Course Curriculum of Fourth Semester

as per the ICAR-Sixth Deans' Committee Report for the Academic Programmes in

AGRICULTURE

- UG-Certificate in Agriculture
- UG-Diploma in Agriculture
- UG-Degree: B.Sc. (Hons.) Agriculture

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with

UG Degree Syllabus Discipline Coordinators &

DICC - UG Degree Syllabus Core Committee

Submitted to the

Directors of Instruction and Deans (F/A) Coordination Committee

~ w.e.f. AY, 2025-26 ~

Course Curriculum of Fourth Semester as per the ICAR-Sixth Deans' Committee Report for Academic Programme in AGRICULTURE

Course Layout

B.Sc. (Hons.) Agriculture

Semester: IV (New) ***w.e.f.*** **Academic Year: 2025-26**

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	**MDC-242**	Entrepreneurship Development and Business Management	3(2+1)	--
2.	**VAC-242**	Agricultural Informatics and Artificial Intelligence	3(2+1)	--
3.	**AGRO-244**	Crop Production Technology-II (*Rabi* Crops)	3(1+2)	--
4.	**AGRO-245**	Water Management	2(1+1)	--
5.	**GPB-242**	Basics of Plant Breeding	3(2+1)	--
6.	**HORT-243**	Production Technology of Vegetables and Spices	2(1+1)	--
7.	**SOIL-243**	Problematic Soils and their Management	2(1+1)	--
8.	**EXTN-242**	Fundamentals of Extension Education	2(1+1)	--
9.	**SEC-246**	Skill Enhancement Course -VI[#] *(To be offered from the list of SEC Courses)*	2(0+2)	--
10.	**OC-1/ OC-2/…**	Online Course(s)/ MOOCs[†]	As opted by student	**NG**
		Total Credit Hrs.=	**22(11+11)**	**G**
MDC: Multidisciplinary Course, **VAC**: Value-added Course, **SEC**: Skill Enhancement Course, **OC**: Online Course, **G**: Gradial, **NG**: Non-gradial				
Post-IV Semester (Only for Exit option for award of UG-Diploma)				
11.	**INT-242**	Internship (10-week)	10(0+10)	**NG**

[†] **Note:** It is mandatory for each Student to complete **total 10 credits** (Non-gradial) of **Online Courses** from available resources across III to VIII semesters under the guidance of assigned Faculty/Advisor.

B.Sc. (Hons.) Agriculture: Fourth Semester

Course-wise Syllabus with Teaching Schedules

Semester : IV		
Course No. : MDC-242	**Credit Hrs. : 3(2+1)**	
Course Title : Entrepreneurship Development and Business Management		
Gradial Common Course across B.Sc. (Hons.) Agriculture, B.Tech. (Agricultural Engineering), B.Tech. (Food Technology), B.Sc. (Hons.) Agri. Business Management		

SYLLABUS

Objectives : (i) To provide student an insight into the concept and scope of entrepreneurship,
(ii) To expose the student to various aspects of establishment and management of a small business unit,
(iii) 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 products/ 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/ Agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

TEACHING SCHEDULE

THEORY [MDC-242]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Entrepreneurship	Meaning and Definitions of an Entrepreneur, Entrepreneurship; Concept & Scope of Entrepreneurship	6
2	Importance of Entrepreneurship	Importance of Entrepreneurship in Agribusiness	
3	Entrepreneurship Development	Need for and objectives of Entrepreneurial development	4
4	Motivational Factors	Types of motivational factors, Role of social and environmental factors in entrepreneurship	4
5	Characteristics of Entrepreneurs	Characteristics, Entrepreneurial attributes and Competencies	4
6	Types of Entrepreneurs	Various types and their significance	4
7	Functions of Entrepreneurs	Key roles and Responsibilities	2
8	Evolution of Entrepreneurship	Historical perspective and Growth	3
9	Process of Entrepreneurship Development	Stages and Approaches in developing entrepreneurship	4
10	Environmental Scanning	Need for scanning, Techniques	2
11	Opportunity Identification	Spotting and Analyzing opportunities	2
12	Infrastructure and Support Systems	Policies, Schemes and Role of financial and other agencies in entrepreneurship development	4
13	Enterprise Functioning Steps	Steps to establish an Enterprise	4
14	Selection of Products/Services	Choosing products, Services and Business forms	3
15	Enterprise Location and Capital Sources	Registration, Site selection, Capital sources/ Acquisition	3
16	Manufacturing and Distribution	Acquiring manufacturing know-how, Packaging and Distribution essentials	3
17	Planning of an Enterprise	Short term and Long-term planning of an Enterprise	3
18 - 19	Project Formulation	Project identification, Selection, Steps in project formulation and Report preparation, etc.	8
20	Enterprise Management	Basics and Importance of managing an Enterprise	3

Continued….

