptoms caused by fungi, bacteria, virus, nematodes etc. Diagnosis and detection of various post-harvest diseases. Methods of detection and identification of seed-borne pathogens, isolation of biocontrol agents, Testing the efficacy of biocontrol agents by dual culture technique. Mass multiplication and methods of application of bio agents, Study of fungicides, bactericides, nematicides and their formulations. Study of pesticide compatibility and their safe-use. Study of plant protection equipments. Bioassay of fungicides, Seed treatment techniques for the control of seed-borne diseases. Biocontrol of post-harvest diseases. Study of seed packaging and storage techniques. Visit to vegetable and fruit markets, bio-pesticide/ pesticide firms. Visit to processing warehouse and testing laboratories.

Suggested Readings

1. Butani, D.K. 1984. Insects and fruits. Periodical Expert Book Agency, New Delhi.
2. Jonathan, E.I., Cannayane, I., Devrajan, K., Kumar, S. and Ramakrishan, S. Agricultural nematology. TNAU, Coimbatore.
3. Metcalf, R.L. and Luckman, W.H. 1982. Introduction to insect pest management. Wiley Inter Science Publishing, New York.
4. Nair, M.R.G.K. 1975. Insects and mites of crops in India. ICAR, New Delhi.
5. Swaroop, Gopal and Das, Gupta. 1986. Plant parasitic nematodes of India: Problems and progress. ICAR, New Delhi.
6. Upadhyay, K.D. and Dwivedi, K. 1997. A textbook of plant nematology. Aman publishing house, Meerut
7. Vasanth Raju David, B. 2001. Elements of economic entomology. Popular Book Depot, Chennai.

PL PATH 102	FUNDAMENTALS OF PLANT PATHOLOGY	3 (2+1)	SEM II

Objectives

1. To get acquainted with the role of different microorganisms in the development of plant disease
2. To get general concepts and classification of plant diseases
3. To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases
5. To get acquainted with various plant disease management principles and practices

Theory

Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology, History of Plant Pathology with special references to India; Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle; Fungi and their morphology, reproduction and classification of fungi;

Bacteria: Morphology, reproduction classification of phytopathogenic bacteria; Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission; Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

Practical

Study of the microscope; Acquaintance with laboratory material and equipment; Study of different plant disease symptoms; Microscopic examination of general structure of fungi; Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria; Microscopic examination of fungal diseased specimen; Microscopic examination of bacterial diseased specimen; Preparation of culture media; Isolation of plant pathogens: Fungi, bacteria and viruses; Purification of plant pathogens; Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides.

Suggested Readings

1. Agrios, G.N. 2010. Plant Pathology. Acad. Press.
2. Alexopoulos, Mims and Blackwel. Introductory Mycology.
3. Dhingra, O.D. and Sinclair, J.B. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
4. Gibbs, A. and Harrison, B. 1976. Plant Virology - The Principles. Edward Arnold, London
5. Goto, M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.
6. Hull R. 2002. Mathew's Plant Virology. 4th edn. Academic Press, New York.
7. Kamat, M. N. Introductory Plant Pathology. Prakash Pub, Jaipur.
8. Mehrotra, R.S. and Aggarwal, A. 2007. Plant Pathology. 7th edn. Tata Mc Graw Hill Publ. Co. Ltd.
9. Nene, Y.L. and Thapliyal, P.N. 1993. Fungicides in Plant Disease Control. 3rd Ed. Oxford & IBH, New Delhi.
10. Pathak, V. N. Essentials of Plant Pathology. Prakash Pub., Jaipur
11. Rajeev, K. and Mukherjee, R.C. 1996. Role of Plant Quarantine in IPM. Aditya Books.
12. Rhower, G.G. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd edn. Vol. II. (Ed. David Pimental). CRC Press.
13. Singh R.S. 2008. Plant Diseases. 8th Ed. Oxford & IBH. Pub. Co.
14. Singh R.S. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.
15. Verma, J.P. 1998. The Bacteria. Malhotra Publ. House, New Delhi.
16. Vyas SC. 1993. Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.

PL PATH 301	DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT	3 (2+1)	SEM V

Objectives

1. To study the symptoms produced on the host
2. To know about the disease cycle of the pathogens during pathogenesis
3. To study the epidemiological factors responsible for disease development
4. To study the management techniques for curbing the major diseases of field and horticultural crops

Theory

Symptoms, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops: Field crops- Rice (blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira); Wheat (rusts, loose smut, Karnal bunt); Maize (banded leaf and sheath blight, southern and northern blight, downy mildew); Sorghum (smuts, grain mold, anthracnose); Bajra (downy mildew, ergot) and Finger millet (blast, leaf spot); Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic); Grams (Ascochyta blight, wilt, grey mold); Pea (downy mildew, powdery mildew, rust); Black gram and Green gram (web blight, Cercospora leaf spot, anthracnose, yellow mosaic); Sugarcane (red rot, smut, grassy shoot, ratoon stunting, PokahBoeng); Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm). Horticultural crops: Citrus (canker, gummosis) and Guava (wilt, anthracnose); Banana (sigatoka, Panama wilt, bacterial wilt, bunchy top); Papaya (foot rot, leaf curl, mosaic) and Pomegranate (bacterial blight); Apple (scab, powdery mildew, fire blight, crown gall) and Peach (leaf curl); Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry (leaf spot); Coconut (bud rot, Ganoderma wilt), Tea (blister blight) and Coffee (rust); Mango (anthracnose, malformation, bacterial blight, powdery mildew); Potato (early and late blight, black scurf, leaf roll, mosaic) and Tomato (damping off, wilt, early and late blight, leaf curl, mosaic); Brinjal (phomopsis blight and fruit rot, sclerotinia blight) and Chilli (anthracnose and fruit rot, wilt, leaf curl); Cucurbits (powdery and downy mildew, wilts) and Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic); Beans (anthracnose, bacterial blight) and Okra (yellow vein mosaic); Ginger (soft rot), Turmeric (leaf Spot) and Coriander (stem gall); Rose (dieback, powdery mildew, black leaf spot) and Marigold (botrytis blight, leaf spots).

Practical

To study the symptoms of different diseases of field and horticultural crops: Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice, downy mildew and powdery of cucurbits, rhizoctonia and Cercospora leaf spot of green gram / black

gram, Alternaria blight and downy mildew of mustard, early blight of late blight of potato and tomato, Phomopsis blight of brinjal, powdery mildew and rust of pea, stem gall of coriander, anthracnose and fruit rot of chilli, taphrina leaf spot of turmeric, red rot of sugarcane, acquaintance with fungicides, antibiotics and biopesticides and their use in management of diseases of horticultural crops. 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.

Suggested Readings

1. Integrated Plant Disease Management by R.C. Sharma
2. Plant Diseases by R.S. Singh
3. Plant Disease Management: Principles and Practices by Hriday Chaube
4. Plant Pathology by G.N. Agrios

PL PATH 010	MUSHROOM CULTIVATION	2 (0+2)	SEM I, II

Objectives

To develop mushroom cultivation skill for entrepreneurial activity

Practical

Mushrooms- an agri-business, nutritional and medicinal value of mushrooms and history of mushroom, Preparation of different culture media and pure culture of different mushrooms, Single spore culture and multi-spore culture. Preparation of mother spawn and preparation of commercial spawn. 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, Spawning methods; preparation of casing materials for button mushroom cultivation; maintenance of environment in mushroom house, Methods of harvesting and packaging of button mushroom, diseases /mould/insect pests and nematodes of button mushroom and their management. Substrate preparation for oyster mushroom cultivation, diseases /mould/insect pests and nematodes of oyster mushroom and their management picking methods and drying of mushrooms. Substrate preparation for milky mushroom cultivation, substrate preparation for paddy straw mushroom cultivation. Post-harvest handling for value addition including dehydration of mushrooms. Cultivation of shiitake mushroom, cultivation of paddy straw mushroom. 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. Visit to different farm houses of the state and DMR, Solan, H.P. Poisonous mushrooms, cultivation of specialty mushrooms. Recent advances in mushroom cultivation; machineries, tools, equipment's required for mushroom cultivation; information technology and mushroom cultivation as an entrepreneur.

Suggested Readings

1. Chadha KL & Sharma SR. 2001. Advances in Horticulture (Mushroom). Vol. XIII. Malhotra Publ. House. Chang ST & Hays WA. 1997. The Biology and Cultivation of Edible Mushrooms. Academic Press.
2. Chang ST & Miles PG. 2002. Edible Mushrooms and their Cultivation. CRC Press.
3. Dhar BL. 2005. Cultivation Technology of High Temperature Tolerant White Button Mushroom. DIPA, ICAR.
4. Kapur JN. 1989. Mushroom Cultivation. DIPA, ICAR.

PL PATH 401	APPLIED PLANT PATHOLOGY	4 (3+1)	SEM VII

Objectives

To get acquainted with pathogenesis in development of plant diseases, epidemiology, and various plant disease management principles and practices.

Theory

Concept of plant disease, importance of plant diseases. Pathogen, inoculum, inoculum potential, Survival & dissemination of inoculum. Penetration and infection process, symptoms development. Role of enzymes and toxins in plant pathogenesis. Factor affecting disease development. Methods of estimation of losses caused by diseases. Definition and concept of epidemiology, rate of epidemic development, types of epidemics, conditions for an epidemic development, elements of epidemics and their interaction, Structures and patterns of epidemics, Modelling system approaches and expert systems in plant pathology. Survey, surveillance and vigilance. Forecasting of plant diseases. Methods and principles of plant disease control with special reference to quarantine, cultural, chemical, biological, host resistance and integrated disease management. Role of biotechnology in disease management.

Practical

Acquaintance with lab equipments. Preparation of media, isolation, purification and pathogenicity, Test of fungal and bacterial pathogens, Studies on detailed systems of diseases and host pathogen interaction, Assessment of losses caused by various types of diseases

Suggested Readings

1. Singh, R.S. (1997). Introduction to Principles of Plant Pathology, Oxford & IBH Co., New Delhi.
2. Agrios, G.N. (1997). “Plant Pathology”, Acad. Press.
3. Teng, P.S. (1987). Crop Loss Assessment and Pest Management, APS Press..
4. Nene, Y.L. and Thapliyal, P.N. (1993). Fungicides in Plant Disease Control, Oxford & IBH Co., New Delhi.
5. Nagarajan, s. (1983). Plant Disease Epidemiology, Oxford & IBH co., New Delhi.

6. Chaube, H.S. & Singh, R. (2001). Introductory Plant Pathology, IBDH co., Lucknow.

PL PATH 402	BIOCONTROL AGENTS AND BIOPESTICIDES	4 (3+1)	SEM VII

Objectives

To get a concept of biological control and role of biopesticides in plant disease management.

Theory

History and Concept of biological control. Mechanism of biological control and Advantage and limitations of bioagents. Mycorrhizal association. Factor affecting biological control agents like physical environment, agroecosystem, operational and cultural practices in biological control of plant pathogens. pathogens and antagonists and their relationship. Various Methods of mass multiplication and application in the field. National and international agencies dealing with biological agents. Promising bioagents of plant pathogens and their mode of action and their compatibility with agro-chemicals. Application and monitoring of biological control in IDM, IPM and organic farming system. Biopesticides available in market.

Practical

Isolation of antagonists from soil., testing their efficacy by dual culture technique compatibility with other bio-pesticides, demonstration and mass multiplication of promising bio-control agents

Suggested Readings

1. Campbell, R. 1989. Biological control microbial plant pathogens.
2. Cook, R.J. and Baker, K.F. 1983. Nature and practice of biological control of plant pathogens
3. Mukerji, K.G., Tewari, J.P., Arora, D.K. and Saxena, G. 1992. Recent developments in bio-control of plant diseases.
4. Windels, C.E. and Lindow, S.E. 1985. Biological control on the phylloplane.
5. Shahid Ahmad and Udit Narain 2007. Eco friendly management of plant diseases.
6. Sampat Nehra 2005. Plant Diseases: Bio-control management.

SEED SCIENCE AND TECHNOLOGY

Course No.	Course Title	Credits	Semester
	Core Courses		
SST 102	Principles and Practice of Seed Science and Technology (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	II
SST 302	Fundamentals of Seed Science And Technology	2 (1+1)	VI
	Total Credits	**4 (2+2)**	
	Skill Enhancement Courses		
SST 011	Quality Seed Production Techniques	2 (0+2)	I, II
SST 012	Seed Testing and Quality Control	2 (0+2)	I, II
SST 103 (SEC)	Seed Production and Seed Testing (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	II
	Total Credits	**6 (0+6)**	
	Elective Course		
SST 401	Commercial Seed Production	4 (3+1)	VII
	Total Credits	**4 (3+1)**	
	Grand Total	**14 (5+9)**	

SST 102	PRINCIPLES AND PRACTICE OF SEED SCIENCE AND TECHNOLOGY (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM II

Objectives

1. To understand the principles of seed science, including seed development, physiology, and quality
2. To learn about seed processing, storage, and testing techniques used to maintain seed viability and vigour
3. To explore the role of seed technology in ensuring the availability of high-quality seeds for sustainable crop production
4. To develop skills to manage seed resources effectively, ensuring the successful establishment and productivity of crops

Theory

Introduction: Importance of improved seed in Indian Agriculture, quality seeds and its characteristics. History: Development of seed industry in India. Seed Program: Types of seed program, development of seed program, basic strategy for organizing seed production, different classes of seeds, generation system of seed multiplication, seed replacement rate (SRR), varietal replacement rate (VRR), agencies involved in seed program. Principles of seed production: Factors affecting genetic purity and varietal deterioration, methods / safeguards to maintain genetic purity during seed production, study of improved production practices for higher seed yield and quality. Economic principles: Study of SMR, importance of SMR, SMR in different crops. Hybrid seed

production: Requirements of hybrid seed production, methods of hybrid seed production and types of hybrids. Varietal and hybrid seed production (Foundation and Certified seed classes) in maize, rice, sorghum, bajra, sunflower, red gram, cotton, castor, chilli, tomato and okra. Varietal seed production in wheat, soybean, chickpea, black gram. Seed processing and packaging: Seed processing-its importance and methods seed packaging and seed branding. Seed testing: Seed testing procedures in different crops, minimum seed standards for certification. Seed storage, different types of storage conditions. Seed legislation: Seeds Act 1966, Seed Rules 1968, Seed (Control) order 1983, New policy on seed development 1988, PPVFRA 2001, Seeds Bill 2004, OECD Seed certification and its importance. Seed marketing: Seed demand forecasting, factor affecting seed marketing, seed supply systems, sale promotional activities for seed marketing, seed marketing organizational structures. International seed trade, developing seed entrepreneurship. Importance of account keeping in seed business. Cost estimation and pricing of seed.

Practical

Identification of seeds of field and horticultural crops, study of seed structure in monocot and dicot seeds. Study of floral biology of important self, cross and often cross pollinated agriculture and horticulture crops. Working of SRR, VRR and SMR Types of isolation, determination of isolation distance, requirements, study of isolation requirements in different crops for foundation and certified seeds. Study of hand emasculation, hand pollination and detasseling techniques. Study of distinguishing morphological characters in varieties and parents of hybrids. Study of synchronization techniques for hybrid seed production, planting ratio. Supplementary pollination techniques, border rows for hybrids seed production. Study of seed cleaning and grading technique, and equipment. Seed packing and seed treatment techniques. Practicing seed testing in different crops seeds. Vigour tests in different crop seed lots. Studying of safe seed storage techniques. Working out cost of seed production, seed pricing. Account keeping books. Visit to seed production plots of public and private sector companies. Visit to seed production organization to understand account keeping and working of seed prices in seed business.

Suggested Readings

1. Agarwal, P.K. and M., Dadlani, 1987, Techniques in Seed Science and Technology. South Asian Publishers, New Delhi.
2. Agarwal, V.K., 2003, Seed Health. International Book Distributing Co.
3. Agrawal, R.L., 1996, Seed Technology. Oxford and IBH Publicity Company, New Delhi.
4. Bhale, M.S., 2013, A Handbook of Seed Certification. Vardhman Books and Periodicals.
5. Joshi, A.K. and Singh, B.D., 2003. Seed Science and Technology. Kalyani Publishers. Ludhiana.
6. Khare, D.P., 1994. Stored Grain Pests and their Management. Kalyani Publishers. Ludhiana.
7. Kulkarni, G.N., 2002, Principles of Seed Technology. Kalyani Publishers. Ludhiana.

8. Nema, N.P., 1986, Principles of Seed Certification and Seed Testing. Pub. Allied Publishers Private limited, New Delhi.
9. Paul, Neergaard, 1977, Seed Pathology, Vol. - I and II. McMillan Press, London.
10. Sen, Subip and Ghosh, Nabinanda, 2002. Seed Science and Technology. Kalyani Publishers. Ludhiana.
11. Singhal, N.C., 2002. Hybrid Seed Production. Kalyani Publishers, Ludhiana.
12. Tunwar, N.S. and Singh, S.V., 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, New Delhi.

SST 302	FUNDAMENTALS OF SEED SCIENCE AND TECHNOLOGY	2 (1+1)	SEM VI

Objectives

1. To impart basic and fundamental knowledge on principles and practices seed science and technology
2. To impart practical skills on scientific seed production and post-harvest quality management

Theory

Introduction to seed technology, definition and importance; Seed quality -definition, characters of good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity, different classes of seed. Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures; post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage. Seed Certification and legislation; Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques.

Practical

Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test, Field inspection, Seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

Suggested Readings

1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. 2014. Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ

5. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. Bhuker Axay, Amit Kumar and Sonia Singh. 2023. Compendious Seed Technology. Kalyani Publishers. Pp. 553, ISBN No. 978935540481.

SST 011	QUALITY SEED PRODUCTION TECHNIQUES	2 (0+2)	SEM I, II

Objectives

1. To develop skills in the identification of crop seeds, objectionable weed seeds, crop varieties/hybrids, and different classes of seed.
2. To impart knowledge on planning and executing seed production practices, including area selection, land and isolation requirements, seed treatment, rouging, hybrid seed production, and seed multiplication systems for field and vegetable crops.
3. To provide understanding and practical exposure to seed certification procedures, seed processing steps and safe storage techniques.

Practical

Identification of crop and objectionable weed seeds, Selection of suitable area for quality seed production, Identification of crop varieties/hybrids-morphological characters, Identification of different classes of seed, Planning for seed production and generation system of seed multiplication, Determination of land requirement and isolation distance for field crops, Seed treatment methods, Seed production techniques of field and vegetable crops, Seed production techniques of cross-pollinated crops, Hybrid seed production in field crops, Hybrid seed production in vegetable crops, Roguing in seed production plots, Procedure for seed certification**,** Field inspection at various stages of seed production, Steps in seed processing and visit to seed processing, Safe seed storage including fumigation technique, Visit to seed production field

Suggested Readings

1. Bhuker Axay, Amit Kumar and Sonia Singh. 2023. Compendious Seed Technology. Kalyani Publishers. Pp. 553, ISBN No. 978935540481.
2. Singhal, N. C. 2003. Hybrid Seed Production in Field Crops. Kalyani Publications, New Delhi.
3. Agrawal, R.L. 2019. Seed Technology. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
4. Neema, N.P. 1986. Principles of Seed Certification and Testing. Allied Publishers, New Delhi
5. Indian Minimum Seed Certification Standards. 2013. Published by Central Seed Certification Board Department of Agriculture & Co-operation Ministry of Agriculture Government of India New Delhi

SST 012	SEED TESTING AND QUALITY CONTROL	2 (0+2)	SEM I, II

Objectives

1. To develop competency in the identification and handling of seed testing equipment, seed structures, sampling procedures, and basic seed testing techniques including physical purity, moisture content, and germination analysis.
2. To provide knowledge and skills in advanced seed quality assessment methods, including vigour testing, viability tests (Tz test), seed dormancy breaking, varietal identification, genetic purity analysis, and testing of coated and pelleted seeds.
3. To train students in seed health testing

Practical

Identification and handling of seed testing equipment's, Identification of seed and seedling structures of monocots and dicots, Sampling procedure in seed stores, Sampling procedures in seed testing laboratory, Procedure for physical purity analysis, Moisture determination in various field and vegetable crops, Germination testing methods field and vegetable crops, Quick viability testing (Tz test) in field crops, Vigour testing in different crops by various tests, Seed dormancy and its breaking methods, Varietal identification by laboratory techniques, Genetic purity analysis by grow-out test, Testing of coated and pelleted seeds, Prediction of relative storability by accelerated ageing technique in different crops, Detection and identification of seed-borne pathogens; detection of damage and identification of storage insects-pests of various field crops.

Suggested Readings

1. ISTA. (2019). Informational rules for seed testing. International Seed Testing Association. Zurich. Switzerland.
2. Bhuker Axay, Amit Kumar and Sonia Singh. 2023. Compendious Seed Technology. Kalyani Publishers. Pp. 553, ISBN No. 978935540481.
3. Renugadevi, J, Srimathi, P., Renganayaki, P. R. and Manonmani, V. 2012. A Handbook of Seed Testing. Agrobios, Jodhpur, Rajasthan.
4. Agrawal, R.L. 2019. Seed Technology. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
5. Handbook of seed testing Published by ICAR.

SST 103 (SEC)	SEED PRODUCTION AND SEED TESTING (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	SEM II

Objectives

1. To understand the principles and techniques of seed production for various crops
2. To learn about seed testing methods to ensure seed quality and viability
3. To explore the regulations and standards governing seed production and testing
4. To develop skills to manage seed production processes effectively, from planting to harvesting and testing, to ensure the availability of high-quality seeds for farmers

Practical

Book keeping of records and accounts of Seed Production. Assessment of market demand and selection of varieties/ hybrids including their parents of the chosen crops grown in the region. Acquaintance of seed classes, seed sources, labels, purchase norms, field and seed standards, quality tests required under certification scheme. Planning and layout of seed production plot under field conditions. Application and amplication of land and isolation requirements as per certification standards. Preparation of land and application of manures and fertilizers, etc. Preparation and raising of nursery beds/seedling raising in polythene bags, etc. Acquaintance of different methods of sowing / transplanting - use of pre-sowing seed treatments-growth regulators/chemicals / rhizobium /other microbial inoculants, etc. Application of planting ratios and border rows and marking of parental rows, Block method of planting in hybrid seed production plot. Application of staggered sowings and manipulation of fertilizers/ growth regulators/micronutrients, etc. on synchrony of parental flowering in hybrid seed production. Application of cultural and nutrient managements for control of physiological shredding of floral buds/fruits/ pods, etc. Timely management of after care operations at various growth stages. Diagnostic identification and management of pest and disease attacks at various growth stages. Diagnostic identification and characterization of A, B, R lines in hybrids of different crops viz. sorghum / sunflower / bajra / red gram / okra / chilli, etc. and their maintenance. Carrying out detasseling operation in maize hybrid seed production. Carrying out hand emasculation and hand pollination operations in hybrid seed production of cotton /tomato /brinjal /chilli /okra, etc. Application of supplementary pollination methods at flowering time to enhance hybrid seed setting and yield, Provision of honey bee colonies, etc. in sunflower, etc.-Observations on seed setting on female parental line. Acquaintance and application of roguing index based on diagnostic morphological characters at pre- and post-harvest stages. Acquaintance of different methods of conducting field inspections by taking field counts to conform to prescribed field standards at different growth stages. Acquaintance of manual apical bud pinching in okra - nipping of vegetative branches of female plants after crossing period in cotton, etc. Determination of physiological maturity and application of different methods of harvesting/ picking in varietal and hybrid seed production. Acquaintance of manual method of sorting and grading in cobs /pods /fruits, etc as per minimum certification standards and procedures. Acquaintance of different methods of shelling /seed ginning / seed extraction and recovery, etc. Management of different methods of threshing/ drying/ processing/ treating/ packaging/ labeling/ sealing/ storing, etc., as per minimum certification standards and procedures. Acquaintance of working designs of threshers, cleaners, driers, processing and packaging machineries, etc. Management of storage pests by different seed treatment methods – fungicides/ insecticides/ botanicals, etc.

Management of seed store sanitation. Visit to farmer’s seed production plots undertaken by NSC /KSSC / Private Sector Seed Companies/ UAS Seed Unit, etc. Visit to UAS Seed plots /ARS Farms / Crop schemes/ Poly houses/ High tech Hort., etc. Visit to GOT farms of KSSC /KSSCA/ Seed Unit, etc. Visit to NSC

/KSSC/KSSCA/ Seed Dealer, etc. Visit to Seed Processing Units/ Seed Testing Laboratory /Seed ware houses/ Cold storage units, etc.

Estimation of cost and returns/ Economics of Seed Production /cost benefit ratio. Estimation of Investment Capital requirements and operational costs. Preparation of Balance Sheet Income and Cash flow statements. Market Survey for estimation of demand and sources of supply. Identification of market channels and the estimation marketing costs and margins. Report writing and submission, Examination.

Suggested Readings

1. Agarwal, P.K. and M. Dadlani, 1987, Techniques in Seed Science and Technology, South Asian Publishers, New Delhi.
2. Agrawal, R.L., 1996, Seed Technology, Oxford and IBH Publicity Company, New Delhi.
3. Agarwal, V.K., 2003, Seed Health, International Book Distributing Co.
4. Bhale, M.S., 2013, A handbook of Seed Certification, Vardhman Books and Periodicals.
5. Joshi, A.K. and Singh, B.D., 2003, Seed Science and Technology, Kalyani Publishers, Ludhiana.
6. Khare, D.P., 1994, Stored Grain Pests and their Management, Kalyani Publishers, Ludhiana.
7. Kulkarni, G.N., 2002, Principles of Seed Technology, Kalyani Publishers, Ludhiana.
8. Nema, N.P., 1986, Principles of Seed Certification and Seed Testing, Allied Publishers Private limited, New Delhi.
9. Paul Neergaard, 1977, Seed Pathology, Vol.-I and II, McMillan Press, London.
10. Sen Subip and Ghosh Nabinanda, 2002, Seed Science and Technology, Kalyani Publishers, Ludhiana.
11. Singhal, N.C., 2002, Hybrid Seed Production, Kalyani Publishers, Ludhiana.
12. Tunwar, N.S., and Singh, S.V., 1988, Indian Minimum Seed Certification Standards. Central Seed Certification Board, New Delhi.

SST 401	COMMERCIAL SEED PRODUCTION	4 (3+1)	SEM VII

Objectives

1. To introduce the basic principles of planting material production at commercial scale and seed quality evaluation.

Theory

General Principles of Seed Production: Raising the seed crop, Introduction, Procurement of a class of Improved seeds, reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement of seed production of field crops, Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixis, male sterility and self-incompatibility and its application

in hybrid seed production of horticultural crops General Principles of Seed Processing: Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling General Principles of Seed Testing: Seed testing-Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling, Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis Seed Certification: History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field and seed standards Seed Industry and Seed Marketing: Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labeling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and /packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand Biotechnology in Seed Technology: History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micro-propagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.

Practical

Planning of Seed Production, requirements for different classes of seeds in field crops - unit area and rate Operation and handling of mechanical drying equipments; effect of drying temperature and duration on seed germination and storability seed processing equipments; seed treating equipments Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc., Visit to seed processing plant and

commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurships visit to nearby areas, Different methods of examination of seeds to assess seed-borne microorganisms and to quantify infection percentage, detection of seed borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micropropagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation

Suggested Readings

1. Agarwal RL. 1997. Seed Technology. 2nd Ed. Oxford & IBH.
2. McDonald MB Jr & Copeland LO. 1997. Seed Production: Principles and Practices. Chapman & Hall
3. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani.
5. Justice OL & Bass LN. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
6. Tunwar NS & Singh SN. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. Chawla H.S. (2008) Introduction to Plant Biotechnology second edition, Oxford &IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049
8. Bhuker Axay, Amit Kumar and Sonia Singh. 2023. Compendious Seed Technology. Kalyani Publishers. Pp. 553, ISBN No. 978935540481.

SOIL SCIENCE

Course No.	Course Title	Credits	Semester
	Core Courses		
SOILS 101	Fundamentals of Soil Science	3 (2+1)	I
SOILS 102 (VAC)	Environmental Studies and Disaster Management (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech (Agricultural Engineering) and B.Tech Biotechnology; To be taught jointly by Dept. of Soil Science, Agricultural Meteorology, Forestry and Microbiology)	3 (2+1)	II
SOILS 104	Soil Fertility Management	3 (2+1)	II
SOILS 201	Soil and Water Management (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	III
SOILS 202	Problematic Soils and their Management	2 (1+1)	IV
	Total Credits	**13 (8+5)**	
	Skill Enhancement Course		
SOILS 013	Soil and Water Testing Services	2 (0+2)	I, II
	Total Credits	**2 (0+2)**	
	Elective Courses		
SOILS 401	Soil Mineralogy, Genesis, Classification and Survey	4 (3+1)	VII
SOILS 402	Soil Management	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**23 (14+9)**	

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

Objectives

To impart knowledge on soil genesis, basic soil properties with respect to plant growth

Theory

Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity), Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils, Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

Practical

Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil

profile, collection and processing of soil for analysis, study of soil texture-feel method, mechanical analysis, determination particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants field capacity; water holding capacity. Study of infiltration rate of soil, determination of pH and Electrical conductivity of soil.

Suggested Readings

1. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers
2. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
3. Soil Fertility and Fertilizers – By Samual L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The Nature and Properties of Soils – By Harry O. Buckman and Nyle C.
5. Soil Science an Introduction 2015. Indian Society of Soil Science. New Delhi.
6. Tisdale S L Nelson W L and Beaton J D 1985. Soil Fertility and Fertilizers 4th Edition. Mac Millan Publishing Company. New York.
7. Kanwar J S. Soil Fertility-Theory and Practice ICAR. New Delhi.
8. Brady N C. Nature and Properties of Soils 10th Edition 1999.
9. Aggarwal J P Yawalkar K S and Bokde S. Manures and Fertilizers 11th Edition 2011. Agri

SOILS 102 (VAC)	**ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech (Agricultural Engineering) and B.Tech Biotechnology; To be taught jointly by Dept. of Soil Science, Agricultural Meteorology, Forestry and Microbiology)**	**3 (2+1)**	**SEM II**

Objectives

1. To expose and acquire knowledge on the environment
2. To gain the state-of-the-art–skill and expertise on management of disasters

Theory

Introduction to Environment - Environmental studies: Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of eco-system. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: 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. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster management: Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Practical

Visit to a local area to document environmental assets river/forest/grassland/hill/ mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster.

Suggested Readings

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp
2. Dhar Chakrabarti, P.G. 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi

4. Parthiban, K.T. Vennila, Prasanthrajan, S., Umesh, M. and Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India. (In Press).
5. Prasanthrajan M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002. First Edition: 2008
6. Prasanthrajan M. 2018. Objective environmental studies and disaster management. ISBN 9789387893825. Scientific publishers, Jodhpur, India. Pp. 146.
7. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerut, India
8. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA

SOILS 104	SOIL FERTILITY MANAGEMENT	3 (2+1)	SEM II

Objectives

To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management

Theory

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 macro 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. Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches.

Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

Practical

Introduction of analytical instruments and their principles, calibration and applications of Coloremetry and flame photometry; Estimation of alkaline hydrolysable N in soils; Estimation of soil extractable P in soils; Estimation of exchangeable K in soils; Estimation of exchangeable Ca and Mg in soils; Estimation of soil extractable S in soils; Estimation of DTPA extractable Zn in soils; Estimation of N in plants; Estimation of P in plants; Estimation of K in plants; Estimation of S in plants.

Suggested Readings

1. Introductory Soil Science by Dilip Kumar Das, Kalyani Publishers
2. Soil Fertility and Nutrient Management by S. S. Singh, Kalyani Publishers
3. Soil Fertility and Fertilizers by Samual L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils by Harry O. Buckman and Nyle C.
5. Soil Science an Introduction 2015. Indian Society of Soil Science. New Delhi.
6. Tisdale S L Nelson W L and Beaton J D 1985. Soil Fertility and Fertilizers 4th Edition. Mac Millan Publishing Company. New York.
7. Kanwar J S. Soil Fertility-Theory and Practice ICAR. New Delhi.
8. Brady N C. Nature and Properties of Soils 10th Edition 1999.
9. Aggarwal J P Yawalkar K S and Bokde S. Manures and Fertilizers 11th Edition 2011. Agri

SOILS 201	SOIL AND WATER MANAGEMENT (For B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM III

Objectives

1. Understand the principles of soil and water management in agriculture
2. Develop skills to sustainably manage soil and water resources to enhance agricultural productivity and environmental sustainability

Theory

Concept of soil, meaning and definition; soil components and important soil physical (soil texture, structure density, porosity, soil water; soil air, soil temperature and soil colour) and chemical (pH, EC, CEC and base saturation) properties in brief, Organic matter, Land capability classification and suitability. Soils of India and respective state, Soil quality and soil health, Distribution of waste land/degraded lands and problem soils in India, problems associated and management of salt affected soils, calcareous soils, acid soils, acid sulphate soils, eroded and compacted soils, flooded/ water logged soils, physically constrained soils, polluted soils. Alternate land use strategies for management of problematic soils including bioremediation/ phytoremidation. Irrigation water- quality and standards, utilization of poor quality water in agriculture.

Practical

Soil sample collection and it's preparation for analysis. Determination of soil colour, density, porosity and moisture content. Determination of soil texture by feel method. Determination of infiltration rate. Determination of aggregate stability. Determination of soil reaction (pH) and total soluble salts content (EC) in soil. Determination of organic matter in soil. Determination of lime requirement of acid soils. Determination of water soluble cations. Determination of water soluble anions. Determination of exchangeable cations (Ca, Mg, Na and K) and computation of ESP. Determination of gypsum requirement of sodic soils. Determination of quality of irrigation water (pH, EC, SAR, RSC, boron, chlorides etc.)

Suggested Readings

1. Brady Nyle C and Ray R Well, 2014. Nature and Properties of Soils. Pearson Education Inc., New Delhi.
2. Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.
3. Thiyageshwari, S., M.V. Sriramachandrasekharan and D. Selvi., 2015. Fundamentals of Soil Inventory, Problem Soils and Irrigation water. Jaya Publishing House, New Delhi (ISBN: 978- 9384337-438).

SOILS 202	PROBLEMATIC SOILS AND THEIR MANAGEMENT	2 (1+1)	SEM IV

Objectives

1. To acquaint the students about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification
2. To give hands on training about estimation of various soil and water quality parameters associated with problem soils.

Theory

Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Waterlogged soils, Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

Practical

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water ((pH, EC, Ca^{2+}, Mg^{2+}, Na^{+}, CO_3^{2-} , HCO_3^{2-} , Cl^{-}, SAR and RSC), Determination of nitrate (NO_3^{-}) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Suggested Readings

1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, AGROBIOS (India).
2. Brady Nyle C and Ray R Well., 2014. Nature and properties of soils. Pearson Education Inc., New D Delhi.

3. Cirsan J. Paul., 1985. Principles of Remote Sensing. Longman, New York
4. Indian Society of Soil Science., 2002. Fundamentals of Soil Science. IARI, New Delhi.
5. Osman, Khan Towhid., 2018., Management of Soil Problems. Springer publication
6. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi
7. Bhatta B. 2011. Remote sensing and GIS, 2nd edn. Oxford University Press, New Delhi
8. USDA Handbook No. 60. (1954). Diagnosis and Improvement of Saline and Alkali Soils. Oxford & IBH.

SOILS 013	SOIL AND WATER TESTING SERVICES	2 (0+2)	SEM I, II

Objectives

1. To improve the awareness and skills of the students in modern techniques of analysis of soil, water along with the commonly used instruments-their principles and working
2. To develop a basic comprehension regarding soil testing, preparations of common analytical reagents for qualitative and quantitative analysis of soil and water

Practical

Basic concepts of chemical analysis, principles of pH meter, EC meter, spectrophotometer, flame photometer and atomic absorption spectrophotometer, Preparation and standardization of solutions and reagents, sampling of soil, collection and preparation of soil samples, Study of soil sampling tools, collection of representative soil sample, its processing and storage, Determination of bulk density of a given soil sample, Determination of particle density of a given soil sample, Determination of soil texture by feel method and study of different textural classes and mass volume relationship of soil, Determination of moisture content of a given soil sample, Determination of available nitrogen in soil samples, Determination of available phosphorus in soil samples, Determination of available potassium in soil samples, Determination of available sulphur in soil samples 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 Collection of water samples, quality criteria, classification and suitability of irrigation water, and water quality index; Determination of pH and EC of irrigation water, Determination of cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) in irrigation water, Determination of anions (NO_3^{-}, CO_3^{2-}, HCO_3^{-}, Cl^{-}, SO_4^{2-}) in irrigation water, computation of SAR and RSC of irrigation water.

Suggested Readings

1. Hesse P. 971. *Textbook of Soil Chemical Analysis*. William Clowes & Sons.
2. Jackson ML. 1967. *Soil Chemical Analysis*. Prentice Hall of India.
3. Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.

4. Kenneth Helrich 1990. *Official Methods of Analysis*. Association of Official Analytical Chemists.
5. Page AL, Miller RH & Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.
6. Bear FE. 1964. *Chemistry of the Soil*. Oxford & IBH.
7. Jurinak JJ. 1978. *Salt-affected Soils*. Department of Soil Science & Biometeorology. Utah State Univ.
8. USDA Handbook No. 60. 1954. *Diagnosis and improvement of Saline and Alkali Soils*. Oxford & IBH.
9. Antil, R.S., Singh, A. and Dahiya, S.S. 2002. Practical Manual for Soil and Plant Analysis. Department of Soil Science, CCS Haryana Agricultural University, Hisar – 125004

SOILS 401	SOIL MINERALOGY, GENESIS, CLASSIFICATION AND SURVEY	4 (3+1)	SEM VII

Objectives

1. To acquaint students with fundamental concept of soil genesis in terms of factors and processes of soil formation, soil taxonomy and to enable the students to conduct the soil survey and interpret soil survey reports in terms of land use planning
2. To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; GIS and applications in agriculture

Theory

Introduction to Pedology - historical development; Perspective on the origin and some fundamental concept of soil genesis, soil as a three dimensional component of the landscape; morphology of soils– soil horizons and their characterization; Soil properties–physical and chemical; Weathering and soil formation- geochemical, pedochemical weathering, stability indices and weathering sequences; pedogenic processes and soil forming actors; Soil classification- principles, historical development and soil taxonomy; land forms– evolution, soil relationships; Introduction to remote sensing and GIS, its application in soil survey, image processing and interpretation, fundamentals of aerial photographs, ground truth data, Global positioning system (GPS) and its components, concept of raster and vector data; land use planning: concept, techniques and factors governing present land use, land capability classification

Practical

Soil profile- morphological, physico-chemical characteristics and soil taxonomy; Introduction to software and data products, aerial photos and satellite imagery interpretation for soil mapping; field trip for ground truth using GPS to study landforms of Haryana and visual markings; supervised and unsupervised classification of digital image, map composition using Arc GIS.

Suggested Readings

1. Brady NC & Weil RR. 2002. The nature and properties of soils. 13th Ed Pearson Education.
2. Boul E.W, Hole ED, MacCraken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publications.
3. Grim RE.1968. Clay mineralogy. McGraw Hill.
4. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi.
5. Sehgal J. 2002. Introductory Pedology: Concepts and Applications. New Delhi
6. Sehgal J. 2002. Pedology- Concepts and Applications. Kalyani Publications.
7. USDA. 1999. Soil Taxonomy. Hand book No. 436. 2nd Ed. USDA NRCS, Washington.
8. Bhatta B. 2011. Remote sensing and GIS, 2nd edn. Oxford University Press, New Delhi
9. Lillesand TM & Kiefer RW. 1994. *Remote Sensing and Image Interpretation*. 3rd Ed. Wiley.
10. Star J & Esles J. 1990. *Geographic Information System: An Introduction*. Prentice Hall.
11. M. Anji Reddy 2012. *A Text Book of Remote sensing and Geographical information systems*. 3rd Ed.
12. Charles D., Ghilani, Paul R., Wolf, Elementary Surveying: An introduction to Geoinformatics 13th Edition 2011.

SOILS 402	SOIL MANAGEMENT	4 (3+1)	SEM VII

Objectives

1. To impart knowledge about the basic concepts of problematic soils and their management
2. To impart comprehensive knowledge of soil fertility, fertilizers and manures as sources of plant nutrients, and to understand the role of fertilizers and manures in sustaining soil fertility

Theory

Soil health and soil quality; soil properties used as indicators of soil quality, Soil as water reservoir and role in water cycle; soil erosion: types, effects, mechanism and control/management; origin and basic concept of problematic soils and factors responsible; characterization of salt-affected soils and their morphological features; management of salt- affected, acid and physically constrained soils; management principles for sandy, clayey, red lateritic and dry land soils; Multipurpose tree species (MPTs) and bio remediation through MPTs of soils, Essential plant nutrients- criteria of essentiality, functions for plant growth, mechanisms for movement and uptake of ions in soils and plants, Forms of nutrients in soils, deficiency symptoms on plants, luxury consumption, nutrient interactions and chelated micronutrients. Soil fertility, evaluation and management for plant growth, soil testing and fertilizer recommendations, Soil and water pollution- sources, brief idea about different pollutants in soils and their managements, Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic, secondary and

micronutrient fertilizers, mixed and complex fertilizers, Organic matter-decomposition, C:N ratios, mineralization and immobilization processes, humus, role of organic matter in soil quality.

Practical

Sampling of soil, collection and preparation of soil samples, determination of available NPKS and organic carbon, determination of micro nutrients (Zn, Cu, Mn, Fe) in soil samples, estimation of soil erodibility indices; identification of problematic soils by analyzing for pH, ECe, soluble cations (Na^+, K^+, Ca^{++} and Mg^{++}) and anions (Cl^-, SO_4^{--}, CO_3^{--} and HCO_3^-); lime requirements of acid soil; gypsum requirement of sodic soil; monitoring of soil salinity in the field; assessment of a soil for its quality in terms of physical, chemical and biological properties.

Suggested Readings

1. Abrol, I.P., Yadav, J.S.P and Massound, F.L. (1988). Salt affected Soil and their Management, FAO (UN).
2. Jurinak, J.J. (1978). Salt-affected Soils, Department of Soil Science & Biometeorology. Utah State University, US.
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. USDA Handbook No. 60. (1954). Diagnosis and Improvement of Saline and Alkali Soils. Oxford & IBH. Brady,
5. N.C. and Weil, R.R. (2002). The Nature and Properties of Soils 13th Edition. Prentice Hall of India, Pvt. Ltd. New Delhi.
6. Das, D.K. (2002). Introductory Soil Science, Kalyani Publisher, New Delhi.
7. 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.
8. Tisdale, S. L., Nelson, W. L., Beaton, J. D. and Havlin, J. L. (2002). Soil Fertility and Fertilizers, Prentice Hall of India, New Delhi.
9. Phogat, V.K. Sheoran, H.S. and Roohi (2020). Course Manual on “Problematic Soils and Their Management”, Department of Soil Science, CCS Haryana Agricultural University, Hisar- 125004. *University Publication Number: CCSHAU/PUB#20-0049*).

VEGETABLE SCIENCE

Course No.	Course Title	Credits	Semester
	Core Course		
VSC 201	Production Technology of Vegetables and Spices	2 (1+1)	III
	Total Credits	**2 (1+1)**	
	Skill Enhancement Course		
VSC 014	Nursery Management in Vegetable Crops	2 (0+2)	I, II
	Total Credits	**2 (0+2)**	
	Elective Courses		
VSC 401	Post Harvest Technology and Value Addition (To be taught jointly by Dept. of Horticulture and Vegetable Science)	4 (3+1)	VII
VSC 402	Commercial Vegetable Production	4 (3+1)	VII
	Total Credits	**8 (6+2)**	
	Grand Total	**12 (7+5)**	

VSC 201	PRODUCTION TECHNOLOGY OF VEGETABLES AND SPICES	2 (1+1)	SEM III

Objectives

1. To educate about the different forms of classification of vegetables
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices
3. To educate about the physiological disorders of vegetables and spices

Theory

Importance of vegetables and spices in human nutrition and national economy, kitchen gardening, brief about origin, area, production, climate, soil requirement, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, insect pests, disease of important vegetable and spices (tomato, okra, brinjal, chili, capsicum, cucumber, bitter gourd , bottle gourd, sweet potato, cassava and moringa, pumpkin, French bean, peas; cole crops such as cabbage, cauliflower, knol-khol; bulb crops such as onion, garlic; root crops such as carrot, radish, beetroot; tuber crops such as potato; leafy vegetables such as amaranth, palak, perennial vegetables, spice crops like turmeric, zinger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices).

Practical

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods - rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications.

Harvesting and post-harvest practices, Economics of vegetables and spices cultivation**,** visit to spice gardens.

Suggested Readings

1. Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur
2. Vegetable crops by J. Kabir, T.K. Bose, M.G. Som
3. Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka

VSC 014	NURSERY MANAGEMENT IN VEGETABLE CROPS	2 (0+2)	SEM I, II

Objectives

1. To develop skill in unemployed youth in nursery management of vegetable crops
2. To strengthen the capacity of youths for sustainable employment in the nursery raising of vegetable crops

Practical

1. Introduction about nursery and it's various types, selection of nursery site, planning and layout and it's management practices *etc.*
2. Demonstration of basic materials, growing media, fertilizers, plant growth regulators, Nursery tool and techniques required for raising of vegetable nursery *etc.*
3. Demonstration and hand on training of soil and media preparation for vegetable nursery, Soil treatments by various techniques including soil solarization, Nursery bed preparation, Plug tray nursery raising technique *etc.*
4. Demonstration of seed treatment practices before sowing of seeds in protrays or in nursery beds.
5. Demonstration of irrigation and related practices required for nursery raising of vegetable crops.
6. Demonstration of pest identification, preventive measures, biological controls, cultural practices *etc*.
7. Commercial nursery development of vegetables like Onion, cucumber, cabbage, cauliflower, chilli, tomato and brinjal *etc.*
8. Entrepreneurship, Agri- financing enterprises, Project Management & Marketing *etc.*
9. Case study on establishment and success of a vegetable nursery.
10. Visit to a commercial vegetable nursery.

Suggested Readings

1. Handbook for Skill Development: Nursery Management of Horticulture Crops by Navaldey Bharti Deepa H. Dwivedi, Satish Serial Publishing House.
2. Essentials of Plant Nursery Management, 2nd Edition by P.K. Ray, Scientific Publisher.
3. Textbook of Vegetables, Tuber crops and Spices by S & Narendra Singh Thamburaj, ICAR, New Delhi.

4. Textbook of Vegetable Crops by Prem Nath and K.R.M. Swamy, ICAR, New Delhi.
5. Vegetable Science and Technology by Pranab Hazra, NIPA Publication.
6. Vegetable Science by Som, M.G. and Hazra, P., Kalyani Publisher.
7. Principles & Practices of Plant Propagation and Nursery Management by C. Rajamanickam, A. Subbiah, J. Rajangam et al., Satish Serial Publishing House.
8. Nursery Management & Horticulture Crops by Deepa Lal, ABU Nayyer, J.K. Meena, D.C. Meena, International Books & Periodical Supply Service, 2024.
9. Vegetable Crops: 2nd Revised and Enlarged Edition by T.R. Gopalkrishanan & T. Pradeep Kumar.

VSC 401	**POST HARVEST TECHNOLOGY AND VALUE ADDITION (To be taught jointly by Dept. of Horticulture and Vegetable Science)**	**4 (3+1)**	**SEM VII**

Objectives

1. To educate about the different pre-harvest, harvest and post-harvest factors affecting the post-harvest life of fruits and vegetables
2. To educate about preparation techniques of value-added products
3. To educate about the different dehydration techniques of horticultural crops

Theory

Importance of post –harvest processing of fruits and vegetables, extent and possible causes of post-harvest losses: Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate; Harvesting and field handling ;Storage (ZECC, cold storage, CA, MA and hypobaric); Value addition concept; Principles and methods of preservation; Intermediate moisture food –Jam ,Jelly ,marmalade, Preserve, candy-Concepts and Standards; Fermented and non-fermented beverages. Tomato products-Concepts and Standards; Drying /Dehydration of fruits and vegetables –concept and methods, osmotic drying. Canning–Concepts and standards, packaging of products.

Practical

Applications of different types of packing, containers 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 candy and tomato products, canned products. Quality evaluation of products-Physicochemical and sensory. Visit to processing unit/industry.

Suggested Readings

1. Post harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal
2. Post-Harvest Technology by Suja Nabi Qureshi, Kounser Javeed and Abhay Kumar Sinha, 2018, Bioscientific Publishers.

3. Postharvest Technology of Horticultural Crops by K.P. Sudheer and V. Indira,2020, New India Publishing Agency,320p.
4. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann, 2014, Daya Publishing House.
5. Postharvest Management and Value Addition of Fruit and Vegetables by Kureel M.K., Biotech, 181p

VSC 402	COMMERCIAL VEGETABLE PRODUCTION	4 (3+1)	SEM VII

Objectives

To educate students on the scientific and commercial cultivation of important vegetable production

Theory

Kitchen gardening, nursery beds and seed beds and its types, Seed treatments, Importance of vegetables & spices in human nutrition and national economy, kitchen gardening, brief about origin, area, production, climate, soil , improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders, insect-pest and diseases of important vegetable and spices (Tomato, Brinjal, Chili, Capsicum, Cucumber, Melons, Gourds, Pumpkin ,French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-Khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak, Perennial vegetables; spice crops such as coriander, fenugreek etc.)

Practical

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 seedling sand 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 PGR sand 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 packing house operations of different vegetable crops

Suggested Readings

1. Textbook of Vegetables, Tuber crops and Spices by S & Narendra Singh Thamburaj, ICAR, New Delhi.
2. Textbook of Vegetable Crops by Prem Nath and K.R.M. Swamy, ICAR, New Delhi.
3. Vegetable Science and Technology by Pranab Hazra, NIPA Publication.
4. Vegetable Science by Som, M.G. and Hazra, P., Kalyani Publisher.
5. Vegetable Crops: 2nd Revised and Enlarged Edition by T.R. Gopalkrihanan & T. Pradeep Kumar.

ANIMAL SCIENCE

Course No.	Course Title	Credits	Semester
	Core Courses		
LPM 102	Livestock and Poultry Management (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	II
LPM 201	Livestock Production and Management (For B.Tech. Biotechnology)	3 (2+1)	III
	Total Credits	**5 (3+2)**	
	Skill Enhancement Courses		
LPM 015	Poultry Production Technology (For B.Sc. (Hons.) Agriculture)	2 (0+2)	I, II
LPM 104	Livestock Production and Management (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	II
	Total Credits	**4 (0+4)**	
	Grand Total	**9 (3+6)**	

LPM 102	LIVESTOCK AND POULTRY MANAGEMENT (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	2 (1+1)	SEM II

Objectives

1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated Farming System

Theory

Role of livestock and poultry in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding management. Management of growers and layers. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry productivity. Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives. Feeding system of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and 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. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types and category of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations, incubation and hatching equipment. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production

Suggested Readings

1. A Textbook of Animal Husbandry by G. C Banerjee
2. A text Book of Livestock Production management in Tropic by D. N. Verma

LPM 201	**LIVESTOCK PRODUCTION AND MANAGEMENT (For B.Tech. Biotechnology)**	**3 (2+1)**	**SEM III**

Objectives

To study the

1. History of livestock in India, animal husbandry and breeds of livestock
2. Management of livestock in terms of the housing system, health, and diseases
3. Economic importance of livestock

Theory

Livestock history in India: Vedic, medieval and modern era. Demographic distribution of livestock and role in the economy. Introductory animal husbandry. Breeds of livestock, cattle, buffalo, sheep, goat and pig. Important economic traits of livestock. General management and feeding practices of animals. Handling and restraining of animals. Housing systems. Importance of grasslands and fodders in livestock production. Common farm management practices including disinfection, isolation, quarantine and disposal of carcass. Common vices of animals and their prevention. Diseases, parasite control, and hygiene care.

History and economic importance of poultry. Poultry breeds. Reproductive system of male and female birds. Formation and structure of eggs. Important economic traits of poultry. Egg production, egg weight, egg quality. Fertility and hatchability, plumage characteristics and comb types. Care and management of chicks, growers, layers and broilers. Brooding management. Hatchery management practices. Poultry Diseases, control and hygiene care.

Practical

Visit to livestock farms/demonstration centres. Breeds of cattle, buffalo, sheep, goat and pigs. Familiarisation with the body parts of animals. Handling and restraining of cattle, buffalo, sheep, goat and swine. Male and female reproductive systems and artificial Insemination. Feeding of livestock. Methods of identification: marking, tattooing, branding, tagging. Milking methods. Record Keeping. Visit to the poultry farm, poultry breeds, body parts of chicken, duck, quail and turkey. Housing, equipment, nesting and brooding requirements. The male and female reproductive systems. Methods of

identification and sexing. Hatchery layout and equipment. Identification of diseases and control of parasites. Vaccination and maintenance of farm records.

Suggested Reading

1. Banerjee GC, 2020, A Textbook of Animal Husbandry, Oxford and IBH Publication.
2. Sastry NSR and Thomas CK, 2020, Dairy Bovine Production, Kalyani Publishers.
3. Thomas CK and Sastry NSR, 2020, Livestock Production Management, Kalyani Publishers.

LPM 015	**POULTRY PRODUCTION TECHNOLOGY (For B.Sc. (Hons.) Agriculture)**	**2 (0+2)**	**SEM I, II**

Objectives

1. Understand the principles of poultry production, including breed selection, nutrition, and housing
2. Learn about disease prevention, biosecurity measures and vaccination protocols in poultry farming
3. Explore efficient management practices to optimize growth, egg production and overall flock health
4. Develop skills to address challenges such as market fluctuations, welfare concerns and environmental sustainability in poultry production

Practical

Orientation. Rearing of backyard poultry chicks (local and improved). Setting and management of broiler poultry farm. Management of poultry for egg production (layers). Brooding and Management of Chicks; Setting up of brooder house, handling of chicks, vaccination. Feeding, Watering and lighting management. Management of Poultry birds; light management, vaccination, debeaking, feeding and watering. Egg collection and storage. Quality egg production. Factors affecting egg quality. Assessment of egg quality. Preparation of poultry feed. Factors affecting feed quality. Storage of feed ingredients. Record Maintenance. Management of farm equipment. Farm waste management; composting; vermicomposting; biogas production, Economic analysis of poultry production. Maintaining the register for income and expenditure on the animals allotted to work out the economics. First Aid and flock health management.

Suggested Readings

1. Forrest, J.C., Aberle E.D., Harlod B.H., Max D.J., Robert A.M. (1975). Principles of Meat Science, W.H. Freeman and Company, San Francisco.
2. Sharma B.D. (2005). Meat and Meat Production Technology (including poultry production technology). Jaypee Brothers Medical Publishers (Pvt.) Ltd., New Delhi.

LPM 104 (SEC)	LIVESTOCK PRODUCTION AND MANAGEMENT (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	SEM II

Objectives

1. To understand the principles of livestock production, including breeding, nutrition, and health management.
2. To learn about efficient management practices to optimize animal welfare, productivity, and profitability.
3. To explore sustainable livestock production systems to minimize environmental impact and ensure long-term viability.
4. To develop skills to address challenges such as disease control, feed management and breeding strategies in livestock farming.

Practical

Orientation. Maintenance of 10 dairy animals (5 cattle and 5 buffaloes). Routine management practices such as cleaning, grooming, colostrum feeding, deworming, vaccination schedule, dehorning/disbudding; methods of identification; dentition; selection and culling of livestock; Record maintenance; assisting during calving; care of pregnant animals. Clean Milk Production: Milking, Different milking methods, Machine milking, Milk packaging. Feeding management; Feeding of calves, heifers, lactating dairy cows and buffaloes, and bulls. Preparation of concentrate mixture, maintenance of equipment required for feed mixing; Feed ingredients; Fodder production: Preserving fodder: Silage preparation: Dry fodder enrichment; Azolla Production; Hydroponics; Feed additives. Use of different farm equipment and their maintenance, e.g., Chaff Cutter, milking machine. Identification of animals in heat and presenting for artificial insemination. Farm waste Management; composting; vermicomposting; biogas production. Sheep and Goat Rearing. Routine management practices for rearing of sheep and goat: cleaning of sheds, watering, feeding, preparation of feed supplements, Deworming, monitoring growth by measurements of regular body parts and weights. Laboratory analysis of milk for quality, feed and fodder samples. Economics of dairy and Sheep/goat farming. Maintaining the register for income and expenditure on the animals allotted to work out the economics. Health Management of Livestock; First Aid.

Suggested Readings

1. Banarjee, D.C., Textbook of Animal Husbandry. Kalyani Publishers, New Delhi.
2. De, Sukumar, Outline of Dairy Technology. Kalyani Publishers, New Delhi.
3. ICAR. Handbook of Animal Husbandry. ICAR.
4. Jadhav N.V. and Siddiqui M.F. Handbook of Poultry Production and Management. Kalyani Publishers, New Delhi.
5. Prasad Jagadish, Animal Husbandry and Dairy Science. Kalyani Publishers, New Delhi.
6. Prasad Jagadish, Poultry and Rabbit Production. Kalyani Publishers, New Delhi.

7. Prasad Jagadish, Sheep, Goat and Swine Production. Kalyani Publishers, New Delhi.
8. Prasad, Jagadish, Principles and Practices of Dairy Farm Management. Kalyani Publishers, New Delhi.
9. Sastry, N.S.R. and Thomas, C.K., Livestock Production Management. Kalyani Publishers, New Delhi.
10. Shreenivashaiah P.V., Scientific Poultry Production. IBH

B.SC. (HONS.) AGRIBUSINESS MANAGEMENT, 4-YEAR PROGRAMME

COURSES: SEMESTER-WISE

Course No.	Course Title	Credits
I Semester		
AGRI 100	*Deeksharambh* (Induction cum Foundation course of 2 week)	2 (0+2) NG
ABM 101	Introduction to Agribusiness Management	2 (2+0)
AG ECON 101	Fundamentals of Agricultural Economics	2 (2+0)
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)
AGRON 107	Introduction to Agronomy and Crop Production Technology	2 (1+1)
ENT 101	Management of Insect Pest of Crops and Stored Grains	2 (1+1)
PL PATH 101	Management of Plant Disease	2 (1+1)
COMP 101(SEC)	Computer Applications in Agriculture	2 (0+2)
MICRO 101 (SEC)	Production Technology for Bio-agents and Bio-Fertilizers	2 (0+2)
ENG 101 (AEC)	Communication Skills	2 (1+1)
MATH 101/ BIO 101	Introductory Mathematics/ Introductory Biology (Need Based)	1 (1+0) NG
NCC I / NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)
TUT	Tutorial	1 (1+0) NG
	Total Credits	**21 (10+11)**
II Semester		
ABM 104	Marketing of Agricultural Inputs and Outputs	2 (1+1)
ABM 106	Agricultural Finance and Insurance	2 (1+1)
AG ECON 102	Farm Management, Production and Resource Economics	3 (2+1)
EXT 102 (AEC)	Personality Development	2 (1+1)
GPB 104	Introduction to Genetics and Plant Breeding	2 (1+1)
LPM 102	Livestock and Poultry Management	2 (1+1)
SOILS 102 (VAC)	Environmental Studies and Disaster Management	3 (2+1)
SST 102	Principles and Practice of Seed Science and Technology	2 (1+1)
SST 103 (SEC)	Seed Production and Seed Testing	2 (0+2)
LPM 104 (SEC)	Livestock Production and Management	2 (0+2)
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)
CCA 102	Co-curricular Activity	1 (0+1) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**24 (10+14)**
AGRI 200	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (10 weeks) Compulsory for students opting for an exit with UG-Certificate after 1st Year	10 (0+10)

III Semester		
ABM 201	Food Business Management	2 (2+0)
ABM 203	Introduction to Accountancy	3 (2+1)
ABM 205	Value Chain and Retail Management in Agribusiness	2 (1+1)
HORT 201	General Horticulture	2 (1+1)
PFE 203/ SWE 203/ABM 209	Protected Cultivation and Secondary Agriculture	2 (1+1)
SOILS 201	Soil and Water Management	2 (1+1)
LPM 015 (SEC)	Poultry Production Technology	2 (0+2)
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)
NCC III/ NSS III	National Cadet Corps III/ National Service Scheme III	2 (0+2) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**20 (10+10)**
IV Semester		
ABM 202	Agricultural Marketing Regulations	3 (2+1)
ABM 204	Business Laws and Ethics	2 (2+0)
ABM 206	Principles and Management of Organizational Behaviour	2 (1+1)
ABM 207 (SEC)	Development of Agribusiness Proposals	2 (0+2)
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)
AG ECON 206	International Trade and Policy in Agriculture	2 (2+0)
FMPE 204	Farm Machinery and Power	2 (1+1)
HORT 204	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)
CCA 202	Co-curricular Activity	1 (0+1) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**18 (11+7)**
AGRI 300	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (10 weeks) Compulsory for students opting for an exit with UG-Diploma after 2nd Year	10 (0+10)
V Semester		
ABM 301	Market Information and Intelligence	3 (2+1)
ABM 303	Capital and Commodity Market	2 (1+1)
ABM 305	Applied Business Statistics	2 (1+1)
ABM 307	Business Research Methods	3 (2+1)
ABM 309	Cooperatives and Producers Organization	3 (2+1)
ABM 311	Social Entrepreneurship	1 (1+0)

AG ECON 301 (MDC)	Agricultural Marketing and Trade	3 (2+1)
AG ECON 303	Introduction to Managerial Economics	3 (2+1)
AGRON 303	Sustainable Farming System and Precision Agriculture	2 (1+1)
AGRI 351	Educational Tour	2 (0+2) NG
NCC IV / NSS IV (AEC)	National Cadet Corps IV/ National Service Scheme IV	2 (0+2) NG
TUT	Tutorial	1 (1+0) NG
	Total Credits	**22 (14+8)**
VI Semester		
ABM 302	Marketing Management	3 (3+0)
ABM 304	Corporate Social Responsibility and Managerial Ethics	3 (2+1)
ABM 306	Rural Marketing	3 (2+1)
ABM 308	Agribusiness Project Management	3 (2+1)
ABM 310	Strategic Business Management	3 (2+1)
ABM 312	Commodity Future Trading	2 (2+0)
AG ECON 304	Grading Standardization and Quality Management in Agri-food Products	2 (1+1)
ABT 304	Fundamentals of Agri Biotechnology	3 (2+1)
TUT	Tutorial	1 (1+0) NG
	Total Credits	**22 (16+6)**
VII Semester		
Elective Courses: A student has to get register five Elective Courses (Major or Minor) each of 4 (3+1) credits *		20 (15+5)
	Total Credits	**20 (15+5)**
VIII Semester **Student READY:** RAWE/ Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship		
AGRI 499	Rural Agricultural Work Experience (RAWE) and Agro Industrial Attachment (AIA) (20 weeks) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)	20
	Total Credits	**20**
Online Courses (MOOC)**		10
	Grand Total	**170+ 10 (MOOC)**+ 17 NG**

* From the bouquet of Elective Courses

** From SWAYAM, Diksha, NPTEL, mooKIT, edX, Coursera or any other portal under intimation to the Dean

B.SC. (HONS.) AGRIBUSINESS MANAGEMENT, 4 YEAR PROGRAMME

FOUNDATION AND COMMON COURSES

Course No.	Course Title	Credits	Semester
FOUNDATION COURSES			
AGRI 100	*Deeksharambh* (Induction cum Foundation Course of 2 weeks)	2 (0+2) NG	I
AGRI 351	Educational Tour	2 (0+2) NG	V
	Total Credits	**4 (0+4) NG**	
COMMON COURSES			
Multidisciplinary Courses (MDC)			
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)	I
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)	IV
AG ECON 301(MDC)	Agricultural Marketing and Trade	3 (2+1)	V
	Total Credits	**9 (6+3)**	
Value Added Courses (VAC)			
SOILS 102 (VAC)	Environmental Studies and Disaster Management	3 (2+1)	II
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)	III
	Total Credits	**6 (4+2)**	
Ability Enhancement Course (AEC)			
ENG 101 (AEC)	Communication Skills	2 (1+1)	I
EXT 102 (AEC)	Personality Development	2 (1+1)	II
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)	I
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)	II
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)	III
	Total Credits	**10 (2+8)**	

B. SC. (HONS.) AGRIBUSINESS MANAGEMENT, 4-YEAR PROGRAMME
CORE COURSES: DEPARTMENT-WISE

Course No.	Course Title	Credits	Semester
Agricultural Economics			
AG ECON 101	Fundamentals of Agricultural Economics	2 (2+0)	I
AG ECON 102	Farm Management, Production and Resource Economics	3 (2+1)	II
AG ECON 206	International Trade and Policy in Agriculture	2 (2+0)	IV
AG ECON 301 (MDC)	Agricultural Marketing and Trade	3 (2+1)	V
AG ECON 303	Introduction to Managerial Economics	3 (2+1)	V
AG ECON 304	Grading Standardization and Quality Management in Agri-food Products	2 (1+1)	VI
	Total Credits	**15 (11+4)**	
Agricultural Extension Education			
EXT 102 (AEC)	Personality Development	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Agronomy			
AGRON 101 (MDC)	Farming Based Livelihood Systems	3 (2+1)	I
AGRON 107	Introduction to Agronomy and Crop Production Technology	2 (1+1)	I
AGRON 303	Sustainable Farming System and Precision Agriculture	2 (1+1)	V
	Total Credits	**7 (4+3)**	
Business Management			
ABM 101	Introduction to Agribusiness Management	2 (2+0)	I
ABM 104	Marketing of Agricultural Inputs and Outputs	2 (1+1)	II
ABM 106	Agricultural Finance and Insurance	2 (1+1)	II
ABM 201	Food Business Management	2 (2+0)	III
ABM 203	Introduction to Accountancy	3 (2+1)	III
ABM 205	Value Chain and Retail Management in Agribusiness	2 (1+1)	III
ABM 202	Agricultural Marketing Regulations	3 (2+1)	IV
ABM 204	Business Laws and Ethics	2 (2+0)	IV
ABM 206	Principles and Management of Organizational Behaviour	2 (1+1)	IV
ABM 208 (MDC)	Entrepreneurship Development and Business Management	3 (2+1)	IV
ABM 301	Market Information and Intelligence	3 (2+1)	V
ABM 303	Capital and Commodity Market	2 (1+1)	V
ABM 305	Applied Business Statistics	2 (1+1)	V
ABM 307	Business Research Methods	3 (2+1)	V
ABM 309	Cooperatives and Producers Organization	3 (2+1)	V
ABM 311	Social Entrepreneurship	1 (1+0)	V

ABM 302	Marketing Management	3 (3+0)	VI
ABM 304	Corporate Social Responsibility and Managerial Ethics	3 (2+1)	VI
ABM 306	Rural Marketing	3 (2+1)	VI
ABM 308	Agribusiness Project Management	3 (2+1)	VI
ABM 310	Strategic Business Management	3 (2+1)	VI
ABM 312	Commodity Future Trading	2 (2+0)	VI
	Total Credits	**54 (38+16)**	
Entomology			
ENT 101	Management of Insect Pest of Crops and Stored Grains	2 (1+1)	I
	Total Credits	**2 (1+1)**	
Genetics and Plant Breeding			
GPB 104	Introduction to Genetics and Plant Breeding	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Horticulture			
HORT 201	General Horticulture	2 (1+1)	III
HORT 204	Post-harvest Management and Value Addition of Fruits and Vegetables (To be taught jointly by Horticulture and Vegetable Science)	2 (1+1)	IV
	Total Credits	**4 (2+2)**	
Plant Pathology			
PL PATH 101	Management of Plant Disease	2 (1+1)	I
	Total Credits	**2 (1+1)**	
Seed Science and Technology			
SST 102	Principles and Practice of Seed Science and Technology	2 (1+1)	II
	Total Credits	**2 (1+1)**	
Soil Science			
SOILS 102 (VAC)	Environmental Studies and Disaster Management (To be taught jointly by Dept. of Soil Science, Agricultural Meteorology, Forestry and Microbiology)	3 (2+1)	II
SOILS 201	Soil and Water Management	2 (1+1)	III
	Total Credits	**5 (3+2)**	

SKILL ENHANCEMENT COURSES

Course No.	Course Title	Credits	Semester
COMP 101 (SEC)	Computer Applications in Agriculture	2 (0+2)	I
MICRO 101 (SEC)	Production Technology for Bio-agents and Bio-Fertilizers	2 (0+2)	I
SST 103 (SEC)	Seed Production and Seed Testing	2 (0+2)	II
LPM 104 (SEC)	Livestock Production and Management	2 (0+2)	II
LPM 015 (SEC)	Poultry Production Technology	2 (0+2)	III
ABM 207 (SEC)	Development of Agribusiness Proposals	2 (0+2)	IV
	Total Credits	**12 (0+12)**	

ELECTIVE COURSES*

Course No.	Course Title	Credits	Semester
ABM 401	Agro-Tourism	4 (0+4)	VII
ABM 402	Seed Business Management	4 (0+4)	VII
ABM 403	Fertilizer Retailing	4 (0+4)	VII
ABM 404	Food Retail Business Management	4 (0+4)	VII
ABM 405	Supply Chain Management of Agricultural Commodities	4 (0+4)	VII
ABM 406	Agri-export Management	4 (0+4)	VII
ABM 407	Hi-tech Horticulture/ Protected Cultivation	4 (0+4)	VII
ABM 408	Packaging and Branding of Agricultural Commodities	4 (0+4)	VII
ABM 409	e-Commerce in Agribusiness	4 (0+4)	VII
ABM 410	Storage and Warehousing of Agricultural Commodities	4 (0+4)	VII
ABM 411	Logistics Management of Agricultural Commodities	4 (0+4)	VII
ABM 412	Custom Hiring of Agricultural Machinery	4 (0+4)	VII
ABM 413	Applications of ICT in Agribusiness	4 (0+4)	VII
ABM 414	Value Addition to Agricultural Commodities	4 (0+4)	VII
ABM 415	Financial Management	4 (0+4)	VII

RAWE AND AIA FOR UG CERTIFICATE AFTER 1ST YEAR AND UG DIPLOMA AFTER 2ND YEAR

Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)			
Sr. No.	**Activities**	**No. of weeks**	**Credits**
1.	General orientation and on campus training by different faculties	1	5
2.	RAWE (Rural Agricultural Work Experience) – Village Attachment	4	
3.	Plant Clinic	1	1
4.	Agro-Industrial Attachment	3	3
5.	Project Report Preparation, Presentation and Evaluation	1	1
	Total	**10**	**10**

RAWE AND AIA FOR B.SC. (HONS.) AGRIBUSINESS MANAGEMENT 4-YEAR PROGRAMME

Rural Agricultural Work Experience (RAWE) and Agro-Industrial Attachment (AIA) (To be taught jointly by Dept. of Agronomy, Agricultural Extension Education and Agricultural Economics)			
Sr. No.	**Activities**	**No. of weeks**	**Credits**
1.	General orientation and on campus training by different faculties	1	10
2.	RAWE (Rural Agricultural Work Experience) – Village Attachment	9	
3.	Plant Clinic	2	02
4.	Agro-Industrial Attachment	6	06
5.	Project Report Preparation, Presentation and Evaluation	2	02
	Total	**20**	**20**

NON-GRADIAL COURSES

Course No.	Course Title	Credits	Semester
AGRI 100	*Deeksharambh* (Induction cum Foundation course of 2 weeks)	2 (0+2)	I
AGRI 351	Educational Tour	2 (0+2)	V
TUT	Tutorial	1 (1+0)	I to VI
	Total Credits	**10 (6+4)**	

SUPPORTING COURSES: DEPARTMENT-WISE

COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

Course No.	Course Title	Credits	Semester
Farm Machinery and Power Engineering			
FMPE 204	Farm Machinery and Power	2 (1+1)	IV
	Total Credits	**2 (1+1)**	
Processing & Food Engineering and Soil & Water Conservation Engineering			
PFE 203/SWE 203/ABM 209	Protected Cultivation and Secondary Agriculture	2 (1+1)	III
	Total Credits	**2 (1+1)**	

COLLEGE OF BASIC SCIENCES AND HUMANITIES

Course No.	Course Title	Credits	Semester
Botany and Plant Physiology			
BIO 101	Introductory Biology (Need based)	1 (1+0) NG	I
	Total Credits	**3 (2+1)**	
Computer Section			
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence	3 (2+1)	III
	Total Credits	**3 (2+1)**	
Languages and Haryanavi Culture			
ENG 101(AEC)	Communication Skills	2 (1+1)	I
	Total Credits	**2 (1+1)**	
Mathematics and Statistics			
MATH 101	Introductory Mathematics (Need based)	1 (1+0) NG	I
	Total Credits	**3 (2+1)**	

COLLEGE OF BIOTECHNOLOGY

Agricultural Bio-technology			
Course No.	**Course Title**	**Credits**	**Semester**
ABT 304	Fundamentals of Agri Biotechnology	3 (2+1)	VI
	Total Credits	**3 (2+1)**	

OTHER SUPPORTING COURSE

Animal Science			
Course No.	**Course Title**	**Credits**	**Semester**
LPM 102	Livestock and Poultry Management	2 (1+1)	II
	Total Credits	**2 (1+1)**	

DIRECTORATE OF STUDENTS' WELFARE

Course No.	Course Title	Credits	Semester
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)	I
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)	II
CCA 102	Co-curricular Activity	1 (0+1) NG	II
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)	III
NCC III/ NSS III	National Cadet Corps III/ National Service Scheme III	1 (0+1) NG	III
CCA 202	Co-curricular Activity	1 (0+1) NG	IV
NCC IV/ NSS IV	National Cadet Corps IV/ National Service Scheme IV	2 (0+2) NG	V
	Total Credits	**6 (0+6)**	

COURSE CONTENTS
BUSINESS MANAGEMENT

Course No.	Course Title	Credits	Semester
Core Courses			
ABM 101	Introduction to Agribusiness Management	2 (2+0)	I
ABM 104	Marketing of Agricultural Inputs and Outputs	2 (1+1)	II
ABM 106	Agricultural Finance and Insurance	2 (1+1)	II
ABM 201	Food Business Management	2 (2+0)	III
ABM 203	Introduction to Accountancy	3 (2+1)	III
ABM 205	Value chain and Retail Management in Agribusiness	2 (1+1)	III
PFE 203/ SWE 203/ ABM 209	Protected Cultivation and Secondary Agriculture	2 (1+1)	III
ABM 202	Agricultural Marketing Regulations	3 (2+1)	IV
ABM 204	Business Laws and Ethics	2 (2+0)	IV
ABM 206	Principles and Management of Organizational Behaviour	2 (1+1)	IV
ABM 208	Entrepreneurship Development and Business Management	3 (2+1)	IV
ABM 301	Market Information and Intelligence	3 (2+1)	V
ABM 303	Capital and Commodity Market	3 (2+1)	V
ABM 305	Applied Business Statistics	2 (1+1)	V
ABM 307	Business Research Methods	3 (2+1)	V
ABM 309	Cooperatives and Producers Organization	3 (2+1)	V
ABM 311	Social Entrepreneurship	1 (1+0)	V
ABM 302	Marketing Management	3 (3+0)	VI
ABM 304	Corporate Social Responsibility and Managerial Ethics	3 (2+1)	VI
ABM 306	Rural Marketing	3 (2+1)	VI
ABM 308	Agribusiness Project Management	3 (2+1)	VI
ABM 310	Strategic Business Management	3 (2+1)	VI
ABM 312	Commodity Future Trading	2 (2+0)	VI
	Total Credits	**56 (39+17)**	
Skill Enhancement Course			
ABM 207 (SEC)	Development of Agribusiness Proposals	2 (0+2)	IV
	Total Credits	**2 (0+2)**	
Elective Courses			
ABM 401	Agro-Tourism	4 (0+4)	VII
ABM 402	Seed Business Management	4 (0+4)	VII
ABM 403	Fertilizer Retailing	4 (0+4)	VII
ABM 404	Food Retail Business Management	4 (0+4)	VII
ABM 405	Supply Chain Management of Agricultural Commodities	4 (0+4)	VII
ABM 406	Agri-export Management	4 (0+4)	VII
ABM 407	Hi-tech Horticulture/ Protected Cultivation	4 (0+4)	VII
ABM 408	Packaging and Branding of Agricultural Commodities	4 (0+4)	VII
ABM 409	e-Commerce in Agribusiness	4 (0+4)	VII

ABM 410	Storage and Warehousing of Agricultural Commodities	4 (0+4)	VII
ABM 411	Logistics Management of Agricultural Commodities	4 (0+4)	VII
ABM 412	Custom Hiring of Agricultural Machinery	4 (0+4)	VII
ABM 413	Applications of ICT in Agribusiness	4 (0+4)	VII
ABM 414	Value Addition to Agricultural Commodities	4 (0+4)	VII
ABM 415	Financial Management	4 (0+4)	VII
	Total Credits	**60 (0+60)**	
	Grand Total	**118(39+79)**	

ABM 101	**INTRODUCTION TO AGRIBUSINESS MANAGEMENT**	**2 (2+0)**	**SEM I**

Objectives

1. To gain a comprehensive understanding of agribusiness structures, functions, and dynamics
2. To develop essential management skills applicable to agricultural enterprises
3. To explore strategies for optimizing production efficiency and maximizing profitability in agribusiness
4. To prepare for diverse careers in farm management, agricultural marketing, finance, and consulting

Theory

Indian Agriculture: Place of Agriculture in Indian Economy, trends in the structure of Indian Economy, Role of Agriculture in Economic Development in India. Trends in agricultural production and productivity, cropping pattern size of farms and farm efficiency. Functions of Management – Planning, organizing, staffing, motivation and control and Principles of Management. Indian agriculture: Impact of Liberalization, Privatization and Globalization on Agribusiness sector. Agribusiness Management: Definition, importance, Scope of Agribusiness Management, Agribusiness Management- Nature, definition, scope and functions. Agribusiness input and output services, Agricultural credit and foreign trade, Planning and Organizing agribusiness. New trends in Agribusiness: Contract farming, Types and scope of contract farming, working of contracts, Contract models, Organic farming, Genetically modified food, Farmer Producers' Organizations (FPO) Case Studies.

Suggested Readings

1. Farm Business Management: The Fundamentals of Good Practice by Peter L Nuthall.
2. Fundamentals of Agribusiness Finance by Ralph W. Battles and Robert C Thompson.
3. Objective Agribusiness Management by S R Panigrahy.
4. Agribusiness: Management, Marketing, Human Resource Development, Communication, and Technology by Robert H Usry and Lanny W Hass.
5. Agribusiness and Market Management by Amod Sharma.

ABM 104	MARKETING OF AGRICULTURAL INPUTS AND OUTPUTS	2 (1+1)	SEM II

Objectives

1. To understand the principles of agricultural marketing, including input and output markets
2. To learn about marketing strategies and techniques for agricultural inputs and products
3. To explore pricing mechanisms, market structures, and distribution channels in the agricultural sector
4. To develop skills to effectively market agricultural inputs and outputs, maximizing profitability for farmers and stakeholders
   Agricultural Marketing- Definition, scope and classification of agricultural marketing.

Agricultural input marketing – meaning and importance; Agricultural Inputs and their types – farm and non-farm, role of cooperative, public and private sectors in agri input marketing. Seed Marketing: Importance, Types of seeds, Demand and supply of seeds; agencies involved in Seed marketing; distribution, export import of seeds; Role of NSC and State Seed Corporation. Government policy on seed marketing. Fertilizer Marketing: Production, export-import, supply of chemical fertilizers. Demand/consumption, regional disparity in consumption, pricing policy; subsidy on fertilizers; marketing system – marketing channels, Agencies involved in fertilizer marketing- Public, Private, Co-operative sectors. Problems in distribution. Plant Protection Chemicals: Production, export/import, consumption, marketing channels. Electricity/Diesel Oil- distribution, pricing of electricity for agriculture use; subsidy on electricity. Farm Machinery and Implement: Production, supply, demand, distribution channels of farm machines; Agencies involved in distribution of agro-machineries and implements. Meaning and importance of Land reforms and tenancy in agriculture, ceiling, elasticity, pricing. Labour markets - productivity, heterogeneity, wage differentials – skill differentials. Credit: importance, types and sources. IT applications in agri- input marketing.

Practical

Input Market Analysis, Primary and Secondary Survey of input use, Exercise on Market Segmentation, Case Study on Product Management, Channel Management in Agri input, Case Study on Brand Management. Designing Communication and Promotion Measures – Seed, Fertilizer, Plant Protection Chemicals, Agricultural Machinery and Implements. Market Research – Seed, Fertilizer, Plant Protection Chemicals, Agricultural Machinery and Implements. Formulation of Marketing Strategy, Report Presentations**.**

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L., Agricultural Marketing in India.
2. Agricultural Economics, Kalyani Publications.
3. Ruddra Dutt and Sundharam K.P.M., Indian Economics.

ABM 106	AGRICULTURAL FINANCE AND INSURANCE	2 (1+1)	SEM II

Objective

1. To understand the principles of agricultural finance, including credit, investment, and risk management.
2. To learn about financial tools and services available to farmers, including loans, grants, and insurance.

Agricultural Finance – meaning, definition, nature and scope. Agricultural Credit - meaning, definition, importance and classification based on various criteria.

Credit Analysis - 3 Rs of Credit; 5 Cs of Credit; and 7 Ps of Credit; Repayment Plans. Financial Statements – meaning, types and uses. Time Value of Money / Principle of Time Comparison – meaning and importance. Compounding and Discounting.

History of financing agriculture in India. Nationalization of banks – meaning and objectives; Village Adoption Scheme – origin and objectives; Lead Bank Scheme – origin and functions; Regional Rural Banks – origin, objectives and features; Micro-financial Institutions: meaning and features; Self Help Groups (SHGs) – meaning and features.

Scale of finance and security for loans. Banking schemes for agricultural finance - Differential Rate of Interest (DIR) Scheme – origin and features; Kisan Credit Card Scheme – origin, objectives and features. Financial inclusion – *Jan Dhan Yojana*, financial literacy and business correspondent model. NPAs in agricultural lending: applicability of the SARFESI Act in agricultural lending.

Financing Agencies: RBI – activities and functions; NABARD – genesis, objectives and functions; AFC – functions; ADB and World Bank – origin and functions; IMF, IFC and IDA. Deposit Insurance and Credit Guarantee Corporation of India (DICGC) – Origin and functions.

e-Payment systems - The Banking Ombudsman Scheme-Non-Banking Financial Institutions (NBFI) – meaning and structure, types of activities of NBFIs -Merchant banking in India – Functions - Mutual Funds – Features and structure - Credit rating agencies in India, Process - Factoring mechanism - Forfeiting services.

Insurance – meaning and definition. Crop Insurance Scheme – origin, meaning, importance and advantages of crop insurance, Comprehensive Crop Insurance Scheme (CCIS), National Agricultural Insurance Scheme (NAIS), Modified National Agricultural Insurance Scheme (MNAIS), and Weather based Crop Insurance and *Fasal Bhima Yojana* and Unified Package Insurance Scheme (UPIS). Assessment of crop losses, determination of compensation, limitations in application and estimation of crop yields. Livestock insurance – origin, meaning and importance.

Practical

Exercises on time value of money - compounding and discounting. Estimation of credit needs for crop and livestock enterprises. Determination of scale of finance for farm enterprises. Repayment plans for short-term loans and term loans. Estimation of risk in crop and livestock enterprises. Estimation of premium amount for insurance.

Visits to financial inclusion branch of commercial bank and regional rural bank; and insurance agency in public and private sectors. Visit to weather station.

Suggested Readings

1. Agarwal, R.N., 1996, Financial Liberalization in India- A study of Banking System and Stock markets.
2. Bagchi, A.K., 1987, The Evolution of the State Bank of India (Part I and II).
3. Bhasin, Niti, 2007, Banking and Financial Markets in India 1947 to 2007.
4. Desai, D.K. and Tambad, S.B., 1973, Farm Finance by a Commercial Bank.
5. Gulati, Ashok and Seema, Bathla, 2002, Institutional Credit to Indian Agriculture: Defaults and Policy Options. NABARD Occasional Paper- 23.
6. Karthykeyan, T.K., 1990, Long-term Financing of Agriculture Land Development Banks in a Multi-Agency System.
7. Mathur, B.L., 1989, Indian Banking- Performance, Problems and Challenges.
8. Mishra, R.K., 2005, Banking Sector Reforms and Agricultural Finance.
9. Murray, William, G., 1947, Agricultural Finance- Principles and Practices of Farm Credit.
10. Nakkiran, S., 1980, Agricultural Financing and Rural Banking in India- An evaluation.
11. Pandey, U.K., 1990, An Introduction to Agricultural Finance.
12. Subba Reddy, S. and Raghuram P., 2005, Agricultural Finance and Management.

ABM 201	FOOD BUSINESS MANAGEMENT	2 (2+0)	SEM III

Objectives

1. Understand the principles of food business management, including production, distribution, and marketing
2. Learn about food safety regulations, quality control, and supply chain management
3. Explore strategies for developing and launching food products, managing operations, and meeting consumer demands
4. Develop skills to analyze market trends, develop business plans, and manage resources effectively in the food industry

Theory

Introduction to food, food business and food business management, Types and classification of Foods, Food Business, Institutions involved in Food preparation, Marketing and Exporting. Present status of food industry in India – Current market size and future potential – Key drivers for growth. Recent advances in food processing, Quality management in food industry- Food Safety and standards (ISO and Codex). Food quality certification- AFS, BRC, HACCP, BFSI. Food traceability. Food preservation methods - Food Packaging and Labelling - Improved food grain storage structures. Logistics management at different stages of marketing the food products. Food business environment and policy. IPR in Food Industry, Entrepreneurship opportunities in food business. Food Economics and Policy, Innovation in food business at domestic and international, Food Business Marketing. Successful business organizations. Food business Environment and Policy, Government, Regulations/

Guidelines for food sector. Food Waste management. Food Retailing, Formats of Food Service Industry, Policies related to Food Processing and Markets, Institutions enabling food processing sector, Food Safety and Standards Authority of India.

Suggested Reading

1. Mahtab. S, (1996) Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Srilakshmi. B, (2006) Food Science, New Age International (Ltd) Publishers, New Delhi.
3. Srilakshmi. B, (2007) Nutrition Science, New Age International (Ltd) Publishers, New Delhi.
4. Swaminathan. M, (1997) An advanced textbook on Food and Nutrition, Volume I, The Bengaluru Printing and Publishing Co. Ltd., Bengaluru.
5. Swaminathan. M, (1997) An advanced textbook on Food and Nutrition, Volume II, The Bengaluru Printing and Publishing Co. Ltd., Bengaluru.

ABM 202	AGRICULTURAL MARKETING REGULATIONS	3 (2+1)	SEM IV

Objectives

1. Understand the regulatory framework governing agricultural marketing at local, national, and international levels
2. Learn about marketing laws, policies, and regulations affecting the sale and distribution of agricultural products
3. Explore the role of government agencies and industry organizations in enforcing marketing regulations and ensuring fair trade practices
4. Develop skills to navigate compliance requirements, understand market access regulations, and mitigate legal risks in agricultural marketing activities

Theory

Evolution of market legislation. Need and scope for market legislation. Review of Agricultural Produce Market Acts in India and Karnataka. Distribution of legislative powers between parliament and state assemblies. Salient features of essential commodities Act-Food Safety and Standards Act 2006, Consumer Protection Bill 2019, Patent Act 2002, Monopolies and Restrictive Trade Practices Act/ Competition Act 2002, Forward Markets Act 1952, Standards of Weights and Measures Act 1976, The Central Warehousing Corporation Act. Provisions of Karnataka Agricultural Marketing (Development Regulation) Act 2007 – Establishment of Market, Constitution of Market Committee (APMC), Special Market, Conduct of Business of the Market Committee, Powers and Duties of Market Committee, Staff of the Market Committee, Regulation of the Contract Farming Trade, Karnataka State Agricultural Marketing Board - Constitution and Functions. Role of state department of Agricultural Marketing and Directorate of Agricultural Marketing and Inspection. Agricultural Marketing Policies of the Government – Administered Price Policies – Commission for Agricultural Costs and Prices (CACP) and its Working. Policies of Procurement, Levy and Public Distribution System. Minimum Support Prices,

Ceiling Price and Parity Prices. Floor Price Scheme. Food Security Policy - Procurement, Buffer Stock, Distribution, Subsidies. Food Zone. Agri Export Zones (AEZS)/ Export Oriented Units (EOUS). Introduction and Meaning of Intellectual Property, Brief Introduction to GATT, WTO, Trips and WIPO, Treaties for IPR Protection: Madrid Protocol, Berne Convention, Budapest Treaty, etc. Types of Intellectual Property and Legislations Covering IPR in India: Patents, Copyrights, Trademark, Industrial Design, Geographical Indications, Integrated Circuits, Trade Secrets. Patents Act 1970 and Patent System in India, Patentability, Process and Product Patent, Filing of Patent, Patent Specification, Patent Claims, Patent Opposition and Revocation, Infringement, Compulsory Licensing, Patent Cooperation Treaty, Patent Search and Patent Database.

Practical

Evolution and Historical Perspectives of Agricultural Marketing Legislation, Marketing Tax and Fees, Different Agents Involved in Marketing Practices, Study on Different Agricultural Marketing Models, Review of Agricultural Marketing Policies. Study on Reform in Agricultural Marketing Sectors in India. Presentation and group discussions on above topics, Visits to different APMC's.

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L., 1994, Agricultural Prices- Analysis and Policy, Oxford and IBH, New Delhi.
2. Encyclopaedia of Agricultural Marketing- Market Regulation and Development (Vol. 3) by Jagdish Prasad. 1999.
3. Kahlon, A.S. and George, M.V., 1965, Agricultural Marketing and Price Policies, Allied Publishers Private Limited, New Delhi.
4. The Karnataka Agricultural Produce Marketing (Regulation and Development) Act 1966 by Sathpal Puliani. 2020.

ABM 203	INTRODUCTION TO ACCOUNTANCY	3 (2+1)	SEM III

Objectives

1. Understand the basic principles and concepts of accounting
2. Learn the fundamentals of financial statements preparation and analysis
3. Explore the role of accounting in business decision-making and financial management
4. Develop skills to record, classify, and interpret financial transactions accurately and effectively

Theory

Introduction to accountancy: Meaning and importance of accounting. Meaning and definition of book keeping. Accountancy objectives of book keeping: branches of accounting. Accounting cycle. Generally Accepted Accounting Principles (GAAP)-concepts and conventions. System of book keeping: Single entry and Double entry system of keeping, Classification of accounts. Golden rules of accounting; Books of accounts: Journal and Ledger –journalizing, ledger posting, and preparation of ledger

accounts. Subsidiary books-Kinds of subsidiary books- Day books: purchase book, sales book, returns book, Bill books, journal proper, Cash books - nature and objectives of cash book, types of cash book, petty cash book; Bank reconciliation statement; Preparation of Trial balance- Methods of trial balance; Final accounts - Trading account, Profit and loss account and Balance sheet; Single entry system of accounts - preparation of statement of affairs, profit or loss statement, advantages and disadvantages. Non-trading organizations. Preparation of accounts relating to non-trading organization. Concepts of revenue and capital expenditure and income, Receipts and payment account, Income and expenditure account, and Balance sheet**.**

Practical

Preparation of journal and recording the business transactions in journal, Preparation of ledger and ledger posting, Preparation and solving of problems relating to subsidiary books, Preparation of cash book with single column, Preparation of cash book with double column, Preparation of cash book with triple column and contra entries, Preparation petty cash book in imprest system, Preparation of bank reconciliation statement, Preparation of trial balance, Preparation of final accounts-trading, profit and loss accounts and balance sheet, Preparation of profit and loss account and balance sheet under single entry system. Preparation of non-trading accounts receipts and payment accounts. Preparation of non-trading accounts - income and expenditure accounts and balance sheet.

Suggested Readings

1. Jain, S.P., Advanced Accountancy.
2. Kadakol, M.B., Accountancy for PUC-I and II.
3. Raman, B.S., Accountancy.

ABM 204	BUSINESS LAWS AND ETHICS	2 (2+0)	SEM IV

Objectives

1. Understand the legal framework governing business operations and transactions
2. Learn about ethical principles and practices in business decision-making and conduct
3. Explore the implications of business laws and ethics on organizational behaviour, corporate governance, and social responsibility
4. Develop skills to navigate legal and ethical challenges, ensuring compliance and fostering trust in business relationships

Theory

Introduction to Indian legal system: Legislative Powers of the States and the Union. Scope and importance of Business laws. Contracts – meaning, significance, types and essentials of a valid contract. The Indian Contract Act-1872. The Indian Partnership Act, 1932 - General Nature, Registration of Partnership, Partnership Deed, Types of Partners, Rights and Duties of Partners. The Companies Act, 1956 and 2013 - General Nature, types of companies, incorporation of a Company, Memorandum of Association and Articles of Association, management of a company. Provisions of important Acts enacted over time related to business environment: Industries

(Regulation and Development) Act, 1951; Income tax Act, 1961. Central Excise Act, 1944; Foreign Exchange Regulation Act (FERA), 1973; Foreign Exchange Management Act (FEMA), 1999; Monopolistic and Restrictive Trade Practices (MRTP), Act, 1969; Competition Act, 2002; Food safety and standards Act, 2006; Customs Act, 1962 and Goods and Service Tax, 2011. FDI Policy of GoI. Business Ethics - Nature and importance of ethics and moral standards. Scope of business ethics in business functional area. Governance mechanism. Companies Act Amendment 2023, OPC, FPC, Section 8.

Suggested Readings

1. Business Law and Ethics- Concepts, Methodologies, Tools, and Applications 2015. Editor: Information Resources Management Association.
2. Business Law and Ethics: Concepts, Methodologies, Tools, and Applications.
3. Business Law and Ethics: Concepts, Methodologies, Tools, and Applications. Volume 1. Business Science Reference, 2015.

ABM 205	VALUE CHAIN AND RETAIL MANAGEMENT IN AGRIBUSINESS	2 (1+1)	SEM III

Objectives

1. Understand the dynamics of value chains in agribusiness, from production to retail
2. Learn about supply chain management, distribution, and logistics in agricultural products
3. Explore retail management strategies, including branding, marketing, and customer relationship management
4. Develop skills to optimize value chain efficiency, reduce costs, and meet consumer preferences in agribusiness retail

Theory

Meaning of value and value chain. Concept of value chain. Difference between supply chain and value chain. Components of value chain. Value chain governance. Value chain methodology. Economics of value chain. Financing of agricultural chain. Market linkages in value chain. Mapping of value chain. Potters value chain. Introduction to Retail Management. Retailing in India. Types of retailers. Retail formats. Online and offiine retailing. Organised and unorganized retailing. Retail location and layout. Retail strategies. Store management. Merchandise and inventory management. Retail marketing mix, role of IT in retail management. E-tailing.

Practical

Presentation and Discussion on above topics. Visit to retail formats. Visits to processing units. Visit to logistics, godowns, warehouses etc.

Suggested Readings

1. Retail Supply Chain Management: Quantitative Models and Empirical Studies (International Series in Operations Research and Management Science, 122).

Softcover reprint of hardcover 1st ed. 2009 Edition by Narendra Agrawal (Editor), Stephen A. Smith (Editor).

2. Retail Supply Chain Management. Hardcover – 5 October 2017. James B. Ayers (Author) and Mary Ann Odegaard (Author).
3. The Retail Value Chain: How to Gain Competitive Advantage through Efficient Consumer Response (ECR) Strategies. Sami Finne, Hanna Sivonen. Kogan Page Publishers, 03-Dec- 2008 - Business and Economics - 384 pages.

ABM 206	PRINCIPLES OF MANAGEMENT AND ORGANIZATIONAL BEHAVIOUR	2 (1+1)	SEM IV

Objectives

1. Understand the fundamental principles of management theory and practice.
2. Explore the dynamics of organizational behaviour, including individual and group dynamics, communication, and motivation
3. Learn to apply management concepts and behavioral theories to solve organizational challenges and improve effectiveness
4. Develop skills in leadership, decision-making, and conflict resolution to enhance organizational performance and employee satisfaction

Theory

Introduction to Management - Management functions - Management levels - Managerial roles - Management skills - Role of management. Evolution of management thought.

Functions of management: Planning: Nature and importance - types of planning - Steps in planning - Decision making – meaning - types of decisions.

Organizing- meaning-nature and purpose of Organizing-Principles of organizing-Organization structure -Managing Human Resources- human resource planning-recruitment- sources of recruitment -Selection- steps in the selection process-Orientation -Training -Management development programs.

Leading- meaning - Leadership theories - Motivation-Meaning and purpose-Motivational theories - Communication-meaning-objectives-importance-types-barriers.

Controlling-meaning and nature of controlling-essential elements of controlling. Ethics and corporate social responsibility in business.

Organizational Behaviour - definition, importance, historical background of Organizational Behaviour, challenges - the organizational Context-Environment – Technology.

Learning - importance of learning -Process-approaches to learning-the learning organization.

Personality-defining personality-types and traits-personality types-the big five-the development of the self-selection methods.

Perception- meaning, selectivity and organization-perceptual sets and perceptual worlds- factors influencing perception and shortcuts in judging others.

Group Dynamics - meaning, need for joining groups, stages of group development

and group decision making techniques. Teams-types, difference between teams and groups. Managing conflicts. Work stress – Types and management strategies. Organizational culture – Definition and creating a culture in organization. Organizational change.

Practical

Study of management structure and organizational pattern of selected business units. Preparation, analysis and presentation of case studies.

Suggested Readings

1. Aaker, David, Kumar, V. and George Day, 1995, Marketing Research, 8th edn, John Wiley and Sons.
2. Andrew J. Dubrin, 2012, Essentials of Management, Thomson Southwestern, 9th edition.
3. Charles W.L. Hill and Steven L. McShane, 2007, Principles of Management, McGraw Hill Education, Special Indian Edition.
4. Harold Koontz and Heinz Weihrich, 2012, Essentials of Management: An International and Leadership Perspective, 9th edn, Tata McGraw- Hill Education.
5. Kerlinger, Fred N., 1986, Foundations of Behavioural Research, 3rd edn.
6. Kotler P., 2001, Marketing Management. Grada, Praha, 10th edn.
7. Koudelka J., 1997, Consumer Behaviour and Marketing. Grada, Praha.
8. Michael A. Kamins, 1993, Secondary Research: Information, Sources and Methods, Applied Social Research Methods, Volume 4, Sage Publications.
9. Samuel C. Certo and Tervis Certo, 2012, Modern Management: Concepts and Skills, Pearson education, 12th edn.

ABM 207 (SEC VI)	DEVELOPMENT OF AGRIBUSINESS PROPOSAL	2 (0+2)	SEM IV

Objectives

1. Learn to identify viable agribusiness opportunities and formulate innovative project proposals.
2. Understand the components and structure of a comprehensive agribusiness proposal, including market analysis, financial projections, and risk assessment.
3. Develop skills to effectively communicate business ideas, secure funding, and implement successful agribusiness ventures.
4. Gain practical experience in preparing and presenting agribusiness proposals that meet the needs of stakeholders and investors.

Practical

- **Project Planning, Monitoring and Evaluation:** Orientation. Hands on experience on preparation of project proposals for horticulture crops, dairy, poultry and agro-processing units. Interaction with staff/experts for midterm corrections and submission of interim report. Hands on experience on preparation

of project proposal for bio-fertilizer and bio-pesticides units, irrigation, equipments and machineries, forest plantations, fishery and land development activities. Interaction with staff/ experts for midterm corrections and submission of interim report. Hands on experience on ex- ante, concurrent and ex-post appraisal. Hands on experience on discounting procedures like NPV, IRR and BCR, preparation of techno-economic feasibility reports of project. Report writing and examination.

- **Marketing Management**: Orientation. Hands on experience on conducting market survey to gain experience on working out consumer profile, competitors, substitutes and their price and features. Designing market strategy. Interaction with staff/experts for midterm corrections and submission of interim report. Hands on experience on forecasting market demand. Pricing methods, creating and organizing an advertising campaign. Various packaging materials used for agro-based products. Product distribution network, marketing cost, marketing planning process. Interaction with staff/ expert for midterm corrections and submission of interim report. Hands on experience on marketing research and information system for new product development and options for extending product life cycle. Spot and online marketing. Export- import policies for agriculture sector. Report writing and examination.
- **Financial Management**: Orientation. Estimation of funds required – capital investment and operational expenses. Share of owned and borrowed funds in the business. Sources of borrowed funds, terms and conditions of borrowings, repayment schedule, cash inflow and cash outflows of business. Interaction with staff/ experts for midterm corrections and submission of interim report. Hands on experience on accounting methods and procedures. Commonly used account systems, the single and double entry system, recording transactions, journals, figures, trial balance, assets and liabilities. Revenue cost of sales and net profit operating and incidental expenses and inventory. Interaction with staff / experts for midterm corrections and submission of interim report. Preparation of financial statements like balance sheet, income statement, profit and loss statement for the business. Exercise on financial ratio analysis. Report writing and examination.

Suggested Readings

1. David D. Van Fleet and George J. Seperich. 2013. Agribusiness: Principles of Management. Delmar, New York.
2. Elizabeth Yeager, Frank J. Dooley, Freddie L. Barnard, Jay T. Akridge and John Charles Foltz. 2012. Agribusiness Management. Routledge, London.
3. Hegde P. 2012. Agribusiness Management. Discovery Publishing House, New Delhi.
4. Karthikeyan M. and Nakkiran S. 2012. Co-operatives and Agri-Business. Discovery Publishing House, New Delhi.
5. Walter David Downey. 1987. Agribusiness Management. Tata McGraw-Hill, New Delhi.

ABM 208	ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT	3 (2+1)	SEM IV

Objective

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Theory

Development of agri-entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/ competencies. Concept, need for 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. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment– identification of product / service – 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, Enterprise Management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. 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, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agri- entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings

1. Charantimath P.M., 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai V., 2015, Entrepreneurship: Development and Management. Himalaya Publishing House.
3. Desai, Vasant, 1997, Small Scale Industries and Entrepreneurship. Himalaya Publ. House.

4. Grover, Indu, 2008, Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Gupta C.B., 2001, Management Theory and Practice. Sultan Chand and Sons.
6. Khanka S.S., 1999, Entrepreneurial Development. S. Chand and Co.
7. Mehra P., 2016, Business Communication for Managers. Pearson India, New Delhi.
8. Pandey M. and Tewari D., 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
9. Singh D., 1995. Effective Managerial Leadership. Deep and Deep Publ.
10. Singhal R.K., 2013, Entrepreneurship Development and Management. Katson Books.
11. Tripathi P.C. and Reddy P.N., 1991, Principles of Management. Tata McGraw Hill.

ABM 301	MARKET INFORMATION AND INTELLIGENCE	3 (2+1)	SEM V

Objectives

1. Understand the importance of market information and intelligence in making informed business decisions
2. Learn methods for collecting, analyzing, and interpreting market data and trends
3. Explore strategies to use market information to identify opportunities, mitigate risks, and gain competitive advantage
4. Develop skills to effectively utilize market intelligence to optimize marketing strategies, pricing, and product positioning in agribusiness

Theory

Market Information-Meaning, Need for market information, Merits of Market Information, Importance of market information - Types of Market Information-Market Intelligence, Market News and Market Outlook - Essential Characteristics of Good Market Information and means of data collection. Compilation, analysis and dissemination of market information and intelligence in India. Sources of compilation and dissemination of market information-institutional and non- institutional. Deficiencies, problems and reliability of market information. Simple forecasting tools for price and demand estimation: time series analysis (trend, seasonal indices), Consumer surveys, Expert opinion survey methods, Market experiments methods, Graphical methods, smoothing techniques and regression methods. Evaluation of forecasts.

Practical

Price and demand analysis of selected agricultural commodities using time series analysis, Consumers' surveys, Experts' opinion survey methods, Market experiments methods, Graphical methods, smoothing techniques, Delphi method and regression methods. Developing market intelligence and information reports.

Suggested Readings

1. Acharya, S.S., 1988, Agricultural Production, Marketing and price policy- A study of Pulses, Mittal Publications, Delhi.
2. Acharya, S.S., and Agarwal, N.L., 1994, Agricultural prices- Analysis and policy, Oxford and IBH, New Delhi.
3. Alexander, Market Intelligence.
4. Fox, Market Information system.
5. Gupta, A.P., 1975, Marketing of agricultural production in India, Voro and Co-Publishers Pvt. Limited, Bombay.
6. Jagadish Prasad, 1966, Encyclopedia of Agricultural Marketing, Mittal Publishers Pvt. Limited, Bombay.
7. Kahlon, A.S. and George, M.V., 1965, Agricultural marketing and Price Policies, Allied Publishers Private Limited, New Delhi.
8. Nayyar, H. and Ramaswamy, P., 1995, Globalization and Agricultural Marketing, Rawat Publications, Jaipur.
9. Prasad, A. Shivarama, Agricultural Marketing in India, Mittal Publications, Delhi.
10. Singhal, A.K., 1989, Agricultural Marketing in India, Anmol Publications, New Delhi.

ABM 302	MARKETING MANAGEMENT	3 (3+0)	SEM VI

Objectives

1. Understand the principles and theories of marketing management
2. Learn strategies for product development, pricing, promotion, and distribution
3. Explore market research techniques to understand consumer behavior and preferences
4. Develop skills to create and implement effective marketing plans to achieve organizational objectives

Theory

Marketing– meaning, importance, functions. Marketing Management- definition, difference between marketing and selling. Guiding philosophy of Marketing. Marketing planning: importance, steps, nature. Market Segmentation – meaning, bases and advantages; Market Targeting– Approaches. Positioning – meaning and strategies. Marketing environment analysis. Marketing Mix – 4 Ps and 7 Ps; Product. Product classifications and new product development and launching. Product life cycle – stages; Branding – meaning, selecting a brand, advantages and disadvantages of branding, types of brands; Packaging: meaning, importance, and functions of packaging. Pricing Methods and strategies. Marketing channel–meaning, market intermediaries, types of channels and functions of marketing channel; channel management strategies, channels of distribution, channel management decisions, management of retailing and wholesaling. Direct marketing–methods and advantages and disadvantages; Promotional mix: meaning, elements and objectives. Services Marketing– introduction, meaning, characteristics and Service Marketing Mix.

Suggested Readings

1. Andrew J. Dubrin, 2012, Essentials of Management, Thomson Southwestern, 9th edition.
2. Chabra and Grover, 2012, Marketing Management, Dhanpatrai and Co, New Delhi.
3. Chandrasekar, K.S., 2010, Marketing Management-Text and Cases, Tata McGraw Hill-Vijaynicole.
4. Charles W.L Hill and Steven L McShane, 2007, Principles of Management, McGraw Hill Education, Special Indian Edition.
5. Harold Koontz and Heinz Weihrich, 2012, Essentials of Management: An International and Leadership Perspective, 9th edition, Tata McGraw-Hill Education
6. Philip Kortler and Kevin Lane Keller, 2012, Marketing Management, PHI 14th Edition.
7. Rajan Sexena, 2005, Marketing Management, Tata McGraw-Hill Education.
8. Samuel C. Certo and Tervis Certo, 2012, Modern Management: Concepts and Skills, Pearson education, 12th edition.
9. Sherlekar, 2013, Marketing Management, Himalaya Publishing House, New Delhi.
10. Sontakki, 2005, Marketing Management, Kalyani Publishers, New Delhi.

ABM 303	CAPITAL AND COMMODITY MARKET	2 (1+1)	SEM V

Objectives

1. Understand the functioning and dynamics of commodity markets in agriculture
2. Learn about price discovery mechanisms, trading strategies, and risk management techniques
3. Explore the factors influencing supply and demand dynamics in commodity markets
4. Develop skills to analyze commodity market trends, assess market opportunities, and make informed trading decisions in agricultural commodities

Theory

Capital market instruments – corporate stock and corporate bonds - Capital market instruments – commercial paper, certificate of deposits - Equities - Common Stocks, Restricted Shares- Preferred Stocks - Fixed income capital market instruments – Bonds, debentures, swap and Mortgage-backed securities-Managing Interest Rate Risk - The Yield Curve - Process and procedures of raising equity capital - Types of investors in capital market - Depository services – meaning and functions - Insider trading - Transaction procedures and settlement- Stock Valuation.

History and evolution of commodity markets. Marketing of food grains – cereals and pulses, production, consumption, marketable surplus. Marketing of commercial crops: coffee, tea, rubber, tobacco, Arecanut, coconut, cotton, oilseeds, spices, jute - supply and demand. Marketing practices, market structure, marketing channels and price spread, organizations and institutions, Commodity Boards and their activities. Marketing of horticultural crops – Fruits, vegetables and flowers - demand, supply and utilization, marketing practices, NHB, NHM, APEDA. Role of commodity

exchanges- difference between national and regional exchanges. Meaning and types of market participants – Hedgers, Speculators, Arbitragers. Derivatives market – meaning, functions and limitations. Types of derivatives - options, forward, futures and swaps. Factors influencing spot and futures markets. Trading strategies. Pricing of futures. Operational mechanism of commodity markets. Settlement process and delivery mechanisms. Strategies using options to hedge risks, long and short positions. Role of banks and warehousing in commodity markets - Global commodity exchanges dealing with agricultural commodities.

Practical

Compilation of basic statistics on area, production, productivity, consumption, export and import of selected crops. Estimating growth. Graphical representation. Visit to Grain Market, Fruit, vegetable and flowers markets. Futures pay-offs calculation. Pricing of derivatives.

Suggested Readings

1. Carter Colin A. 2003. Futures and Options Markets: An Introduction, Prentice-Hall: Upper Saddle River, NJ.
2. Chatnani, Niti Nandini. Commodity Markets, Tata McGraw Hill Education Private Limited, New Delhi.
3. Hull John C. 2005. Fundamentals of Futures and Options Markets, 5th edn, Prentice Hall: Upper Saddle River, NJ.
4. Kulkarni, Bharat. Commodity Markets and Derivatives, Excel Books, A-45, Naraina, Phase I, New Delhi.
5. McDonald and Robert L. 2006. Derivatives Markets, 2nd edn, Addison Wesley: Boston.
6. Wayne Purcell and Stephen Koontz. 1999. Agricultural Futures and Options, Principles and Strategies (2nd edn), Prentice-Hall (ISBN 0-13-779943-8).

ABM 304	CORPORATE SOCIAL RESPONSIBILITY AND MANAGERIAL ETHICS	3 (2+1)	SEM VI

Objectives

1. Understand the concept and significance of corporate social responsibility (CSR) in business
2. Learn about ethical theories and principles guiding managerial decision-making
3. Explore strategies for integrating CSR practices into business operations and stakeholder engagement
4. Develop skills to analyze ethical dilemmas, make responsible decisions, and promote ethical behavior within organizations

Theory

Introduction to Corporate Social Responsibility (CSR): Meaning and Definition of CSR, History and evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR- overlapping concept. Concept of sustainability. Stakeholder Management. CSR through triple bottom line and Sustainable Business;

relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India; models of CSR in India, Carroll's model; drivers of CSR; major codes on CSR; Initiatives in India. International framework for corporate social Responsibility, Millennium Development goals, Sustainable development goals, Relationship between CSR and Millennium Development Goals (MDGs). United Nations (UN) Global Compact 2011. UN guiding principles on business and human rights. Organisation for Economic Co-operation and Development (OECD) CSR policy tool, International Labour Organization (ILO) tri-partite declaration of principles on multinational enterprises and social policy. CSR-Legislation in India and the world. Section 135 of Companies Act 2013. Scope for CSR Activities under Schedule VII, Appointment of Independent Directors on the Board, and Computation of Net Profit's Implementing Process in India. The Drivers of CSR in India, Market based pressure and incentives, civil society pressure, the regulatory environment in India. Counter trends. Performance in major business and Programs. Voluntarism Judicial activism. Identifying key stakeholders of CSR and their roles. Role of Public Sector in Corporate, government Program s that encourage voluntary responsible action of corporations. Role of Non-profit and Local Self-Governance in implementing CSR; Contemporary issues in CSR and MDGs. Global Compact Self-Assessment Tool, National Voluntary Guidelines by Govt. of India. Understanding roles and responsibilities of corporate foundations.

Review of current trends and opportunities in CSR. Review of successful corporate initiatives and challenges of CSR. Analysis and presentation of case Studies of Major CSR Initiatives.

Suggested Readings

1. Bharat's Corporate Social Responsibility by Kamal Garg. Edition 2023
2. Business Ethics and Corporate Social Responsibilities, 1st Edition 2017, by Mathur, SP, Mathur, Nishu, New Age International (P) Ltd. Publishers.
3. Corporate Social Responsibility, Jun 2019, by Andrea Giordani.
4. Corporate Governance Values and Ethics Book for MBA by Dr Neeru Vasishth and Dr Namita Rajput.

ABM 305	APPLIED BUSINESS STATISTICS	2 (1+1)	SEM V

Objectives

1. Understand the fundamental concepts and techniques of statistical analysis in business contexts
2. Learn how to collect, organize, and interpret data to make informed business decisions
3. Explore the application of statistical tools and methods in various business functions such as marketing, finance, and operations
4. Develop skills to use statistical software packages effectively for data analysis and visualization in business settings

Introduction to Sampling Theory, Sampling versus Complete Enumeration, Methods of Sampling: Probability sampling design –Simple Random Sampling (WR and

WOR), Use of Random Number Tables for selection of Simple Random Sample. Concept of Stratified Sampling, Determining sample size for Simple Random and Stratified Sampling under Equal, Proportional, Neyman's and Optimal allocations. Concept of Systematic sampling, Cluster, Multistage and Probability Proportional to Size (PPS) sampling along with their advantage and disadvantages. Non- probability sampling scheme: Judgment, convenience, quota and accident sampling scheme. Time series analysis: Introduction, Spatial, temporal and conditional series, Objectives of time series, components of time series: Trend, Seasonal, Cyclical and Irregular components. Measurement of trend: Graphical, Semi-Average, Moving Averages and Central Moving Averages, Isolation of trend by moving averages, Ordinary Least Squares (OLS), and fitting of trend. Index numbers: Concept and Definition, objectives of index numbers, advantages and limitations. Prerequisites of index numbers, Types of Index numbers: Price index number (retail and whole sale), Quantity index numbers, Value index numbers. Construction of Simple index numbers under simple aggregative and simple average of relatives (fixed and chain based) method. Construction of weighted index numbers under weighted aggregative method. Chain index number, conversion of chain base index number to fixed base index number, fixed base index number to chain base index number. Statistical Quality Control: Definition of control charts, uses of control charts, chance and assignable causes, parts of control charts (central line and control limits). Control charts for variables X-bar and R charts, control charts for fraction defective (p) and control charts for number of defects per unit. Operating characteristic curves for control charts.

Practical

Use of Random Number Tables for selection of Simple Random Sample (WR/WOR). Computing Mean and Variance for Simple random samples. Determining sample size for Simple Random samples. Determining sample size for Stratified Sampling under Equal, Proportional, Neyman's and Optimal allocation. Graphical presentation of various time-series components. Presenting trend line using Graphical and Semi-Average methods. Computation of Moving Average and Central Moving Average, Isolation of trend by moving averages. Fitting of trend line using Ordinary Least Squares (OLS). Construction of Price index number: Retail and Whole sale. Construction of Quantity index numbers and Value index numbers. Construction of Simple index numbers under simple aggregative and simple average of relatives (fixed and chain based) method. Construction of weighted index numbers under weighted aggregative method. Construction of Chain index number, conversion of chain base index number to fixed base index number, fixed base index number to chain base index number. Construction of X bar and R charts for variables. Construction of fraction defective (p) and number of defects per unit. Construction of Operating characteristic curves for control charts.

Suggested Readings

1. A Textbook of Agril. Statistics. R. Rangaswamy.
2. Advanced Practical Statistics. S.P. Gupta.
3. Fundamentals of Mathematical Statistics. S.C. Gupta and V.K. Kapoor.
4. Introduction to Time Series and Forecasting. Brockwell P.J and Davis RA.

5. Quality Control and Industrial Statistics. John Wiley. Duncan A.J.
6. Sampling Inspection Tables. Dodge H.F. and Romig H.G.
7. Sampling Techniques. Cochran W.G.
8. Statistical Methods in Quality Control. Cowden D.J.
9. Statistical Quality Control. Grant E.L. and Leavenworth R.S.
10. Survey Sampling Theory and Methods. Chaudhari A and Stenger H.
11. Time Series Analysis: Forecasting and Control. Box G.E.P., Jenkins G.M. and Reinsel G.C.

ABM 306	RURAL MARKETING	3(2+1)	SEM VI

Objectives

1. Understand the unique characteristics and challenges of marketing in rural areas
2. Learn strategies for reaching and engaging rural consumers effectively
3. Explore methods for adapting marketing tactics to suit rural market dynamics and preferences
4. Develop skills to identify market opportunities, create tailored marketing campaigns, and enhance rural market penetration for agricultural products and services

Theory

Definition, Scope and Nature of Rural Marketing. Constraints in Rural Marketing and Strategies to Overcome Constraints. Rural Consumer vs. Urban Consumers, Characteristics of Rural Consumers. Rural Market Environment: (a) Demographics; (b) Economic Factors; (c) Rural Infrastructure. Consumer behaviour: meaning and importance, Rural Consumer Behaviour: Meaning, Factors Affecting Rural Consumer Behaviour – Social Factors, Cultural Factors, Technological Factors, Lifestyle, Personality. Rural marketing strategies: Relevance of Marketing Mix for Rural Market/Consumers. Product Strategies- Rural Product Categories – FMCGs, Consumer Durables, Agriculture Goods and Services; Importance of Branding, Packaging and Labelling. Nature of Competition in Rural Markets, the Problem of Fake Brands. Rural market segmentation – occupational segmentation. Sociological segmentation, Thomson rural Market Index, MICA rural marketing ratings and Lin Quest Data. Pricing Strategies and Objectives, pricing policies - innovative pricing methods for rural markets. Promotional Strategies. Segmentation, Targeting and Positioning for Rural Markets. Distribution Strategies for Rural Consumers: Channels of Distribution- HAATS, Mandis, Public Distribution System, Co-operative Society, Distribution Models of FMCG, Model for Rural Markets (Case Study Based). Communication Strategy: Challenges in Rural Communication, Developing Effective Communication, Determining Communication Objectives, Designing the Message, Selecting the Communication Channels. Creating Advertisements for Rural Audiences. Rural Media – Mass media, Non-conventional Media, Personalized Media. Innovative Distribution Channels like ITC E-choupal, Godrej Adhar, HUL Shakti. Rural Retail Markets: Understanding the rural retail environment, Emergence of modern retail

markets in rural areas. Principles of Innovation for Rural Market Need for Innovation in Rural Market, Role of Government and NGOs in Rural Marketing.

Practical

Studying rural marketing environment, Rural Marketing Research, Process of research in Rural Markets, Sources and Methods of Data Collection, Data Collection Approaches in Rural Markets. Corporate Sector in rural marketing, Rural Specific Promotion Media and Methods. Field visits / case studies: Understanding the Rural Market – A Practical Approach Case Studies.

Suggested Readings

1. Acharya S.S. and N.L. Agrawal. Agricultural Marketing in India. Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
2. Memoria C.B. and R.L. Joshi. Principles and Practice of Marketing in India. Kitab Mahal, 15, Thorn hill Road, Allahabad.
3. Pradeep Kashyap (2012). Rural Marketing, Published by Dorling Kindersley (India) Pvt. Ltd.

ABM 307	BUSINESS RESEARCH METHODS	3 (2+1)	SEM V

Objectives

1. Understand various research methodologies and their application in business settings
2. Learn how to formulate research questions, design studies, and collect data for business analysis
3. Develop skills to critically evaluate research findings and apply them to business decision- making
4. Gain proficiency in using statistical tools and software for data analysis in business research

Theory

Business Research– Meaning, types, importance and characteristics of good research. Ethics in business research. Research proposal - purpose, types and its importance. Research process – Problem identification. Developing an Approach to the problem. Research design - definition, classification and types. Sampling design- Meaning, steps in sampling design and process. Types of sampling: Probability and Non-probability sampling. Determining sample size. Meaning and types of Sampling error. Data sources – primary and secondary data types. Data Collection Methods: Observations, survey and interview. Focus group discussion and panel data. Measurement and scaling techniques – basic scales of measurement, scaling techniques. Attitude measurement – Likert scale. Data editing, coding, classification, tabulation. Data Analysis – qualitative and quantitative methods. Use of parametric and nonparametric tests: T-test, Z-test, F-test, Chi-square test and ANOVA and its applications – Correlation, simple and multiple regression techniques. Steps in report writing.

Practical

Preparing business research proposal – Problem identification and research questions, formulation of research design, sampling framework and hypothesis. Data mining - Collection of primary and secondary data – Sources. Preparation of interview schedule and questionnaire for primary data collection - Administration of mailed questionnaire and on-line survey. Conducting field level enquiry and data collection. Organizing other methods of data collection - Focus group discussion/panel data collection / observation / case study. Application of scaling techniques in business research. Data editing - coding and tabulation - Application of statistical tools (Descriptive statistics) in business research. Understanding cause and effect and functional relationships among the variables.

Suggested Readings

1. Cooper D.R. and P. S. Schindler, 2007, Business Research Methods, Tata McGraw Hill Company Ltd.
2. Kothari C.R., 2007, Research Methodology, New Age International Publishers.
3. Andrea Ahlemeyer-Stubbe and Shirley Coleman, A Practical Guide to Data Mining for Business and Industry, John Wiley and Sons Limited, United Kingdom (e book).
4. Ledolter, Johannes, Data Mining and Business Analytics with R, John Wiley and Sons, New Jersey (***e - Book***).

ABM 308	**AGRIBUSINESS PROJECT MANAGEMENT**	**3 (2+1)**	**SEM VI**

Objectives

1. Understand the principles and practices of project management specific to the agribusiness sector
2. Learn to plan, execute, and monitor agribusiness projects effectively, considering factors such as time, cost, and resources
3. Explore risk assessment and mitigation strategies to ensure successful project outcomes in agricultural settings
4. Develop skills to lead teams, coordinate activities, and communicate effectively to stakeholders in agribusiness projects

Theory

Meaning and definition of project, general features of projects, importance and objectives of project analysis. Categories of projects based on various criteria. Project cycle, stages of project cycle – conception, formulation, appraisal, implementation, monitoring and evaluation. Criteria for appraising projects – ex-ante and ex-post evaluation. Differences between economic and financial analysis in project evaluation. Costs and benefits of agribusiness projects, comparing costs and benefits of agribusiness projects. Externalities – meaning and definition, positive externalities, negative externalities and internalization of externalities, divergence between social costs and benefits of a project. Undiscounted measures of project worth – Accounting Rate of Return (ARR), ranking by inspection, payback period, proceeds per rupee of outlay and average annual proceeds per rupee of outlay. Time value of money -

compounding and discounting, choice of discount rate. Discounted cash flow measures of project appraisal – Net Present Worth (NPW), Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR). Risk and uncertainty. Sensitivity analysis, general kinds of sensitivity analyses, social cost benefit analysis, and rationale for social cost benefit analysis. Project management– meaning, importance and triple constraint. Project management structures functional organization, project organization and matrix organization - meaning, advantages and disadvantages. Project Rating Index (PRI), Work Breakdown Structure (WBS) and Responsibility Assignment Matrix (RAM / RACI). Network analysis – CPM and PERT. Project financing - sources of financing a project. Business incubators - definition, types and their benefits. Project control monitoring time performance (Gantt Charts, Control Charts), performance index and per cent complete index. Project audit and project closure.

Practical

Generation of agribusiness project ideas, project proposals in agribusiness sector (private and public), exercises on feasibility studies and formulation of detailed project proposals. Investment analysis - undiscounted measures and discounted measures of project worth. Review of case studies pertaining to management of agribusiness projects.

Suggested Readings

1. Austin James .1992. Agro Industrial Project Analysis Critical Factors. John Hopkin University Press, London.
2. Joseph Phillip Hella and Daniel Wilson Ndyetabula. 2012. Agribusiness Project Appraisal: Theory and Applications, Intersperses – Tanzania.
3. Prasanna Chandra, 2014. Projects: Preparation. Appraisal, Budgeting and Implementation, Tata McGraw Hill.
4. Price Gittinger, J. 1982. Economic Analysis of Agricultural Projects. John Hopkins University Press.
5. UNIDO. 1978. Manual for Preparation of Industry Feasibility Studies. United Nations.

ABM 309	COOPERATIVES AND PRODUCERS' ORGANIZATIONS	3 (2+1)	SEM V

Objectives

1. Understand the principles and structures of cooperatives and producers' organizations in agriculture
2. Learn about the benefits and challenges of cooperative business models for smallholder farmers and producers
3. Explore strategies for organizing, managing, and governing agricultural cooperatives and producers' organizations effectively
4. Develop skills to foster collaboration, collective marketing, and value addition through cooperative and producer-led initiatives in agriculture

Theory

Management of cooperative enterprises: Concept, Meaning, definition, unique features– Issues in cooperative management–Cooperative Governance-Human resource development in cooperatives- Professionalization of cooperatives. Co-operative management structure: Role and responsibilities of General Body, Board of Directors, President and Chief Executive Officer. Decision making in cooperatives-Performance evaluation parameters for co-operatives. Capital and cooperatives–Meaning-Purpose of Equity-Equity Management and cooperatives -The Importance of Financial Planning -Equity Types -Equity Management Considerations. Producer Organizations: concept, meaning, types, characteristics and scope. Process guidelines for promotion of FPOs. Steps in Registration of PCs. Management of Producer Companies: Membership, Powers of General Body, powers of Executive Committee, Funds, accounts and audit, appropriation of net profit. Role of central and state governments in supporting FPOs, Role of NABARD in promoting Producer Organizations.

Practical

Case studies on evaluation of the performance of co-operative organisations. Case studies on democratic decisions and ethical dilemma. Assessing capital requirements of a Producer Company, Assessment of financial viability of the business of Producer Companies, Assessing institutional performance of Producer Company.

Suggested Readings

1. A Guide Book for Producer Organization (PO) and Producer Group (PG), 2018 by Prabir Datta.
2. Farmer Producer Organisations, 2015, National Bank for Agriculture and Rural Development.
3. Making Farmer Producer Organizations Achieve Viability: A Practical Guide, 2021 by Sanjiv Phansalkar and Avinash Paranjape.
4. State of Sector Report - Farmer Producer Organizations in India, 2021 by Sanjiv Phansalkar, Vedprakash, Aneesha Bali and Anish Kumar.

ABM 310	STRATEGIC BUSINESS MANAGEMENT	3 (2+1)	SEM VI

Objectives

1. Understand the concepts and frameworks of strategic management
2. Learn to analyze internal and external factors influencing business strategy
3. Develop skills to formulate, implement, and evaluate strategic plans to achieve organizational objectives
4. Explore strategies for sustainable growth, competitive advantage, and adaptation to dynamic business environments

Theory

Introduction to Strategies: Introduction, Fundamentals of Strategy, Conceptual Evolution of Strategy, Scope and Importance of Strategies. Strategic Management: Introduction, Need, scope, key features and importance of strategic management.

Strategists at various management levels, Types of Strategies, Limitations of Strategic Management. Strategy Analysis and its Importance. The External Environment-The General, Industry, and Competitor Environments-External Environmental Analysis -Scanning–Monitoring-Forecasting–Assessing. Segments of the General Environment-The Demographic Segment-The Economic Segment-The Political/Legal Segment - The Socio-cultural Segment - The Technological Segment - The Global Segment-Industry Environment Analysis- Competitor Analysis-Ethical Considerations. The Internal Environment-The Nature of Internal Environmental Analysis -The Context of Internal Analysis-Creating Value -The Challenge of Internal Analysis-Resources, Capabilities, and Core Competencies-Building Core Competencies - Value Chain Analysis –Outsourcing-Competencies, Strengths, Weaknesses, and Strategic Decisions.

Business-Level Strategy -The Purpose of a Business-Level Strategy -Types of Business-Level Strategies -Cost Leadership Strategy -Differentiation Strategy - Focus Strategies -Integrated Cost Leadership/Differentiation Strategy. Competitive Rivalry and Competitive Dynamics-Competitor Analysis-Market Commonality - Resource Similarity -Drivers of Competitive Actions and Responses
- strategic and Tactical Actions type of Competitive Action.

Corporate-Level Strategy-Levels of Diversification-Value-Creating Diversification: Related Constrained and Related Linked Diversification -Unrelated Diversification - Value-Neutral Diversification: Incentives and Resources -Value-Reducing Diversification: Managerial Motives to Diversify. Acquisition and Restructuring Strategies -Merger and Acquisition Strategies - Reasons for Acquisitions - Restructuring -Downsizing -Downs coping. International Strategy -Identifying International Opportunities: Incentives to Use an International Strategy-International Business-Level Strategy -International Corporate-Level Strategy-Environmental Trends-Risks in an International Environment -Political Risks -Economic Risks. Cooperative Strategy -Strategic Alliances as a Primary Type of Cooperative Strategy-Business-Level Cooperative Strategy Corporate-Level Cooperative Strategy-International Cooperative Strategy -Network Cooperative.

Practical

Case studies of agribusiness units with respect to their objectives and evaluation of their business strategies, strategic alliances, strategy implementation, implications and challenges.

Suggested Readings

1. Global Strategic Management, 2015 by Jedrzej George Frynas and Kamel Mellahi.
2. Strategic Management: Planning for Domestic and Global Competition, 2018, by John A. Pearce, Richard B. Robinson, and Amita Mital.
3. Strategic Management and Business Policy: Globalization, Innovation and Sustainability, 2018, by Thomas L. Wheelen, J. David Hunger and Alan N. Hoffman.
4. The Secrets of Strategic Management: The Ansoffian Approach, 2006 by Igor H. Ansoff and Peter H. Antoniou.

ABM 311	SOCIAL ENTREPRENEURSHIP	1(1+0)	SEM V

Objectives

1. Understand the concept and principles of social entrepreneurship
2. Learn about innovative business models that address social and environmental challenges
3. Explore strategies for creating sustainable social impact while ensuring financial viability
4. Develop skills to identify social problems, design solutions, and implement projects that benefit communities

Theory

Social Entrepreneurship: concept, meaning, historical perspective of social entrepreneurship. Factors impacting transformation into social entrepreneurship. Characteristics of social entrepreneurs. Differences between business and social enterprise. Forms of social enterprises, Profit and non-profit Proprietorships, partnership and company; Non-Governmental organisation, Trust and Company. Third Sector Organizations (TSOs) and social enterprises. Similarities and differences with other forms of enterprises. Organisation of social enterprise. Financing of social enterprise. Legal compliance and management of resistance. Management: strategy, finance, HRM and marketing. Governance challenges - accountability, transparency and democracy. Measurement of social outcomes and impact, social accounting, social return on investment. Innovations in social enterprises. Successful social enterprises in India.

Suggested Readings

1. Bornstein, David and Susan Davis. 2010. Social Entrepreneurship: What Everyone Needs to Know? Oxford University Press, New York.
2. Bornstein, David. 2007. How to Change the World: Social Entrepreneurs and the Power of New Ideas. Oxford University Press, New York.
3. Doherty, Bob, George Foster and Chris Mason. 2009. Management for Social Enterprise. Sage Publications, USA.
4. International Journal of Social Entrepreneurship and Innovation, Inder science.
5. Journal of Social Entrepreneurship, Taylor and Francis.
6. Praszkier, Ryszard and Andrzej Nowak. 2011. Social Entrepreneurship: Theory and Practice. Cambridge University Press, Cambridge.
7. Yunus, Muhammad. 2010. Building Social Business: The New Kind of Capitalism that Serves Humanity's Most Pressing Needs. Public Affairs, New York.

ABM 312	COMMODITY FUTURES TRADING	2 (2+0)	SEM VI

Objectives

1. Understand the fundamentals of commodity futures markets and their role in price discovery and risk management

2. Learn about trading strategies, including hedging and speculation, to manage price volatility
3. Explore the regulatory framework and operational aspects of commodity futures trading
4. Develop skills to analyze market trends, assess risk-reward scenarios, and make informed trading decisions in commodity futures markets

Theory

History and Evolution of commodity markets – Terms and concepts: spot, forward and futures, Markets – factors influencing spot and future markets. Speculatory mechanism in commodity futures. Transaction and settlement – delivery mechanism - role of different agents - trading strategies - potential impact of interest rate, Foreign Exchange, FDI in Commodity Markets. Risk in commodity trading, importance and need for risk management measures - managing market price risk: hedging, speculation, arbitrage, swaps - pricing and their features. Important global and Indian commodity exchanges - contracts traded – special features -Regulation of Indian commodity exchanges – SEBI and its role. Fundamental vs Technical analysis – construction and interpretation of charts and chart patterns for analyzing the market trend – Market indicators – back testing. Introduction to technical analysis software – analyzing trading pattern of different commodity groups.

Suggested Readings

1. Acharya, S.S., 1988, Agricultural Production, Marketing and price policy- A study of Pulses, Mittal Publications, Delhi.
2. Jagadish Prasad, 1966, Encyclopedia of Agricultural Marketing, Mittal Publishers Pvt. Limited, Bombay.
3. Kahlon, A.S. and George, M.V., 1965, Agricultural Marketing and Price Policies, Allied Publishers Private Limited, New Delhi.
4. Nayyar, H. and Ramaswamy, P., 1995, Globalization and Agricultural Marketing, Rawat Publications, Jaipur
5. Prasad, A. Shivarama, Agricultural Marketing in India, Mittal Publications, Delhi.
6. Singhal, A.K., 1989, Agricultural Marketing in India, Anmol Publications, New Delhi.

ABM 401	AGRO-TOURISM	4 (0+4)	SEM VII

Objectives

1. Understand the concept and potential of agro-tourism as a form of rural development
2. Learn about the principles and practices of sustainable agro-tourism operations.
3. Explore strategies for integrating agriculture, tourism, and hospitality to create unique visitor experiences
4. Develop skills to plan, market, and manage agro-tourism enterprises that contribute to local economies and promote cultural exchange

Practical

Agro-tourism: Introduction, importance, scope, forms of agro-tourism, advantages and implementations, introduction to Indian culture. Govt. policies and legislations in respect of tourism and agro-tourism and environment protection laws. Requirements for Agro-tourism. Farm, forest, garden, fish tank/ponds, residential huts, etc. Constraints in operation and management of Agro-tourism activities. Management of resources – Human resources, Natural resources and Garbage management at Agro-tourism centre. Entrepreneurship development: Role and functions, Hospitability: Food and beverages and accommodation services. Communication skill and service; Capital investment, sources and capital budgeting. Project proposal- Preparation and feasibility tests, Accounts and record keeping etc. Marketing strategies for Agro-tourism products and services. Publicity of tourism- Advertisement and use of media.

Suggested Readings

1. Agritourism, by M. Sznajder, L. Przezbórska and F. Scrimgeour.
2. Agrotourism Management: A Complete Practical Guide, 2020, by S. G. Walke, Atul Kumar and Vinaydeep Brar.
3. The New Agritourism, January 2008, by Barbara Berst Adams.

ABM 402	SEED BUSINESS MANAGEMENT	4 (0+4)	SEM VII

Objectives

1. Understand the principles of seed business management, including production, marketing, and distribution
2. Learn strategies for quality control, seed certification, and regulatory compliance in seed industry operations
3. Explore market analysis and branding techniques to enhance seed sales and market share
4. Develop skills to develop and implement business plans that ensure profitability and sustainability in the seed industry

Practical

Seed Technology – Role of Seed Technology, Seed Industry in India, National Seed Corporation, State Seed Corporations, National Seed Project and State Farms and their role. Development and Management of Seed Program s – Seed Village Concept, Basic Strategy of Seed Production and Planning and Organization of Seed Program; Types of Seed Program – Nucleus seed, Breeders seed, Foundation seed and Certified seed etc. Maintenance of genetic purity – Minimum seed certification standard and Management of breeders and Nucleus seed; Management of seed testing laboratory and research and development. Management of seed processing plant, seed storage management; seed packaging and handling. Seed Marketing; GM Crop seed, IPR, PBR, Patents and related issues and their impact on developing countries; Statutory intervention in the seed industry; Seed legislation and seed law enforcement, Seed act; Orientation and visit to seed production farms, seed processing Units, NSC, SSC and seed testing laboratories.

Suggested Readings

1. Agricultural Marketing in India, 2021, by S.S. Acharya and N.L. Agarwal.
2. Seed Technology and Management, 2021, by Dr. Bilal Ahmad Wani.
3. Seed Technology Processing Storage and Marketing by Kanwar H S *et al.*, Jain Brothers.
4. Vegetable Hybrid Seed Production and Management, 2010, by K. Vanangamudi.

ABM 403	FERTILIZER RETAILING	4 (0+4)	SEM VII

Objectives

1. Understand the principles of fertilizer retailing, including product knowledge, sales techniques, and customer service
2. Learn about inventory management, pricing strategies, and distribution logistics in fertilizer retail operations
3. Explore marketing strategies to attract and retain customers, including promotions and loyalty programs
4. Develop skills to effectively manage fertilizer retailing operations, optimize sales, and maximize profitability while meeting regulatory requirements and ensuring environmental stewardship

Practical

Fertilizer development – concept, scope, need, resource availability; import and export avenues for fertilizer; types of fertilizers, grading and chemical constituents, role of fertilizers in agricultural production, production and consumption of fertilizer in India. Raw material needed and principles of manufacturing of nitrogenous, phosphatic and potassic fertilizers, secondary nutrient sources and micronutrient formulations. Production efficiency and capacity utilization; quality control and legal aspects- fertilizer control order. Testing facilities; constraints in fertilizer use and emerging scenario of fertilizer use; assessment of demand and supply of different fertilizers, fertilizer distribution, fertilizer storage. Field trials and demonstration, fertilizer pricing policy; scope of biofertilizer; environmental pollution due to fertilizer use.

Suggested Readings

1. Growing Gardens, Building Power: Food Justice and Urban Agriculture (Nature, Society, and Culture), 2022, by Justin Sean Myers.
2. Retailing Management | 9th Edition, 2021, by Michael Levy, Barton Weitz and Dhruv Grewal.
3. Soil Fertility and Fertilizers: An Introduction to Nutrient Management, 2016, by Kindly Edition
4. The Retail Start-Up Book: Successfully Plan, Launch and Grow a Business, 2022, by Rowland Gee, Danny Sloan and Graham Symes.

ABM 404	FOOD RETAIL BUSINESS MANAGEMENT	4 (0+4)	SEM VII

Objectives

1. Understand the principles of food retail management, including product assortment, merchandising, and customer service
2. Learn about inventory management, supply chain logistics, and pricing strategies in food retail operations
3. Explore marketing techniques to attract and retain customers, including promotions, branding, and store layout optimization
4. Develop skills to effectively manage food retail businesses, ensure food safety, and meet consumer demands in a competitive market environment

Practical

Introduction to International Food market, India's Competitive Position in World Food Trade, Foreign Investment in Global Food Industry, Retail management and Food Retailing, The Nature of Change in Retailing, Organized Retailing in India, E-tailing and Understanding Food Preference of Indian Consumer, Food Consumption and Expenditure pattern, Demographic and Psychographic Factors Affecting Food Pattern of Indian Consumer. Value Chain in Food Retailing, Principal trends in food wholesaling and retailing, food wholesaling, food retailing, the changing nature of food stores, various retailing formats, competition and pricing in food retailing, market implications of new retail developments, value chain and value additions across the chain in food retail, food service marketing. 4 P's in Food Retail Management, Brand Management in Retailing, Merchandise pricing, Pricing Strategies used in conventional and non-conventional food retailing, Public distribution system, Promotion mix for food retailing, Management of sales promotion and Publicity, Advertisement Strategies for food retailers. Managing Retail Operations, Managing Retailers' Finances, Merchandise buying and handling, Merchandise Pricing, Logistics, procurement of Food products and Handling Transportation of Food Products. Retail Sales Management Types of Retail Selling, Salesperson selection, Salesperson training, Evaluation and Monitoring, Customer Relationship Management, Managing Human Resources in retailing, Legal and Ethical issues in Retailing.

1. Berman, B. and Evans, J.R. 2009. Retail management. Pearson Education, New Delhi, 343p.
2. CII Global Retail Report, Confederation of Indian Industry, New Delhi.
3. Hasty, R. and Reardon, R.1997. Retail management. McGraw Hills Education, New Delhi, 339p.
4. Journal of Retailing. Elsevier, Netherlands.
5. Singh, H. 2014. Retail Management: A global perspective: Text and Cases. S. Chand and Co Ltd, New Delhi, 871p.
6. Journal of Business and Retail Management Research, Academy of Business and Retail Management, UK.

ABM 405	SUPPLY CHAIN MANAGEMENT OF AGRICULTURAL COMMODITIES	4 (0+4)	SEM VII

Objectives

1. Understand the principles and practices of supply chain management specific to agricultural commodities
2. Learn to optimize the flow of agricultural products from farm to consumer, including procurement, transportation, and distribution
3. Explore strategies for inventory management, storage, and quality control to minimize waste and ensure product integrity
4. Develop skills to coordinate and integrate activities along the agricultural supply chain to enhance efficiency, reduce costs, and meet customer demands

Practical

Supply Chain: Changing Business Environment; SCM: Present Need; Conceptual Model of Supply Chain Management; Evolution of SCM; SCM Approach; Traditional Agri. Supply Chain Management Approach; Modern Supply Chain Management Approach; Elements in SCM. Demand Management in Supply Chain: Types of Demand, Demand Planning and Forecasting; Operations Management in Supply Chain, Basic Principles of Manufacturing Management. Procurement Management in Agri. Supply chain: Purchasing Cycle, Types of Purchases, Contract/Corporate Farming, Classification of Purchases Goods or Services, Traditional Inventory Management, Material Requirements Planning, Just in Time (JIT), Vendor Managed Inventory Logistics Management: History and Evolution of Logistics; Elements of Logistics; Management; Distribution Management, Distribution Strategies; Pool Distribution; Transportation Management; Fleet Management; Service Innovation; Warehousing; Packaging for Logistics, Third-Party Logistics (TPL/3PL); GPS Technology. Concept of Information Technology: IT Application in SCM; Advanced Planning and Scheduling; SCM in Electronic Business; Role of Knowledge in SCM; Performance Measurement and Controls in Agri. Supply Chain Management- Benchmarking: introduction, concept and forms of Benchmarking.

Suggested Readings

1. Groznik, A. and Xiong, Y. 2014. Pathways to Supply Chain Excellence. CC BY Intech Publishers, USA, 342p.
2. Kaplinsky, R. and Morris, M. 2014. A Handbook for Value Chain Analysis. IDRC, UK, 217p.
3. Miller, C. and Jones, L.M. 2010. Agricultural Value Chain Finance: Tools and Lessons Food and Agriculture Organization of United Organizations, Italy, 321p.
4. Springer, H.A. 2007. Value links: The methodology of value chain promotion. GIZ LRED, South Africa, 290p.
5. Vermeulen, S., Woodhill, J., Proctor, F. and Delnoye, R. 2014. Chain-wide learning for inclusive agri-food market development. IIED, 398p.

ABM 406	AGRI-EXPORT MANAGEMENT	4 (0+4)	SEM VII

Objectives

1. Understand the principles and practices of exporting agricultural products
2. Learn about international trade regulations, documentation, and logistics specific to agri- exports
3. Explore market analysis and market entry strategies to identify and capitalize on export opportunities
4. Develop skills to manage export operations effectively, negotiate contracts, and navigate global markets to maximize returns for agricultural products

Practical

International Trade - meaning, definition, nature and scope. Salient features of international trade, differences between internal trade and international trade, advantages and disadvantages of international trade.

Theories of international trade - mercantilism, theory of absolute cost advantage, theory of comparative cost advantage and modern theory of international trade. Terms of trade - meaning and types. Free trade - meaning, advantages and disadvantages, free trade agreements.

Protectionism - meaning, advantages and disadvantages of protectionism, types of protection- tariffs, quotas, subsidies, dumping, cartels and commodity agreements. Balance of Trade (BoT) and Balance of Payments (BoP) - meaning, differences between BoT and BoP, India's BoT and BoP position. Foreign exchange – meaning, foreign exchange rate, types of foreign exchange rate, mechanisms of determining foreign exchange rate. Foreign exchange market – meaning and functions, instruments of international payments, foreign exchange control and foreign exchange reserves.

WTO – origin, structure, objectives and functions. Agreement on Agriculture - domestic support, market access and export subsidies. FAO / WHO Codex Alimentarious and SPS measures.

Export procedures and documentations, types of export - direct export and indirect export, export houses – objectives and types. Agricultural export promotion organizations - APEDA, MPEDA, Commodity Boards and State Export Promoting Agencies. India's agricultural exports and imports – composition and trading countries. India's foreign trade policy – meaning and objectives.

Suggested Readings

1. Agricultural Exports of India, by Priya Kumari.
2. Export Import Management, 2nd edn by Justin Paul and Rajiv Aserkar, Oxford.
3. Innovations in Agri-Business Management, 2009, by Karnam Lokanadhan.
4. Management of Agribusiness and Agri Exports ,2022, by Rupali Bipin Sheth, Nutan Thoke and Asmita V. Kulkarni.

ABM 407	HI-TECH HORTICULTURE/ PROTECTED CULTIVATION	4 (0+4)	SEM VII

Objectives

1. Understand the principles and techniques of hi-tech horticulture, including protected cultivation methods
2. Learn about advanced technologies such as greenhouse and hydroponic systems for optimized crop production
3. Explore strategies for climate control, irrigation, and nutrient management to maximize yield and quality in protected cultivation
4. Develop skills to implement and manage hi-tech horticulture practices for sustainable and profitable crop production

Practical

Introduction, importance and scope of hi-tech horticulture in India, Hi-tech nursery management and mechanization of horticultural crops, Micropropagation of horticultural crops, Hi-tech field preparation and planting methods, Protected cultivation: Advantage and constraints, Environmental control in green house-temperature, light, CO_2, relative humidity and ventilation methods and techniques, Micro irrigation systems and its components, EC/pH based irrigation/ fertigation scheduling, Hi-tech canopy management of horticultural crops, High density orcharding in Mango, guava, papaya, citrus, pineapple etc, Remote sensing and geographical information system, Differential geo-positioning system (DGPS), Component of precision farming and application of precision farming in horticultural crops (fruit, vegetables and ornamental crops 2 crops each), Mechanized harvesting produce, Post harvest management for export

Suggested Readings

1. Hi Tech Horticulture (Pb) by Prasad and S Et Al, Agrobios
2. Protected Cultivation by Pradhan, Adikant, Satish Serial Publishing House
3. Protected Cultivation of Horticulture Crops by Prabhakar, Itigi
4. Textbook of Protected Cultivation and Precision Farming For Horticultural Crops by Kumar, B Ashok et al, Jain Brothers

ABM 408	PACKAGING AND BRANDING OF AGRICULTURAL COMMODITIES	4 (0+4)	SEM VII

Objectives

1. Understand the importance of packaging and branding in enhancing the marketability of agricultural commodities
2. Learn about effective packaging materials, designs, and techniques for preserving product quality and attracting consumers
3. Explore branding strategies to differentiate agricultural products, build brand equity, and create value for consumers
4. Develop skills to design, implement, and evaluate packaging and branding strategies that meet market demands and enhance competitiveness in the agricultural sector

Practical

Customer: How to Identify Customer Needs, How to Make Product Development as per the Customer need, Recent Trends in Marketing, Target Customer (Definition and general Info), Psychographics (lifestyle, Hobbies, behavior pattern), Demographics (Age, Education, gender.), Consumer segmentation.

Food Processing: What is Food Processing. Processing stages for Various products, Methods of Food Preservation.

Food Packaging: Introduction to food packaging and opportunities for start-ups, Food packaging materials: (Paper, metal, glass, plastics and cardboard), Food Packaging: an important tool for nutrition, safety and effective marketing, Food Packaging Machinery, Selection Criteria for Food Packaging system, Types of Packaging, Advances in food packaging (or A peep into the future of food packaging).

Branding: What is Brand? Communication platform between customer and product, What are their characteristics? Why does the product need branding? How does branding help? What are the drivers? Branding ideas (case studies).

How To Promote Branding: How to get prominence? Visual Merchandising, Retail Merchandising, How does the Branding category help?

Suggested Readings

1. Agricultural Marketing in India by S.S. Acharya and N.L. Agarwal, 202.1
2. Cultures of Commodity Branding (UCL Institute of Archaeology Publications) by Andrew Bevan and David Wengrow, 2016 Kindle Edition.
3. From Commodity To Experience - Why Semiconductor Branding Is Important Now? by A Singh, 2011.
4. Modified and Controlled Atmospheres for the Storage, Transportation, and Packaging of Horticultural Commodities, by Elhadi M. Yahia, 2009.

ABM 409	E-COMMERCE IN AGRIBUSINESS	4 (0+4)	SEM VII

Objectives

1. Understand the principles and dynamics of e-commerce within the context of agribusiness
2. Learn about e-commerce platforms, technologies, and strategies for marketing and selling agricultural products online
3. Explore the benefits and challenges of e-commerce adoption in agribusiness, including logistics, payment systems, and customer engagement
4. Develop skills to leverage e-commerce opportunities to reach wider markets, increase sales, and improve efficiency in agricultural trade

Theory

Introduction- meaning and forces behind E-commerce, industry framework, brief history of E-commerce, advantages of E-commerce, Inter-organizational E-commerce, Intra organizational E-commerce, Pure v/s Partial E-commerce. Network infrastructure for E-commerce, the internet, intranets and extranets as E-commerce infrastructure. Encryption- WWW and security encryption, transaction security,

secret key encryption, public key encryption, virtual private network, implementation management issues; Electronic payments- overview of E-payments, digital token based electronic payment system, smart cards, credit cards / debit cards based electronic payment system, emerging financial instruments, home banking and online banking. Electronic Data Interchange (EDI), Development of EDI, Application of EDI in business, legal requirements in E-commerce. Introduction of Ecommerce in supply chain management (SCM) and customer relationship management (CRM). E-commerce standards- Introduction, types of standards, document translation standards. E-commerce law- introduction, E-commerce transaction, electronic fund transaction act and regulation, forms of agreement, legal issues in Indian scenario. Mobile commerce introduction to M-commerce, mobile computing application s, wireless application protocols, WAP technology. Web Security- Introduction to web security, firewalls and transaction security, client server network, emerging client server security threats, firewalls and network security.

Practical

E-commerce- case studies of which include six success stories like India times. com, Rediff. com, Baazee. com, SAIL, ITC- E-choupal, AMUL, Digital Marketing- Introduction, the effects of E-business technologies on marketing strategy, First generation marketing tools- Email marketing, online marketing, search marketing, affiliate marketing. Second generation digital marketing tools and viral marketing, Future challenges and opportunities of E-commerce.

Suggested Readings

1. Agribusiness Management Theory and Practices by Dr Shoji Lal Bairwa and Dr Ch and ra Sen and Dr L K Meena and Dr Meera Kumari, Write and Print Publications
2. Agribusiness Management, January 2019, by Biswas and Giri Mishra, Himalaya Books Pvt. Ltd.
3. Books from same Author: Dr Shoji Lal Bairwa and Dr Ch and ra Sen and Dr L K Meena and Dr Meera Kumar
4. E-Commerce Business: The Essential Guide to E-Commerce Success, Learn All the Valuable Information You Need in Starting a Successful E-Commerce Business S.P. Suarker, Oct 2020 · Author's Republic. Narrated by Marcus Mulenga

ABM 410	STORAGE AND WAREHOUSING OF AGRICULTURAL COMMODITIES	4 (0+4)	SEM VII

Objectives

1. Understand the principles of storage and warehousing for agricultural commodities
2. Learn about storage techniques, facilities, and equipment used to maintain product quality and minimize losses
3. Explore strategies for inventory management, handling, and distribution to optimize storage efficiency and reduce post-harvest losses

4. Develop skills to design, manage, and operate storage and warehousing facilities effectively to ensure the availability of high-quality agricultural commodities for market

Practical

Distribution management - storage and warehousing and transportation management for agricultural products; marketing agencies/intermediaries – roles and functions; distribution channels involved in agribusiness.

Suggested Reading

1. Agricultural Marketing in India by S.S. Acharya and N.L. Agarwal, 2021.
2. Emerging Trends in Agricultural Marketing in India by Ashok M. V, 2021.
3. Groznik, A. and Xiong, Y. 2014.Pathways to Supply Chain Excellence.CC BY Intech Publishers, USA,342
4. Modified and Controlled Atmospheres for the Storage, Transportation, and Packaging of Horticultural Commodities, by Elhadi M. Yahia, 2019.

ABM 411	LOGISTICS MANAGEMENT OF AGRICULTURAL COMMODITIES	4 (0+4)	SEM VII

Objectives

1. Understand the principles of logistics management as applied to agricultural commodities
2. Learn about transportation, inventory management, and supply chain optimization techniques specific to agricultural logistics
3. Explore strategies for efficient handling, storage, and distribution of agricultural products to minimize costs and maximize value
4. Develop skills to plan, coordinate, and execute logistics operations effectively to ensure timely delivery and quality preservation of agricultural commodities

Practical

Introduction to physical distribution, Logistics management, Logistics Management and its elements, Modern Concepts in Logistics, Role of logistics in strategy, Inbound and outbound supply chain management, Container – types, Different types of cargo, Packaging and Material Handling, Introduction to supply Chain Management (SCM), Sourcing, Transportation, Indian supply chain architecture, Introduction to warehousing, Warehouse functions, Warehouse types, Warehouse providing value added services, Warehouse internal operations, Warehousing equipment, Inventory, Safety and security in warehouses, Future trends in warehousing, Introduction – recent developments in logistics, Transport and mobility technologies, Green logistics, Cold chain logistics, Block chain and big data analytics in logistics, 3 D printing and wearable devices in logistics, Transport Services, Costing and Performance, Administration and Control and use of IT.

1. Ballou, R.H. and Samir, K. 2012. Business logistics/Supply chain management. Pearson Education, New Delhi, 429p.

2. Groznik, A. and Xiong, Y. 2014.Pathways to Supply Chain Excellence. CC BY Intech Publishers, USA,342p.
3. Kaplinsky, R. and Morris, M. 2014.A Handbook for Value Chain Analysis. IDRC, UK, 217p.
4. Miller, C. and Jones, L. M. 2010. Agricultural Value Chain Finance: Tools and Lessons Food and Agriculture Organization of United Organizations, Italy,321p.
5. Springer, H. A. 2007. Value links: The methodology of value chain promotion. GIZ LRED, South Africa, 290p.
6. Vermeulen, S., Woodhill, J., and Proctor, F., and Delnoye, R.2014. Chain-wide learning for inclusive agri-food market development. IIED, 398p.

ABM 412	CUSTOM HIRING OF AGRICULTURAL MACHINERY	4 (0+4)	SEM VII

Objectives

1. Understand the principles and benefits of custom hiring services for agricultural machinery
2. Learn about the management and operation of custom hiring centers for efficient machinery utilization
3. Explore strategies for providing cost-effective machinery services to smallholder farmers and agricultural communities
4. Develop skills to assess demand, set pricing, and manage logistics effectively in custom hiring operations to support sustainable agricultural practices

Practical

Understand general discipline in the class room and workshop (Do's and Don'ts) Study the scope and importance of Farm Mechanization industry in India Familiarize with different farm machineries' manufacturers and their brands/models Understand the role of a Custom Hiring Service Provider and the progression pathways State the importance of entrepreneurship Select entrepreneurship as an alternate career option State customer hiring centre meaning and its role in promotion Explain the differences between entrepreneurship, self employment and wage employment Discuss case studies, video presentation, group discussion, debates and exercise in entrepreneurship activities Discuss and interact with successful entrepreneurs and business people in a similar field to gain expertise State the role and reward of entrepreneurship Explain the need and importance of market assessment List components and techniques of market survey/ assessment Explain demand analysis and assessment of farmers needs Identify possible sources of finance/loan Identify potential customers and maintain customer database Conduct target market assessment and decide positioning of products/ services which is easily accessible to potential buyers List criteria for selection of location for conducting business Understand government laws, local state laws and other regulations for business activity Identify distribution and marketing channels considering the requirements and constraints associated with the same Estimate costing and pricing Calculate risk assessment in business Identify opportunities for scaling up the business Collect

information related to various subsidies/funds/ schemes offered by the government, authorized state units and other financial institutions Track and maintain records, and monitor them on a regular basis Explain promotional strategies for the business based on the budget and target segment State minimizing costs and maximizing profits steps Select the machineries for Custom Hiring Centre.

Suggested Readings

1. Review of and recommendations for custom hiring centers for mechanization in Nepal and the Asian region: 2021, by Food and Agriculture Organization
2. Testing, Evaluation of Agricultural Machinery, Equipment, by Smith, 2020
3. Testing and Evaluation of Agricultural Machinery 2nd Revised and Enlarged Edn by M L Mehta
4. Unit Operations of Agricultural Processing by K.M. Sahay and K.K Singh, 2004

ABM 413	APPLICATION OF ICT IN AGRIBUSINESS	4 (0+4)	SEM VII

Objectives

1. Understand the role and importance of Information and Communication Technology (ICT) in agribusiness
2. Learn about various ICT tools and applications for farm management, market analysis, and supply chain optimization
3. Explore strategies to leverage ICT to enhance productivity, efficiency, and competitiveness in agribusiness operations
4. Develop skills to implement and integrate ICT solutions effectively to address challenges and capitalize on opportunities in the agricultural sector

Practical

Introduction and scope of ICT in Agriculture, Need for ICT in Agricultural Extension. National Policies on ICT in Agricultural Extension. Role of communications in ICT: Concept, elements and their characteristics. Message: meaning, dimensions of a message characteristics of a good message, message treatment and effectiveness, distortion of message. Methods of communication: meaning and function. Forms of communication. Role of Mass Media in dissemination of farm technology. Modern communication media: electronic video, tele text, tele conference, computer assisted instruction. Telephone/Mobile Technology: Farmer Call Centre, SMS Broadcast Service, m-krishi. ICT initiatives of NGOs and Private Companies. ICT initiatives by ICAR and SAUs, Value Added Services, Fisher Friend Project, SMS Services to farmers by Department of Agriculture. Practices of ICT for Agricultural Extension: aAQUA, Digital Green, e-Agrik (e-Agriculture), e- Sagu (e-cultivation), KISSAN (Karshaka Information Systems Service and Networking), Solutions through Information, VASAT-Virtual Academy for the Semi-Arid Tropics, Touch Screen Kiosk, e-Extension (e-Soil Health Card Program). Village Knowledge Centre (VRC/VRC/CIC): Introduction, concept, process for setting VRC. Warana Wired Village Project, Web Portals: AGRISNET,

DACNET, InDG, DEAL, i-KISAN, e- Krishi, ASHA, IFFCO- Agri-Portal, Agriwatch Portal, i-Shakti. ICTs for market information and Agri-Business: AGMARKNET, e-KRISHI VIPNAN, ICT-e-CHOPAL, EID Garry-Indiagriline.

Suggested Readings

1. Agribusiness and Technology: Revolutionizing the Future of Farming by Sujit Sahgal, 2021.
2. Contributions to Technological Sovereignty, by Alberto Diantini, Massimo De Marchi, et al., 2022.
3. Educational Technology and ICT by Dr. A.B. Bhatanagar and Dr. Anurag Bhatnagar, 2016,

ABM 414	VALUE ADDITION TO AGRICULTURAL COMMODITIES	4 (0+4)	SEM VII

Objectives

1. Understand the importance of value addition in increasing the market value of agricultural commodities
2. Learn techniques for processing, packaging, and branding to enhance the quality and appeal of agricultural products
3. Explore strategies to diversify product lines and create new revenue streams through value- added products
4. Develop skills to identify value addition opportunities, optimize production processes, and meet consumer preferences for higher-quality agricultural commodities

Practical

Food processing and value addition basics, Hygiene and sanitation in food processing Standards for food processing, Sorting and grading of fruits and vegetables, Preparation of fruits and vegetables for processing, Production of fruit marmalade (jam), Production of peanut flour and peanut butter, Solar drying of fruits and vegetables, Milk value addition, Mushroom production, Packaging and packaging material, Branding and labelling.

Suggested Readings

1. A Comprehensive Manual for Food Technology and Agricultural Value Addition, by Stephen Wachira Kariuki | 13 April 2021.
2. Agricultural Marketing in India by S.S. Acharya and N.L. Agarwal, 2021.
3. Composting Agricultural Residues for Value Addition, by Seema Garcha, 25 July 2010.
4. Postharvest, Value Addition and Export: Agricultural Commodity Export and Processing by Adeniyi Oyegbile, 4 September 2022.

ABM 415	FINANCIAL MANAGEMENT	4 (0+4)	SEM VII

Objectives

1. Understand the principles of financial management and its importance in business

2. Learn how to analyze financial statements, manage budgets, and make investment decisions
3. Explore strategies for financing operations, managing cash flow, and mitigating financial risks
4. Develop skills to optimize financial performance, enhance profitability, and ensure long-term sustainability in business operations

Practical

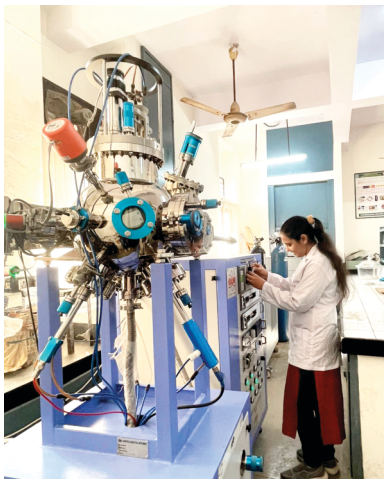
Estimation of project cash flows, Evaluation of proposals. Evaluation techniques-Discounting and non-discounting techniques. Risk analysis in capital budgeting. Estimation of working capital requirements; Inventory Management; Appraisal of project proposals using capital budgeting techniques. Computation of costs of borrowed capital, preferred stock, equity capital and retained earnings. Calculation of Operating Leverage, Financial Leverage and Combined Leverage. Valuation of stocks and debentures. Estimation of operating cycle.

Suggested Readings

1. Khan and Jain 2014., Financial Management, Tata McGraw Hill.
2. Pandey, I.M., 2010. Financial Management (10^{th} edn), Vikas Publishing House (P) Ltd, New Delhi.
3. Ravi M.K. 2015. Financial Management: Theory, Problems, Cases. Taxman Publications Prentice Hall of India Learning (8^{th} edn).
4. Sharma, R. K., and Sasi Guptha K., Management Accounting, Kalyani Publishers.
5. Vyaptakesh, S. 2012. Fundamentals of Financial Management, Pearson Publishers.

COLLEGE OF BASIC SCIENCES & HUMANITIES


National Science Day-2025
Harnessing Science for a Self-Reliant and Sustainable Viksit Bharat-2047
Keynote Speaker
Dr. Devinder Kumar
Chief Guest
Prof. B. R. Kamboj
Vice-Chancellor
CCSHAU, Hisar




WESTERN SYDNEY
UNIVERSITY

COLLEGE OF BASIC SCIENCES & HUMANITIES

SUPPORTING COURSES FOR B.SC. (HONS.) AGRICULTURE, B.SC. (HONS.) AGRIBUSINESS MANAGEMENT, B.SC. (HONS.) COMMUNITY SCIENCE, B.F.Sc., B.TECH (AGRICULTURAL ENGINEERING) AND B.TECH. BIOTECHNOLOGY

Course No.	Course Title	Credits	Semester
	Biochemistry		
BIOCHEM 202	Basic Biochemistry (For B.Tech. Biotechnology)	4 (3+1)	IV
BIOCHEM 302	Essentials of Plant Biochemistry (For B.Sc. (Hons.) Agriculture)	3 (2+1)	VI
	Total Credits	**7 (5+2)**	
	Botany and Plant Physiology		
BIO 101	Introductory Biology (Need based) (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	1 (1+0) NG	I
BIO 103	Basic Biology (For B.Tech. Biotechnology)	2 (2+0)	I
PL PHY 201	Fundamentals of Crop Physiology (For B.Sc. (Hons.) Agriculture and B.Tech. Biotechnology)	3 (2+1)	Agri.: V Biotech: III
	Total Credits	**5 (4+1)**	
	Chemistry		
CHEM 201	Engineering Chemistry (For B. Tech. (Agricultural Engineering)	3 (2+1)	III
	Total Credits	**3 (2+1)**	
	Computer Section		
COMP 101 (SEC I)	Computer Applications in Agriculture (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	I
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc. and B.Tech. Biotechnology)	3 (2+1)	Agri: III AM: III CS: IV FS: IV Biotech: IV
	Total Credits	**5 (2+3)**	
	Languages and Haryanavi Culture		
ENG 101 (AEC)	Communication Skills (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech. (Agricultural Engineering) and B.Tech. Biotechnology)	2 (1+1)	Agri: I AM: I FS: I Biotech: I CS: II AE: II

ENG 301 (AEC)	Human Values and Personality Development (For B. Tech. Agricultural Engineering)	2 (1+1)	V
	Total Credits	**4 (2+2)**	
Mathematics and Statistics			
MATH 101	Introductory Mathematics (Need based) (For B.Sc. (Hons.) Agriculture & B.Sc. (Hons.) Agribusiness Management)	1 (1+0) NG	I
MATH 103	Basic Mathematics (For B.Tech. Biotechnology)	2 (2+0)	I
MATH 201	Engineering Mathematics I (For B. Tech. Agricultural Engineering)	3 (3+0)	III
MATH 203	Biomathematics (For B.Tech. Biotechnology)	2 (2+0)	III
MATH 202	Engineering Mathematics II (For B. Tech. Agricultural Engineering)	3 (3+0)	IV
STAT 301	Biostatistics (For B.Tech. Biotechnology)	2 (1+1)	VI
STAT 302	Basic and Applied Agril Statistics (For B.Sc. (Hons.) Agriculture)	3 (2+1)	VI
STAT 401	Agricultural Statistics and Data Analysis (for B. Tech. Agricultural Engineering)	2 (1+1)	VII
STAT 402	Statistical Methods (For B.Sc. (Hons.) Community Science)	2 (1+1)	VII
	Total Credits	**19 (15+4)**	
Microbiology			
MICRO 101 (SEC II)	Production Technology for Bio-agents and Bio-fertilizers (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	I
MICRO 102	Elementary Microbiology (For B.Tech. Biotechnology)	2 (1+1)	II
MICRO 302	Agricultural Microbiology and Phyto-remediation (For B.Sc. (Hons.) Agriculture)	2 (1+1)	VI
	Total Credits	**6 (2+4)**	
Physics			
PHY 203	Engineering Physics (For B. Tech. Agricultural Engineering)	3 (2+1)	III
	Total Credits	**3 (2+1)**	
Sociology			
SOC 101	Rural Sociology and Educational Psychology (For B.Sc. (H) Agriculture)	2 (2+0)	I
SOC 201	Rural Sociology (For B.Sc. (Hons.) Community Science)	2 (2+0)	III
SOC 202	Human Ethics (For B.Tech. Biotechnology)	1 (1+0)	IV
	Total Credits	**5 (5+0)**	

COURSE CONTENTS: DEAPRTMENT-WISE
BIOCHEMISTRY

Course No.	Course Title	Credits	Semester
BIOCHEM 202	Basic Biochemistry (For B.Tech. Biotechnology)	4 (3+1)	IV
BIOCHEM 302	Essentials of Plant Biochemistry (For B.Sc. (Hons.) Agriculture)	3 (2+1)	VI
	Total Credits	**7 (5+2)**	

BIOCHEM 202	BASIC BIOCHEMISTRY (For B.Tech. Biotechnology)	4 (3+1)	SEM IV

Objectives

1. To study the structure and functions of biomolecules of living organisms
2. To study metabolism and bioenergetics
3. To study secondary metabolites and their applications

Theory

Introduction and importance. Acids, bases and buffers of living systems. Biomolecules: carbohydrates, lipids, proteins and nucleic acids – structure, functions and properties, Vitamins and animal hormones.

Bioenergetics. Metabolism – basic concept: glycolysis, citric acid cycle, gluconeogenesis, HMP pathway, oxidative phosphorylation, fatty acid oxidation; ketone bodies.

Overview & significance of secondary metabolites: alkaloids, phenolics and their applications in food and pharmaceutical industries. Role of phytohormones: Auxin, Gibberellins, Cytokinin, Ethylene and Abscisic acid.

Practical

Qualitative tests for carbohydrates, amino acids, proteins and lipids. Extraction and characterization of lipids by TLC. Determination of acid, iodine and saponification values of oil. Extraction, quantitative estimation and separation of sugars by paper chromatography.

Suggested Readings

1. Nelson DL and Cox MM, 2017, Lehninger principles of biochemistry, 7th edn, W. H. Freeman.
2. Satyanarayana U and Chakrapani U, 2021, Essentials of Biochemistry, Elsevier.

BIOCHEM 302	ESSENTIALS OF PLANT BIOCHEMISTRY (For B.Sc. (Hons.) Agriculture)	3 (2+1)	SEM VI

Objectives

To impart the fundamental knowledge on structure and function of cellular components, biomolecules and the biological processes in plants

Theory

Biochemistry − Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Bio-molecules − Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins − physiological and metabolic role. Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes. Metabolic energy and its generation − Metabolism − Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. Biosynthetic Pathways −Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

Practical

Preparation of standard solutions and reagents, Determination of pH, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry’ s method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value, saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

Suggested Readings

1. Nelson and Cox. 2008. Lehninger Principles of Biochemistry. Fourth/Fifth edition. Freeman (Can be downloaded)
2. Conn, Stumpf, Bruening and Doi. 2006. Outlines of Biochemistry. Fifth Edition. Wiley
3. Horton, Moran, Rawn, Scrimgeour, Perry. 2011. Principles of Biochemistry. Fifth Edition. Pearson/Prentice Hall (Can be downloaded)
4. Heldt. 2005. Plant Biochemistry. Elsevier (Can be downloaded)
5. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.

BOTANY AND PLANT PHYSIOLOGY

Course No.	Course Title	Credits	Semester
BIO 101	Introductory Biology (need based) (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	1 (1+0) NG	I
BIO 103	Basic Biology (For B.Tech. Biotechnology)	2 (2+0)	I
PL PHY 201	Fundamentals of Crop Physiology (For B.Sc. (Hons.) Agriculture and B.Tech. Biotechnology)	3 (2+1)	Agri.: V Biotech: III
	Total Credits	**5 (4+1)**	

BIO 101	INTRODUCTORY BIOLOGY (NEED BASED) NON-GRADIAL (For B.Sc. (Hons.) Agriculture & B.Sc. (Hons.) Agribusiness)	1 (1+0) NG	SEM I

Objectives

To impart the basics of plant cell and structure of flowers to non-biology background students.

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.

Suggested Readings

1. Biology- Text Book of class XI, NCERT, New Delhi
2. Biology- Text Book of class XII, NCERT, New Delhi

BIO 103	BASIC BIOLOGY (For B.Tech. Biotechnology)	2 (2+0)	SEM I

Objectives

1. To study the basic taxonomy and classification of plants
2. To study the features of the plant kingdom and morphology
3. To study the internal structure of plants
4. To study cells and biomolecules
5. To study the animal kingdom and nomenclature
6. To study the organisation of mammalian systems

Theory

The plant kingdom and features of each group. Morphology, modifications and functions of root, stem, leaf, flower and inflorescence. Pollination and fertilisation. Fruit types. Structure of dicot and monocot seeds, and seed germination.

Cell structure. DNA, chromosomes and genes. Cell and tissue types. Internal structure of root, stem and leaf.

Plant taxonomy, systems of classification. Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

Introduction to Zoology. Structure and functions of the cell and cell organelles. The difference between prokaryotic and eukaryotic cells. Structure and function of biomolecules. Types of simple and compound tissues.

Binomial nomenclature. Classification and general survey of the animal kingdom. Functional organisation of various systems of a mammal: digestive, circulatory, respiratory, excretory, nervous and reproductive. Laws of inheritance. Multiple allelism - blood groups. Genetic disorders in human and their inheritance.

Suggested Readings

1. Bendre AM and Kumar A, 1999, Textbook of Practical Botany. Vol. 2, 7th edn, Rastogi Publications.
2. Bendre AM and Pande PC, 2009, Introduction to Botany, Rastogi publications.
3. Bhatia K.N. and Tyagi M.P. 2020 Elementary Biology. A Truemen publication
4. David M Hillis; H Craig Heller; Sally D Hacker; David W Hall; David E Sadava. 2020. Life: the science of biology, 12th edn, Sunderland publication. eBook
5. Dutta AC, 1995, A Class Book of Botany, 16th edn, Oxford University Press.
6. NCERT 2021. Biology of Class XI. NCERT, India.
7. Pande PC and Jain DK, 2022, A textbook of Botany, Angiosperm. S. Chand publications.
8. Bhatia KN and Tyagi MP, 2020, Elementary Biology, A Truemen Publication.
9. Chopra G and Dhami PS, 2021, A Textbook of Biology, Pradeep Publications.
10. David MH, Craig HH, Sally DH, David WH and David ES, 2020, Life: the science of biology, 12th Ed, Sunderland Publication.
11. NCERT, 2022, Biology of Class XI, 2022-23. NCERT, India.

PL PHY 201	**FUNDAMENTALS OF CROP PHYSIOLOGY (For B.Sc. (Hons.) Agriculture and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM Agri.: V Biotech: III**

Objectives

To explain about the basic physiological process of plant viz. plant cell and water relations, mineral nutrition, carbon metabolism, reproductive physiology and plant growth and development

Theory

Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science; Diffusion and osmosis; Physiological roles of water to crop plants; Definition of water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation; Water use efficiency; Essential and beneficial elements; Passive and active transport of mineral element; Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms; Foliar nutrition and root feeding − significance; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap − theories and mechanism; Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand culture. Overview of plant cell - organelle and their functions. Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.

Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O2 during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C3, C4 and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in C4 plant: Productivity of C4 plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, CO2, O2 etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Kreb Cycle and ETC, Factors affecting respiration (O2, temperature, CO2 etc.). Terminologies / Definitions: Growth, Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc. Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome Introduction to Vernalization (What is vernalization, devernalization etc.), Meaning, classification (seasonal, sequential etc), relation with abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence. Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR), Plant growth inhibitor. Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2, 4 −D, GAs, Kinetin etc).

Practical

Study on structure and distribution of stomata; Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content; Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant; Identification of nutrients by hydroponics; Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis; Study on senescence and abscission, hormonal regulation of senescence; Demonstration of the effects of different PGRs on plants, Leaf anatomy of C3 and C4 plants.

Suggested Readings

1. Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes
2. Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Molle and Angus Murphy
3. Plant Physiology by Robert M. Devlin and Francis H. Witham
4. Plant Physiology by Lincoln Taiz and Eduardo Zeiger
5. Plant Physiology by Frank B. Salisbury and Cleon W. Ross

CHEMISTRY

Course No.	Course Title	Credits	Semester
CHEM 201	Engineering Chemistry (For B. Tech. Agricultural Engineering)	3 (2+1)	III
	Total Credits	**3 (2+1)**	

CHEM 201	ENGINEERING CHEMISTRY (For B. Tech. Agricultural Engineering)	3 (2+1)	SEM III

Objectives

To make the students acquainted with applications of chemistry in engineering and different chemical processes in agricultural and food engineering

Theory

Phase rule**:** Phase, component, degree of freedom, application to one component system, viz. water system, sulphur system, two component system, viz. pb-Ag system, desilverisation of Pb.

Colloids**:** Classification, properties like optical activity-Tyndall effect, Brownian movement, electrical properties –electrophoresis.

Corrosion**:** causes, types and methods of prevention- proper designing. Cathodic protection using pure metal and metal alloys, use of inhibitors.

Water**:** Temporary and permanent hardness, disadvantages of hard water, scale and sludge formation of boilers, boiler corrosion.

Basic idea on thermo-gravimetric analysis, polarographic analysis, nuclear radiation, detectors and analytical applications of radio-active materials, discovery of isotopes and new elements, release of atomic energy, radio-active tracer and carbon dating.

Fuels**:** Classifications, calorific value and its determination by bomb calorimeter.

Principles of food chemistry**:** Lipids, proteins, carbohydrates and their classifications, vitamins and their importance.

Enzymes and co-enzymes important in food processing and storage, their use in manufacturing of ethanol and acetic acid by fermentation method.

Introduction to food preservatives, definition, types natural and artificial preservative and its use, colouring and flavouring reagents of foods.

Lubricants**:** Classifications, properties-viscosity, flash point and fire point mechanism, thick film, thin film and extreme pressure, neutralization point, saponification number and mechanical stability.

Polymers**:** Type of polymerization with examples (addition, free radical); Different properties of polymers chemical resistance, crystallinity. Effect of heat on polymers, general use, molecular weight determination.

Introduction to IR spectroscopy**:** Basic principles of spectroscopy, Beer-Lambarts law, types of vibration, symmetric, asymmetric vibration and it type, absorbances of different functional group in IR.

Practical

To separate colored components by using Paper Chromatography.To determine of temporary and permanent hardness of water by EDTA method; To study the different types of fuels and compare their characteristics; To study different types of foods and their ingredients; Determination of alkalinity in the given water sample; Determination of available chlorine in bleaching powder; To estimate chloride in water sample; To estimate dissolved oxygen in water sample; Determination of viscosity of lubricant by REDWOOD Viscometer; To determine flash and fire point of an oil by PENSKY MARTEN's flash point apparatus; To determine λ max and verification of Beer-Lambert law.

Suggested Readings

1. Bahl, B. S., Bahl, A. and Tuli, B. D. 2007. *Essentials of Physical Chemistry*. S. Chand and Co. Ltd, Delhi.
2. Finar, I. L. 2002. *Organic Chemistry*. Vol I and II. Pearson.
3. Glasstone, S. *Elements of Physical Chemistry*. The Macmillan Company of India Limited.
4. Jain and Jain. 2016. *Engineering Chemistry*. Dhanpat Rai Publication.
5. Jain, P. L. and Jain, M. 1994. *Engineering Chemistry*. Dhanpat Rai publishing company Pvt. Ltd, Delhi.
6. Morrison, R. T., Boyd, R. N. and Bhattacharjee, S. K. 2010. *Organic Chemistry*. Pearson.
7. Sharam, Y. R. 2013. *Elementary Organic Spectroscopy*. S Chand.

COMPUTER SECTION

Course No.	Course Title	Credits	Semester
COMP 101 (SEC I)	Computer Applications in Agriculture (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	I
COMP 202 (VAC)	Agricultural Informatics and Artificial Intelligence (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc. and B.Tech. Biotechnology)	3 (2+1)	Agri: III AM: III CS: IV FS :IV Biotech: IV
	Total Credits	**5 (2+3)**	

COMP 101 (SEC I)	**COMPUTER APPLICATIONS IN AGRICULTURE (For B.Sc. (Hons.) Agribusiness Management)**	**2 (0+2)**	**SEM I**

Objectives

1. To understand the role of computer applications in modern agricultural practices.
2. To learn to use agricultural software and tools for data analysis, modeling, and decision- making.
3. To explore the application of Geographic Information Systems (GIS) and remote sensing in precision agriculture.
4. To develop skills in utilizing technology to optimize farm management, improve productivity, and reduce environmental impact.

Practical

Working with MS-DOS/Windows. Database concept and type. Database design. Data entry operation. Word processing: MS Office. Database management program. Use of electronic spreadsheet and graphics. Statistical and mathematical functions. Advanced statistical analysis Toolpak in MS Excel. Use of SPSS/SAS statistical packages. Basics of computer networking – LAN, SAN, Network topologies, Internet and Intranet – Basics of Email – Exposure to web browsing (structure of URL), Types of websites – Internet service provider – using internet news. Application of Geographic Information System (GIS) and remote sensing in agriculture

Suggested Readings

1. Computers in Agriculture: Fundamentals and Applications (Hardcover – 20 October 2016) by Sharma Manish, Anil Bhatt
2. Computer Applications in Agriculture By William Otto Rasmussen.
3. Computer Applications in Agriculture and Agribusiness (Paperback – Import, 1 June 1994) by Michael E. Newman (Author).

COMP 202 (VAC)	**AGRICULTURAL INFORMATICS AND ARTIFICIAL INTELLIGENCE (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Management, B.Sc. (Hons.) Community Science, B.F.Sc. and B.Tech. Biotechnology)**	**3 (2+1)**	**SEM Agri: III AM: III CS: IV FS: IV Biotech: IV**

Objectives

1. To acquaint student with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision-making processes, etc.
2. To provide basic knowledge of computer with applications in Agriculture
3. To make students familiar with Agricultural-Informatics, its components and applications in agriculture

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 data base, Uses of DBMS in Agriculture. Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction general programming concepts. 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, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management. Smartphone mobile apps in agriculture for farm advice: Market price, post-harvest management etc. Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information. Decision support systems: Concepts, components and applications in Agriculture. Agriculture Expert System, Soil Information Systems etc., for supporting farm decisions. Preparation of contingent crop planning and crop calendars using IT tools. Digital India and schemes to promote digitalization of agriculture in India.

Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

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 documents, MS-EXCEL-Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, 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/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smartphones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial technology, AR/ VR demonstration, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Suggested Readings

1. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
2. Fundamentals of Computer by V. Rajaroman.
3. Introduction to Information Technology by Pearson.
4. Introduction to Database Management System by C. J. Date.
5. Introductory Agri-Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.

LANGUAGES AND HARYANAVI CULTURE

Course No.	Course Title	Credits	Semester
ENG 101 (AEC)	Communication Skills (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech. (Agricultural Engineering) and B.Tech. Biotechnology)	2 (1+1)	Agri: I AM: I FS: I Biotech: I CS: II AE: II
ENG 301	Human Values and Personality Development (for B. Tech. Agriculture Engineering)	2 (1+1)	V
	Total Credits	**4 (2+2)**	

ENG 101 (AEC)	**COMMUNICATION SKILLS (For B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Agribusiness Mangement, B.Sc. (Hons.) Community Science, B.F.Sc., B.Tech. Agricultural Engineering and B.Tech. Biotechnology)**	**2 (1+1)**	**SEM** **Agri: I** **AM: I** **FS: I** **Biotech: I** **CS: II** **AE: II**

Objectives

To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication.

Theory

Communication Process**:** The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Structural and Functional Grammar**:** Sentence structure, modifiers, connecting words and verbal; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults;

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed;

Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

Suggested Readings

1. Allport, G. W.1937. Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele and Gyles Brandreth. 1994. How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale. 1997. The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter S J. 2012. Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. Kumar S and Pushpa Lata. 2011. Communication Skills. Oxford University Press.
6. Neuliep James W. 2003. Intercultural Communication A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, Allan. 1998. Body Language. Sudha Publications, Delhi.
8. Raman M and Singh P. 2000. Business Communication. Oxford University Press.
9. Seely J. 2013. Oxford Guide to Effective Writing and Speaking. Oxford University Press.
10. Thomson A J and Martinet A V. 1977. A Practical English Grammar. Oxford University

ENG 301	**HUMAN VALUES AND PERSONALITY DEVELOPMENT (For B. Tech. Agricultural Engineering)**	**2 (1+1)**	**SEM V**

Objectives

1. To make students realize their potential strengths, cultivate their inter-personal skills and improve employability
2. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Strengthening of self-reflection.
5. Development of commitment and courage to act.

Theory

Personality definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Type A and Type B Behaviours, personality and Organizational Behaviour. Technical Writing: Reports & its types, Letters & its types. Foundations of individual behaviour and factors influencing individual behaviour, Models of individual behaviour, Perception and attributes and factors affecting perception. Learning: Meaning and definition, theories and principles of learning,

Learning and organizational behaviour, Learning and training, learning feedback. Speaking on given topics.

Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behaviour, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics. Comprehension Passages (General & Technical articles).

Practical

Learning Styles and Strategies, Motivational needs, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behaviour. Introduction to Phonetics and spoken English, Phonemic symbols, Syllable, Word Accent.

Suggested Readings

1. Andrews, Sudhir. 1988. How to Succeed at Interviews. Tata McGraw-Hill.
2. Heller, Robert. 2002. Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim. 2003. Reducing Stress. Essential Manager series. Dk Publishing.
4. Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5. Mile, D.J. 2004. Power of Positive Thinking. Delhi. Rohan Book Company.
6. Kumar, Pravesh. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House.
7. Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
8. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.
9. Human Values and Professional Ethics by R R Gaur, R Sangal, G P
10. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
11. The Story of Stuff (Book).
12. Rediscovering India - by Dharampal
13. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
14. India Wins Freedom - Maulana Abdul Kalam Azad
15. Vivekananda - Romain Rolland (English)

MATHEMATICS AND STATISTICS

Course No.	Course Title	Credits	Semester
MATH 101	Introductory Mathematics (Need based) (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	1 (1+0) NG	I
MATH 103	Basic Mathematics (For B.Tech. Biotechnology)	2 (2+0)	I
MATH 201	Engineering Mathematics I (For B. Tech. Agricultural Engineering)	3 (3+0)	III
MATH 203	Biomathematics (For B.Tech. Biotechnology)	2 (2+0)	III
MATH 202	Engineering Mathematics II (For B. Tech. Agricultural Engineering)	3 (3+0)	IV
STAT 301	Biostatistics (For B.Tech. Biotechnology)	2 (1+1)	VI
STAT 302	Basic and Applied Agril Statistics (For B.Sc. (Hons.) Agriculture)	3 (2+1)	VI
STAT 401	Agricultural Statistics and Data Analysis (For B. Tech. Agricultural Engineering)	2 (1+1)	VII
STAT 402	Statistical Methods (For B.Sc. (Hons.) Community Science)	2 (1+1)	VII
	Total Credits	**19 (15+4)**	

MATH 101	INTRODUCTORY MATHEMATICS (Need Based) (For B.Sc. (Hons.) Agriculture and B.Sc. (Hons.) Agribusiness Management)	1 (1+0) NG	SEM I

Objectives

To make the students acquainted with the basic mathematics applied in agriculture and their applications

Theory

Algebra: Progressions- Arithmetic, Geometric and Harmonic Progressions. Matrices: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by adjoint method, Properties of determinants up to 3rd order and their evaluation.

Differential Calculus: Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue. Partial

differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of the functions of the form y = f (x) and y = f (x1, x2).

Integral Calculus: Integration -Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts. Area under simple well-known curves.

Mathematical Models: Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

Suggested Readings

1. NCERT, 2012, Mathematics of Class XII, NCERT, India.
2. Sharma RD, 2014, Mathematics of Class XII, Dhanpat Rai Publisher.
3. Narayan, S. 2004. *Differential Calculus*. S. Chand and Co. Ltd. New Delhi.
4. Narayan, S. 2004. *Integral Calculus*. S. Chand and Co. Ltd. New Delhi.

MATH 103	**BASIC MATHEMATICS (For B.Tech. Biotechnology)**	**2 (2+0)**	**SEM I**

Objectives

1. To study the basic principles and functions in mathematics, like limits and continuity
2. To study differentiation and integration
3. To study matrices and determinants

Theory

Functions: Defination, types of functions. Limit: Introduction, left-handed and right-handed limits, general rules for calculating limits, Standard limits. Continuity: Definition of continuity, continuity of algebraic functions, continuity of trigonometric and exponential functions. Types of discontinuity

Differentiation: Differentiation by the first principle, sum, difference, product and quotient formulae, differentiation using the chain rule, differentiation of functions in parametric and implicit form, logarithmic differentiation, geometrical interpretation of derivative. Successive differentiation, geometrical interpretation of derivative, maxima and minima, tangent and normal.

Integration: Integration of simple functions, Integration by substitution, integration by partial fractions, integration by parts, integration by trigonometric substitution.

Matrices and Determinants: Definition of matrix, addition, subtraction and multiplication, inverse of matrix. Properties of determinants Solution of linear equations by Cramer's rule and the inverse of a matrix.

Suggested Readings

1. NCERT, 2012, Mathematics of Class XII, NCERT, India.
2. Sharma RD, 2014, Mathematics of Class XII, Dhanpat Rai Publisher.

MATH 201	ENGINEERING MATHEMATICS I (For B. Tech. Agricultural Engineering)	3 (3+0)	SEM III

Objectives

To make the students acquainted with the basic mathematics, including calculus, Matrices and complex analysis applied in engineering and their applications in solving engineering problems

Theory

Differential calculus: Functions of two or more variables, Taylor's and Maclaurin's expansions, Maxima and minima.

Integral calculus: Double integrals, change of order of integration, triple integrals, application of double and triple integrals to find area and volume.

Vector calculus: Scalar and vector point functions, vector differential operator Del, gradient of scalar point function, divergent and curl of vector point function and their physical interpretations, line, surface and volume integrals, Green's, Stock's and Divergence theorem (without proofs).

Fourier series: Periodic functions, Euler's formulae, functions having arbitrary period, even and odd functions, half-range series expansion, series expansion of functions with finite discontinuity.

Complex Analysis: Functions of a complex variable, limit, continuity and analytic function, Cauchy-Reimann equations, harmonic functions.

Matrices: Elementary transformations, Gauss elimination, Gauss-Jordan method to find the inverse of a matrix. rank of a matrix, solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton Theorem-its use to find the inverse of a matrix, linear transformation, diagonalization of matrices.

Suggested Readings

1. Grewal, B. S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
2. Narayan, S. 2004. A Text Book of Vector. S. Chand and Co. Ltd. New Delhi.
3. Narayan, S. 2004. Differential Calculus. S. Chand and Co. Ltd. New Delhi.
4. Narayan, S. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.

MATH 203	BIOMATHEMATICS (For B.Tech. Biotechnology)	2 (2+0)	SEM III

Objectives

1. To study the basic theories of mathematics
2. To study factor reduction and eigenvalues
3. To study the applications of biomathematics

Theory

Rolle's theorem, Lagrange's theorem, Taylor's and Maclaurin's series. Partial differentiation, Euler's theorem on homogeneous functions, and change of variable. Jacobian, maxima and minima of two or more than two variables, Elementary transformations, Rank of matrix, Echelon form, Solution of system of linear

equations, eigenvalues and eigenvectors of a matrix. Reduction formulae, definite integrals and their properties, Area under simple, well known curves.

Solution of ordinary differential equation of first degree and first order and their application for the determination of the volume of blood and drug distribution. Epidemic models, simultaneous differential equation of first order and their applications to predator models. Linear differential equations of higher order and their applications to the simple biological problem. Numerical methods for solving algebraic and transcendental equations.

Suggested Readings

1. Grewal BS, 2013, Higher Engineering Mathematics, Khanna Publishers.
2. Rastogi SK, 2008, Biomathematics, Krishna Prakashan Media Pvt. Ltd.
3. Srivastava AC and Srivastava PK, 2011, Engineering Mathematics, Vol. I, PHI Learning Pvt. Ltd.
4. Srivastava AC and Srivastava PK, 2011, Engineering Mathematics, Vol.III, PHI Learning Pvt. Ltd.

MATH 202	ENGINEERING MATHEMATICS II (For B. Tech. Agricultural Engineering)	3 (3+0)	SEM IV

Objectives

To make the students acquainted with the application of various advanced mathematics such as differential equations, Laplace transform and applications of numerical methods in engineering.

Theory

Ordinary Differential Equations: First order differential equations, exact and reducible to exact form by integrating factors, linear differential equation and Bernoulli's equation, equations of first order and higher degree, Clairaut's equation. Higher order differential equations: Methods of finding complementary functions and particular integrals, methods of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients.

Partial Differential Equations: Partial derivative and total derivative, homogeneous functions and Euler's theorem. Formation of PDE, higher order linear PDE with constant coefficients, solution of non-linear PDE, Charpit's method.

Laplace Transform: rules for Laplace transform and inverse Laplace transform, applications to find solutions of ordinary and simultaneous differential equations.

Numerical Methods: Finite difference operators and their relationship, factorial notation. Newton's forward and backward interpolation formula, Newton's divide difference interpolation and Lagrange's interpolation formula, numerical differentiation and integration rule, numerical solutions of ODE by Taylor's series, Euler's and modified Euler's method, Runge-Kutta method of order four.

Suggested Readings

1. Grewal, B S. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
2. Narayan, S. 2004. A Text Book of Vector. S. Chand and Co. Ltd., New Delhi.
3. Narayan, S. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
4. Narayan, S. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
5. Ramana, B. V. 2008. Engineering Mathematics. Tata McGraw-Hill, New Delhi.

STAT 301	BIOSTATISTICS (For B.Tech. Biotechnology)	2 (1+1)	SEM VI

Objectives

1. To study the variables and descriptive statistics
2. To study various distributions
3. To study experimental data analysis and interpretation

Theory

Random variables: expected value and its variance; probability distribution of random variables; conditional probability; Bayes' theorem and its applications; introduction to uniform, binomial, Poisson, normal, exponential, and gamma probability distributions.

Random mating populations, Hardy-Weinberg Law. Introduction to Poisson process and Markov chains. Transition probability matrix, n-step transition probabilities, steady state. Random walk models. Sensitivity and specificity. Positive and negative predictive values.

Chi-square test: testing heterogeneity, use in the genetic experiment, detection of linkage, linkage ratios and their estimation. Analysis of variance. One-way and two-way classification with interaction. Analysis of covariance. Incomplete block designs. Estimation and significance of genotypic and phenotypic variation.

Practical

Expected value and variance of discrete and continuous distributions. Uniform, binomial, Poisson, normal, exponential and gamma probability distributions. Hardy-Weinberg Law. Construction of the transition probability matrix in Markov Chains. Calculation of sensitivity and specificity. Positive and negative predictive values. Detection and linkage using chi-square test; one-way and two-way analysis of variance. Analysis of covariance. Incomplete block designs. Estimation of heritability.

Suggested Readings

1. Gupta SC, Kapoor VK, 2007, Fundamentals of applied statistics, 4th edn, S Chand and Sons.
2. Kaps M and Lamberson WR, 2017, Biostatistics for Animal Science, 3rd edn, CABI.
3. Triola MM, Triola MF and Roy J, 2017, Biostatistics for the Biological and Health Sciences, 2nd edn, Pearson.

STAT 302	BASIC AND APPLIED AGRIL STATISTICS (For B.Sc. (Hons.) Agriculture)	3 (2+1)	SEM VI

Objectives

To provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis

Theory

Introduction to Statistics and its Applications in Agriculture: Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams −Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data − Histogram, Frequency Polygon and Ogives.

Measures of Central Tendency: Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean− Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median-Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.

Measures of Dispersion: Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficient of Dispersions. Co-efficient of Variation.

Measures of Skewness and Kurtosis: Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Probability Theory and Normal Distribution: Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability- Definition and Limitations. Axiomatic Probability.

Addition and Multiplication Theorem (without proof): Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution-Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve. Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type

I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples: F-test for Variance. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

Practical

Diagrammatic and Graphical representation of data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one sample, two sample independent and dependent). Analysis of variance one-way classification. CRD. Selection of random sample using simple random sampling.

Suggested Readings

1. Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.
2. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
3. Basic Statistics by B. L. Agarwal, New Age International Publishers.
4. Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.
5. Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.
6. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

STAT 401	**AGRICULTURAL STATISTICS AND DATA ANALYSIS (For B. Tech. Agricultural Engineering)**	**2 (1+1)**	**SEM VII**

Objectives

To make the students acquainted with important statistical data analysis tools and application of these for research in agricultural engineering

Theory

Introduction to statistics: Definition, advantages and limitations; Data- types of data, quantitative and qualitative; variable - discrete and continuous; Frequency distribution table: construction of frequency distribution table (inclusive and exclusive)- number of classes, length of class, tally marks, frequency, class midpoint, cumulative frequencies, frequency curves, graphs and charts. Measures of central tendency: Definition, characteristics of ideal average, different measures; arithmetic mean, median, mode, geometric mean and harmonic mean for grouped and ungrouped data, merits and demerits; Measures of dispersion: definition, different measures (absolute and relative); range, quartile deviation, mean deviation, standard deviation (SD), variance and coefficient of variation. Probability: Definition and

concept of probability; Random variable: concept of random variable and expectation; Simple linear correlation: concept, definition, types and its properties; Simple linear regression: concept, definition and its properties; Normal distribution: definition, density function, curve, properties, standard normal distribution (SND), properties including area under the curve (without proof); Binomial distribution: definition, density function and properties; Poisson distribution: definition, density function and properties; Introduction to sampling: definition of statistical population, sample, random sampling, parameter, statistic, sampling distribution, concept of standard error of mean. Testing of hypothesis – hypothesis, null hypothesis, types of hypotheses, level of significance, degrees of freedom – statistical errors; Large Sample test (Z-test), small sample t-test (one tailed, two tailed and paired tests); Testing of significance through variance (F-test), Chi-square test: goodness of fit and testing of independence of attributes (2 × 2 contingency table)

Practical

Construction of frequency distribution tables and frequency curves; Computation of arithmetic mean, median and mode for un-grouped and grouped data; Computation of harmonic and geometric mean; Computation of standard deviation (SD); Variance and coefficient of variation for un-grouped and grouped data; Computation of skewness, kurtosis; Standard normal distribution test for single sample mean (population SD known and unknown); SND test for two samples means (population SD known and unknown); Computation of binomial distribution; Computation of Poisson distribution; Calculation of correlation coefficient and its testing; Calculation of regression coefficient, regression line; Student's t-test for single sample mean; t-test for two samples means; Paired t test; F– test for equality for two sample variance test; Computation of Chi-square test: goodness of fit and testing of independence of attributes (2 × 2 contingency table) and m × n.

Suggested Readings

1. Agrawal, B. L. 1991. Basic Statistics. Wiley Eastern Ltd. New Age International Ltd.
2. Chandel, S. R. S. 1999. A Handbook of Agricultural Statistics. Achal Prakasan Mandir, Kanpur
3. Gupta, S. C. and Kapoor, V. K. 1970. Fundamentals of Mathematical Statistics. Sultan Chand & Sons. Gupta, S. C. and Kapoor, V. K. 2019. Fundamental Applied Statistics. Sultan Chand & Sons.
4. Nageswara Rao, G. 2007. Statistics for Agricultural Sciences. BS Publications.
5. Rangaswamy, R. 2018. A Text Book of Agricultural Statistics. New Age Int. Publications Ltd.

STAT 402	**STATISTICAL METHODS (For B.Sc. (Hons.) Community Science)**	**2 (1+1)**	**SEM VII**

Objectives

To develop understanding among students about sampling and data analysis techniques, methods of data analysis using various statistics.

Theory

Introduction to statistics and its applications in agriculture, graphical representation of data, measures of central tendency. Dispersion and their merits and demerits. Probability and distribution: definition of probability, addition and multiplication theorem (without proof). Simple problems based on probability. Binomial and Poisson Distributions. Correlation and regression: definition of correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation, Spearman correlation coefficient and their properties. Linear Regression Equations. Introduction to Test of Significance, One sample; two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 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. Introduction to various statistical packages.

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 test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table. Selection of random sample using Simple Random Sampling. Use of software packages.

Suggested Readings

1. Agarwal, B. L. 2006. Basic Statistics. New Age International Publisher.
2. Gupta SC. 2006. *Fundamentals of Statistics.* Himalaya Publ. House.
3. Panse VG & Sukhatme PV. 1985. *Statistical Methods for Agricultural Workers.* ICAR. Rao GN. 2007. *Statistics for Agricultural Science.* Oxford & IBH.
4. Snedecor GW & Cochran WG. 1968. *Statistical Methods.* Oxford & IBH.
5. Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.
6. Sukthame & Ashok C. 1984. *Sampling Theories and Surveys with Application.* 3rd Ed. ICAR.
7. Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.
8. William S. Cleveland (1994) The Elements of Graphing Data, 2ndEd., Chapman & Hall

MICROBIOLOGY

Course No.	Course Title	Credits	Semester
MICRO 101 (SEC II)	Production Technology for Bio-agents and Bio-fertilizers (For B.Sc. (Hons.) Agribusiness Management)	2 (0+2)	I
MICRO 102	Elementary Microbiology (For B.Tech. Biotechnology)	2 (1+1)	II
MICRO 302	Agricultural Microbiology and Phyto-remediation (For B.Sc. (Hons.) Agriculture)	2 (1+1)	VI
	Total Credits	**6 (2+4)**	

MICRO 101 (SEC II)	**PRODUCTION TECHNOLOGY FOR BIO-AGENTS & BIO-FERTILIZERS (For B.Sc. (Hons.) Agribusiness Management)**	**2 (0+2)**	**SEM I**

Objectives

1. To understand the principles and methods of producing bio-agents and bio-fertilizers.
2. To learn techniques for mass production and formulation of beneficial microorganisms.
3. To explore the role of bio-agents and bio-fertilizers in sustainable agriculture and soil health management.
4. To develop skills to integrate bio-agents and bio-fertilizers into crop production systems for enhanced yield and reduced environmental impact.

Practical

Agricultural Microbiology: Relevance of Biofertilizer in Agriculture. Types of Biofertilizers [(a) Nitrogen fixers: Rhizobium, Azotobacter, Azospirillum, Glucano acetobacter, Cyanobacteria and Azolla; (b) P-solubilizers: PSB, PSF; (c) K-solubilizers; (d) Zn-solubilizers; (e) P-mobilizers: AM fungi; (f) Development of consortia]. Mass Production Techniques [(a) Carrier based; (b) Liquid Biofertilizers]. Methods of application. Quality Control (Standards as per FCO (1985) amended in 2009).

Suggested Readings

1. Atlas Bartha. Microbial Ecology - Fundamentals and Application. Pearson (Fourth edn).
2. Bhoopander Giri, Ram Prasad et al. Biofertilizers for Sustainable Agriculture and Environment (Soil Biology Book 55).
3. Bikas R. Pati and Santi M. Mandal. Recent Trends in Biofertilizers.
4. Eiri Board. Handbook of Biofertilizers and Vermiculture. 1 January 2009.

5. Himadri Panda. Complete Technology Book on Biofertilizer and Organic Farming.
6. J. Nicklin, K. Graeme-Cook, T. Paget and R. Killington. Instant Notes in Microbiology. Viva.
7. M K Rai. Handbook of Microbial Biofertilizers.
8. Mark S. Coyne. Soil Microbiology - An Exploratory Approach. Delmar Publishers-2004
9. Michael Madigan, John Martinko, David Stahl and David Clark. Brock-Biology of Microorganisms. Pearson (Thirteen Edition).

MICRO 102	ELEMENTARY MICROBIOLOGY (For B.Tech. Biotechnology)	2 (1+1)	SEM II

Objectives

To study the-

1. History of microbiology and major groups of eukaryotes and prokaryotes
2. Preservation methods and repositories
3. Bacterial growth and metabolism
4. Applications of microbes

Theory

History of microbiology and its applied areas. Microorganisms and their role in health and the environment. Control and prevention measures against microorganisms/ diseases. Introduction to eukaryotic and prokaryotic cells. Major groups of eukaryotes: fungi, algae and protozoa. Major groups of prokaryotes: bacteria, archaea, rickettsia and chlamydia. Preservation of microorganisms and microbial repositories at the national and international levels.

Bacterial growth. Metabolism in bacteria, ATP generation, chemoautotrophy, photoautotrophy, respiration, and fermentation. Viruses, Bacteriophages, structure and properties, lytic and lysogenic cycles, viroids, and prions. Role of microorganisms in nutrient recycling (Biogeochemical cycles)

Beneficial microorganisms in agriculture, biofertilisers, and microbial pesticides. Microbes in composting and biodegradation. Microbiology of water and food.

Practical

Microscope and other instruments in a microbiological laboratory. Media preparation, sterilisation and aseptic methods for isolation, identification, preservation and storage. Identification of bacteria by staining methods. Purification of microorganisms by streak plate method. Enumeration of bacteria by pour plate and spread plate methods. Micrometry.

Suggested Readings

1. Woolverton CJ, Sherwood LM, and Willey JM, 2016, Prescott's Microbiology, McGraw-Hill Education.

MICRO 302	AGRICULTURAL MICROBIOLOGY AND PHYTO-REMEDIATION (For B.Sc. (Hons.) Agriculture)	2 (1+1)	SEM VI

Objectives

1. To get an introduction to microbiology with specific focus on its significance in agriculture science
2. To get acquainted with the bacterial structure and the function of the different bacterial components
3. To get highlights on different fields of microbiology
4. To get highlights on the bioremediation of polluted soils using microbial mediators and phytoremediation
5. To get a concept of biological control and the role of biopesticides in plant disease management.

Theory

Introduction to Microbiology: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology: Discovery of microscope, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life**.** Bacteria: cell structure, nutritional classification of bacteria, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, genetic engineering. Soil Microbiology: Nutrient mineralization and transformation**,** Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning**.** Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management Concepts of rhizosphere microbiology- Rhizodeposits - biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiomeresidents and their roles. Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability**.** Bioremediation of polluted soils using microbial mediators**.** Phytoremediation of polluted soils**.**

Practical

Study of the microscope; Acquaintance with laboratory material and equipment; Microscopic observation of different groups of microorganisms: moulds & yeasts; Direct staining of bacteria by crystal violet; Negative or indirect staining of bacteria by nigrosin; Gram staining of bacteria; Study of phyllosphere and rhizosphere microflora; Measurement of microbial growth; Preparation of culture media; Isolation and purification of rhizospheric microbes; Isolation and purification of N-fixers; Isolation and purification of Nutrient solubilizers; Isolation and purification of Endophytes.

Suggested Readings

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
2. Rangaswami, G. and Bagyaraj, D. J. 2005. Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. and Ghosh, T. 2004. Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. 2007. A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi − 10014
5. Salyers, A. A. and Whitt, D. D. 2001. Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.
6. Prescott, L. M. 2002. Microbiology 5th Edition. McGraw-Hill Inc, US

PHYSICS

Course No.	Course Title	Credits	Semester
PHY 203	Engineering Physics (For B. Tech. Agricultural Engineering)	3 (2+1)	III
	Total Credits	**3 (2+1)**	

PHY 203	ENGINEERING PHYSICS (For B. Tech. Agricultural Engineering)	3 (2+1)	SEM III

Objectives

To make the students acquainted with applications of physics in engineering and different physical processes in agricultural engineering

Theory

Unit-I: Magnetism : Dia, para and ferro-magnetism- classification; Langevin theory of dia, and para magnetism, adiabatic demagnetization, Weiss molecular field theory and ferromagnetism, Curie-Weiss law.

Unit-II: Introduction to quantum mechanics : Wave particles duality, photoelectric effect, de-Broglie concept, uncertainty principle, wave function, time dependent and time independent Schrodinger equation.

Unit-III: Spectroscopy : Qualitative explanation of Zeeman effect, Stark effect and Paschen back effect, Raman spectroscopy.

Unit-IV: Solid state physics : Statement of Bloch function, bands in solids, distinction between metals, insulators and semi-conductors; Semiconductors: intrinsic and extrinsic semi-conductors, donors and acceptor levels, law of mass action, determination of energy gap in semi-conductors, Hall effect; Superconductivity: super conductivity, critical magnetic field, Meissner effect, Type I and II superconductors, isotope effect, London equations, BCS Theory, Josephsons effect, DC and AC squids, introduction to high Tc superconductors.

Unit-V: LASERS and MASERS : Spontaneous and stimulated emission, Einstein A & B coefficients, population inversion, Ruby lasers, He-Ne laser and semiconductor laser; Masers.

Unit-VI: Optical fibre and Illumination : Optical fibre**:** Physical structure, basic theory, type of modes, characteristics of optical fibre and applications.

Illumination**:** Laws of illumination, luminous flux, luminous intensity, candle power and brightness.

Practical

To verify law of transverse vibrations along a string using electrical tuning fork; To study hysteresis loss of magnetic materials; To demonstrate the Meissner effect; To measure the transition temperature of a high; temperature superconductor; Determine dielectric constant of material using De Sautys bridge; Study the variation of magnetic field with distance along the axis of a current carrying circular coil and to determine the radius of the coil; Determine the energy band gap in a semi-conductor

using a p-n junction diode; Determine the low resistance using Carey Foster bridge without calibrating the bridge wire.

Suggested Readings

1. Avadhanulu M N. 2013. An Introduction to Lasers theory and applications. S. Chand Publication
2. Chattopadhyay D and Rakshit P C. 2011. Electricity and Magnetism. S. Chand
3. Ghatak A K and Lokanathan S. 2022. Quantum Mechanics, Theory and Application. Trinity Press.
4. Griffiths D J and Schroeter 2018. Introduction to Quantum Mechanics. Cambridge University Press.
5. Khandelwal D P. 1985. A laboratory Manual of Physics. Vani Publications.
6. Kittel C. 2005. Introduction to Solid State Physics. Wiley Eastern Pvt. Ltd.
7. Mani H S and Mehta G K. 2022. Modern Physics. Affiliated East-West Press.
8. Omar M A. 2002. Elementary Solid State Physics. Pearson.
9. Prakash S. 2011. Optics. Pragati Prakashan, Meerut.
10. Saraf B and Khandelwal D P. 1982. Physics through Experiments, Vol. I & II. Vikas Publication, New Delhi.
11. Subramanyam N, Lal B and Avadhanulu M N. 2012. A Text book of Optics. S. Chand.
12. Taneja, S.P. 2004. Modern Physics for Engineers, R. Chand & CO, New Delhi.

SOCIOLOGY

Course No.	Course Title	Credits	Semester
SOC 101	Rural Sociology and Educational Psychology (For B.Sc. (Hons.) Agriculture)	2(2+0)	I
SOC 201	Rural Sociology (For B.Sc. (Hons.) Community Science)	2 (2+0)	III
SOC 202	Human Ethics (For B.Tech. Biotechnology)	1 (1+0)	IV
	Total Credits	**5 (5+0)**	

SOC 101	RURAL SOCIOLOGY AND EDUCATIONAL PSYCHOLOGY (For B.Sc. (Hons.) Agriculture)	2 (2+0)	SEM I

Objectives

Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with Extension Education

Theory

Sociology and rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension, and interrelationship between rural sociology and Agricultural Extension. Extension Education and Agricultural Extension: Meaning, definition, scope, and importance. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation and role of social groups in Agricultural Extension.

Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and- differences between class and caste system. Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension. Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension. Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change. Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension, Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Personality: Meaning, definition, types, factors influencing

the personality and role of personality in agricultural Extension. Teaching: Learning process: Meaning and definition of teaching, learning, learning experience and learning situation, elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

Suggested Readings

1. A. R. Desai -Rural Sociology in India
2. Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development
3. J.B. Chitambar -Introductory Rural Sociology
4. M.B. Ghorpade- Essential of psychology
5. C.N. Shankar Rao – Sociology: Principles of Sociology with an Introduction to Sociological Thought. S Chand and Company Ltd. New Delhi.
6. Prepared You Tube videos
7. R Velusamy Textbook on Rural Sociology and Educational Psychology
8. Ray, G. L. -Extension Communication and Management
9. Sandhu A. S. -Textbook on Agricultural Communication
10. Web Materials

SOC 201	RURAL SOCIOLOGY (For B.Sc. (Hons.) Community Science)	2 (2+0)	SEM III

Objectives

1. To develop understanding about sociological concepts with special reference to rural community.
2. To understand approaches to rural planning and status of rural women

Theory

Sociology and Rural sociology – Meaning and significance; Difference between rural and urban community; Indian rural social stratification: Caste & Class- Concept, characteristics and difference, Change in social stratification and implementation of constitutional provisions; Indian rural institutions: Social- Family and marriage (Nature, forms and changes), Economic- Jajmani system and division of labour, Political- Panchayati Raj; Religion: Functional significance of beliefs, traditions and customs; Rural poverty: Meaning, types and causes; Rural social change: Concept, process and factors of transformation; Planned social change- Approaches to rural planning, improvement and transformation; Status of women in rural India and their role in rural and agricultural development.

Suggested Readings

1. Chitambar, J.B. (1973). Introductory rural sociology. New York, John Wilex and Sons.
2. Desai, A.R. (1978). Rural sociology in India. Bombay, Popular Prakashan, 5th Rev.ed.
3. Doshi,S.L. (2007). Rural sociology. Delhi Rawat Publishers.
4. Jayapalan, N. (2002). Rural sociology. New Delhi, Altanic Publishers.
5. Sharma, K.L. (1997). Rural society in India. Delhi, Rawat Publishers

SOC 202	HUMAN ETHICS (For B.Tech. Biotechnology)	1 (1+0)	SEM IV

Objectives

1. To study the meaning and concepts of human behaviour
2. To study human ethical values
3. To study spirituality and attitude
4. To study the methods of stress management

Theory

Universal human aspirations, happiness, and prosperity. Human values and ethics: concept, definition, significance, and sources. Fundamental values: right conduct, peace, truth, love, and non-violence. Ethics: professional, environmental, and ICT. Sensitisation towards others, particularly senior citizens, the developmentally challenged, and gender.

Spirituality, positive attitude and scientific temper. Teamwork and volunteering. Rights and responsibilities. Road safety, Human relations, and family harmony. Modern challenges and value conflict. Sensitization against drug abuse and other social evils. Developing personal code of conduct (SWOT Analysis). Management of anger and stress.

Suggested Readings

1. Gaur RR, Sangal R and Bagaria GP, 2011, A Foundation Course in Human Values and Professional Ethics, Excel Books.
2. Mathur SS, 2010, Education for Values, Environment and Human Rights, RSA International.
3. Sharma RA, 2011, Human Values and Education -Axiology, Inculcation and Research, R. Lall Book Depot.
4. Sharma RP and Sharma M, 2011, Value Education and Professional Ethics, Kanishka Publishers.
5. Srivastava S, 2011, Human Values and Professional Ethics, S K Kataria and Sons.
6. Srivastava S, 2011, Environmental Science, S K Kataria and Sons.
7. Tripathi, A. N., 2009, Human Values, New Age International (P) Ltd, Publishers.

CENTRE OF FOOD SCIENCE AND TECHNOLOGY

Course No.	Course Title	Credits	Semester
FST 301	Food Science and Processing (For B.Tech. Biotechnology)	3 (2+1)	VI
FST 401	Food Safety and Standards (For B.Sc. (Hons.) Agriculture)	4 (3+1)	VII
FST 402	Food Science and Nutrition (For B.Sc. (Hons.) Agriculture)	4 (3+1)	VII
	Total Credits	**11 (8+3)**	

FST 301	**FOOD SCIENCE AND PROCESSING (For B.Tech. Biotechnology)**	**3 (2+1)**	**SEM VI**

Objectives

1. To study food and nutrition for good health
2. To study food spoilage, processing and preservation
3. To study the methods of assessing physical and chemical qualities

Theory

Food and nutrition; Food production and consumption trends in India; Food groups and concept of balanced diet, RDA, biotoxins, antinutritional factors and secondary metabolites; Major deficiencies of calories, proteins, vitamins and micronutrients; Causes of food spoilage; Principles of processing and preservation of food by heat, low temperature, drying and dehydration, chemicals and fermentation; Preservation through ultraviolet and ionizing radiations; Postharvest handing and processing technology of fruits, vegetables, cereals, oilseeds, milk, meat and poultry; Food safety, adulteration, HACCP and Indian food laws; Status of food industry in India.

Practical

Physical and chemical quality assessment of cereals, fruits, vegetables, egg, meat and poultry; Value added products from cereals, millets, fruits, vegetables, milk, egg and meat; Visit to local processing units.

Suggested Readings

1. Gopalan, C., Rama Sastri, B.V. and Bala Subramanian, S.C. (2005). *Nutritive Value of Indian Foods*. NIN, ICMR, Hyderabad.
2. ICAR. (2013). *Handbook of Agricultural Engineering*. ICAR Publications, New Delhi
3. Manay, S. & Shadaksharaswamy, M. (2020). *Foods Facts and Principles*. New Age International Publishers.
4. Srivastava, R.P. and Kumar, S. (2019). *Fruit and Vegetable Preservation-Principles and Practices*, CBS Publishers.
5. www.fassi.gov.in

FST 401	FOOD SAFETY AND STANDARDS (For B.Sc. (Hons.) Agriculture)	4 (3+1)	SEM VII

Objectives

1. To know hazards and understand to protect food from contamination
2. To understand the need for food safety systems
3. To use the scientific approach and practices towards safety

Theory

Food safety: definition, importance and factors affecting food safety; recent concerns- new and emerging pathogens, recent outbreaks; hazards- types (physical, chemical, biological), sources of contamination, management of hazards/contaminations- need and control of parameters: temperature, production design, packaging and food storage; hygiene and sanitation- personal hygiene, food establishments and surface sanitation; pest and rodent control; water- hygiene and quality standards; waste disposal; food safety measures: food safety management systems- basic concepts, components, need and newer approaches to food safety; risk analysis; PRPs- GHPs, GMPs, SSOPs, etc.; HACCP and TQM; GFSI; Food laws and standards: Indian food regulatory regime- FSSA; global scenario- CAC, WTO, SPS, TBT, etc.; other laws and standards related to food- ISO series; Indian and International standards for food products; product labelling and nutritional labelling, organic foods.

Practical

Quality attributes of raw and processed foods, water quality analysis; assessment of surface sanitation by swab/rinse method; personal hygiene; process flow for food establishment; GHP and GMP in a food factory; FSMS: hazard identification and risk analysis; OPRPs. development of HACCP plan; understand the ISO 22000; organizational structure of FSSAI and CAC; design a label for food product.

Suggested Readings

1. Deshpande, H.W. & Katke, S.D. 2021. Food Quality, Assurance and Certification.
2. Fernandes, C. *Safe Food Handling: HACCP Booklet for Food Handlers*, Notion Press.
3. Fortin, N.D. 2009. Food Regulation. John Wiley & Sons, New Jersey.
4. Khatekar, D. & Sarkate, N. 2023. *Handbook of Food Safety*, Step Up Academy.
5. Mathur, P. 2018. *Food Safety and Quality Control*, The Orient Blackswan.
6. Sherikar, A.T., Bachhil, V.N. & Thapliyal, D.C. 2013. *Textbook of Elements of Veterinary Public Health*. ICAR.

FST 402	FOOD SCIENCE AND NUTRITION (For B.Sc. (Hons.) Agriculture)	4 (3+1)	SEM VII

Objectives

To impart knowledge on the biochemical aspects of various nutrients and its interactions in food during processing, storage and deterioration

Theory

Introduction on fundamentals of food science and human nutrition; food- sources and its functions; basic food groups; concept of balanced diets; nutritional requirements and recommended daily allowances (RDA); malnutrition- over and under nutrition and nutritional disorders; water in foods, properties and water activity; major food constituents-carbohydrates, proteins, fats- sources, classification, functions, physico-chemical and nutritional characteristics; effect of processing; digestion, absorption, transport and metabolism in human system; vitamins and minerals- classification, dietary sources, functions, deficiency diseases and effect of processing; anti-nutritional factors; postharvest storage and losses during processing; food spoilage; enzymes in food industry; food additives.

Practical

Standard solutions and buffers; TSS; pH; acidity; water activity; proximate analysis of foods; calorific value of foods, estimation of vitamins, phenols, flavonoids, carotenoids, anti-nutrients in food stuff

Suggested Readings

1. De Man, J.M. 1976. *Principles of Food Chemistry*. AVI.
2. Gibney M.J., Lanham-New S.A., Cassidy, A. & Voster, H.H. (ed.) 2009. *Introduction to Human Nutrition*. Wiley-Blackwell
3. Gopalan, C., Rama Sastri, B.V. & Bala Subramanian, S.C. 2021. *Nutritive Value of Indian Foods*, NIN, ICMR, Hyderabad.
4. Kumar, D. 2019. *Food Science and Nutrition*, Random Publications.
5. Manay, N.S. & Shadaksharaswamy, M. 2020. *Foods Facts and Principles*, New Age International Publishers.
6. Mudambi, R.S. & Rao, S. 1985. *Food Science*, Wiley Eastern Ltd.
7. Rekhi, T. and Yadav, H. 2014. *Fundamentals of Food and Nutrition*. Elite Publishing House.
8. Swaminathan, M. 1999. *Essentials of Foods and Nutrition*, Vol. I. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
9. Trueman, P. 2007. *Nutritional Biochemistry*, MJP Publishers

DIRECTORATE OF STUDENTS' WELFARE


Chaudhary Charan Singh Haryana Agricultural University, Hisar
NATIONAL SERVICE SCHEME
NATIONAL INTEGRATION CAMP
October 23-29, 2024
Youth for my Bharat
Dr. M.L. Khichar
Prof. B.R. Kamboj
Sh. Randhir Panihar
M.L.A., NALWA
Dr. Dinesh Kumar
State NSS Officer


Chaudhary Charan Singh Haryana Agricultural University, Hisar
NATIONAL SERVICE SCHEME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DIRECTORATE OF STUDENTS' WELFARE

Course No.	Course Title	Credits	Semester
NCC I/ NSS I (AEC)	National Cadet Corps I/ National Service Scheme I	2 (0+2)	I
NCC II/ NSS II (AEC)	National Cadet Corps II/ National Service Scheme II	2 (0+2)	II
CCA 102	Co-curricular Activity	1 (0+1) NG	II
CCA 201 (AEC)	Physical Education, First Aid, Yoga Practices and Cultural Activities	2 (0+2)	III
NCC III/ NSS III	National Cadet Corps III/ National Service Scheme III	2 (0+2) NG	III
CCA 202	Co-curricular Activity	1 (0+1) NG	IV
NCC IV/ NSS IV	National Cadet Corps IV/ National Service Scheme IV	2 (0+2) NG	V
	Total Credits	**6 (0+6)**	

NCC I/ NSS I (AEC)	NATIONAL CADET CORPS I/ NATIONAL SERVICE SCHEME I	2 (0+2)	SEM I

National Cadet Corps (NCC I)

Objectives

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical/ Awareness programmes

- Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
- Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
- Sizing, numbering, forming in three ranks, open and close order march, and dressing.
- Saluting at the halt, getting on parade, dismissing, and falling out.
- Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
- Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
- Command and control, organization, badges of rank, honors, and awards
- Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership. Character/ personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.

- Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.
- Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 and 3 years, respectively along with 1-2 annual camps.

National Service Scheme (NSS I)

Objective

1. Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical/ Awareness programmes

- Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
- Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
- NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
- Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration.
- Indian history and culture, role of youth in nation building, conflict resolution and peacebuilding. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.
- Citizenship, constitution, and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community-based organizations) and society.

A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

NCC II/ NSS II (AEC)	NATIONAL CADET CORPS II/ NATIONAL SERVICE SCHEME II	2 (0+2)	SEM II

National Cadet Corps (NCC II)

Objective

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Practical/ Awareness programmes

- Arms Drill-Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/ long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.
- Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding.
- Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.
- Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
- The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
- Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

National Service Scheme (NSS II)

Objective

1. To evoke social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skillful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

Practical/ Awareness programmes

- Importance and role of youth leadership
- Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
- Definition and importance of life competencies, problem-solving and decision-making interpersonal communication. Youth development programs
- Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations
- Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

CCA 201 (AEC)	**PHYSICAL EDUCATION, FIRST AID, YOGA PRACTICES AND CULTURAL ACTIVITIES**	**2 (0+2)**	**SEM III**

Objectives

1. To make the students aware about Physical Education, First Aid and Yoga Practices
2. To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through yoga

Practical

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; History of Yog, Types of Yog, Introduction to Yog,

- Asanas (Definition and Importance) Padmasan,san, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan
- Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh

- Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
- Role of yoga in sports
- Teaching of Asanas – demonstration, practice, correction and practice.

History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics Need and requirement of first aid. First Aid equipment and upkeep. First aid Techniques, First aid related with Respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Music- Importance of Music in life, rhythm in music, role of music in personality development, naad, swar, shruti, alankar, gamak, vadi-samvadi, in music. Importance of expression, Dance and Meditation.

Dramatics- History and theory of theatre. Acting, directing, stage design craft of script and dialogue

Haryana Folk Lore and Culture- Society and Folk Lore, Historical context, folk music in different regions, instruments used in Haryana Folk Lore, Singing style of different folk gharanas.

COMMITTEE FOR FINALISATION OF UG COURSE CURRICULUM