21	Production Management	Product types, Levels of products, Product mix, Quality control, Cost of production, Production control	4
22	Material Management	Raw material costing and Inventory control strategies	4
23	Personnel Management/ Human Resource Management	Manpower planning, Labour turnover, Wages/ Salaries	4
24	Financial Management	Funds, Fixed and Working capital, Costing, Pricing, Book-keeping basics	4
25 - 26	Accounting and Taxation	Journals, Ledgers, Subsidiary books, Annual financial statements, Taxation basics	4
27	Marketing Management	Market, Types of markets, Marketing assistance	4
28 - 29	Market Strategies and Pricing	Marketing strategies, Pricing strategies and Market penetration	4
30	Crisis Management	Crisis types, Strategies for managing raw material, etc.	2
31	Leadership in Crisis Situations	Role of leadership in handling crises	2
32	Financial Crises and Solutions	Strategies for financial crisis management	2
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [MDC-242]

Exercise No.	Exercise Title
1	Visit to Small-Scale Industries/ Agro-Industries. (Objective: To understand setup and operations of small-scale units)
2	Interaction with Successful Entrepreneurs. (Objective: To gain insights from real-life entrepreneurial experiences)
3	Case Study on Agro-Entrepreneurs. (Objective: To analyze successful agribusiness ventures)
4	Visit to Financial Institutions. (Objective: To learn about funding options and financial support)
5	Identification of Agribusiness Ideas. (Objective: To identify viable agribusiness ideas based on demand)
6	Analyzing Project Proposals. (Objective: To study structure and elements of project proposals)

Continued…

7	Preparing a Project Proposal. (Objective: To develop a basic proposal for an agribusiness venture)
8	Project Report Writing Techniques. (Objective: To practice format and structure for project reports)
9	Marketing Strategies Case Study. (Objective: To analyze effective marketing strategies in agribusiness)
10	Production and Cost Control Analysis (Objective: To study basic cost control measures in production)
11	Inventory Control Simulation (Objective: To apply inventory management methods in a hypothetical setup)
12	Basic Bookkeeping (Objective: To practice fundamental bookkeeping for small businesses)
13	Market Research Techniques (Objective: To use surveys and questionnaires for market insights)
14	Project Proposal Presentation (Objective: To present project ideas for feedback)
15	Review of Project Proposal (Objective: To refine project proposals based on feedback)
16	Final Evaluation of Proposals (Objective: To assess and finalize projects)

Suggested Readings [MDC-242]:

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 V. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House, Mumbai.
4. Gupta C.B. 2001. Management Theory and Practice. Sultan Chand and Sons, New Delhi.
5. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy, Udaipur.
6. Khanka S.S. 1999. Entrepreneurial Development. S. Chand and Co., New Delhi.
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., New Delhi.
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, New Delhi.

Semester	**: IV**	
Course No.	**: VAC-242**	**Credit Hrs. : 3(2+1)**
Course Title	**: Agricultural Informatics and Artificial Intelligence**	
Gradial Common Course across B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Horticulture, B.Tech. (Biotechnology), B.Tech. (Food Technology), B.Sc. (Hons.) Agri. Business Management, B.Sc. (Hons.) Forestry, B.F.Sc. (Hons.), B.Sc. (Hons.) Community Science		

SYLLABUS

Objectives :

(i) To acquaint students with the basics of computer applications in Agriculture, multimedia, database management, application of mobile app and decision-making processes etc.,

(ii) To provide basic knowledge of computer with applications in Agriculture,

(iii) To make the students familiar with Agricultural-Informatics, its components and applications in Agriculture and Artificial Intelligence.

THEORY

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office® for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database- concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to general programming 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, input-output 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: 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-PowerPoint for creating, editing and presenting a scientific document, MS-EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data. 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 smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, AR/VR demonstration, India Digital Ecosystem of Agriculture (IDEA).

TEACHING SCHEDULE

THEORY [VAC-242]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1- 3	**Introduction to Computers, Anatomy of Computers** **Memory Concepts:** **Operating System:**	Definitions; Characteristics of Computer; Components of Computer; CPU: CU, ALU, MU; Input Devices; Output Devices; Units of Memory: bit to TB, Types: Primary, Secondary; Definitions and Types: Single user, Multi-user and features. OS Special Types (Brief Overview): Batch, Real-Time, Time Sharing, Distributed, Network OS. Functions of operating system	7
4 - 6	**Applications of MS Office®**	MS Word: Creating a New Document, Formatting option features; Insertion of Table; MS Excel: Creating worksheet and graph, Functions for Data Analysis: AVERAGE, COUNT, SUM, MIN, MAX, MEDIAN, MODE, STDEV, STDEVP, VAR, VARP, CORREL, PERCENTILE; Mathematical functions in MS-Excel: SUM, AVERAGE, AVERAGEIF, COUNT, COUNTIF, MOD, ROUND	7
7 - 9	**Database and DBMS**	Database: Definitions, Concepts and Types; Uses of DBMS in Agriculture; Characteristics of Database; Structure of Database Management System, Tables: Concept of view, Primary key, Foreign key; Creating Database: SQL query: Create, Insert, Select, Delete, Update. Form: Steps for Creating Forms, Entering Data in forms, Report using MS-ACCESS: Steps for Creating Reports, Printing reports.	7

Continued…

VAC-242…

10	**Internet and World Wide Web (www)**	Concepts and components; Internet: Introduction; Definition of LAN, WAN, MAN and Internet Internet Service Provider (ISP); World Wide Web; Hypertext; Web Browser; Web Page and Websites; E-Mail: Creating Email, Email Addresses, Using Email, Sending the message, CC and BCC; Search Engine	7
11 - 12	**Introduction to Computer Programming**	Computer Programming: Introduction, General concepts, Standard input/output operations.	7
13 - 14	**e-Agriculture**	Concepts, Application & Importance of IT in e-Agriculture; AGRINET: Introduction, Objectives; Advantages and Challenges in Agriculture.	7
15 - 16	**Computer Models in Agriculture**	Statistical, Weather Analysis and Crop Simulation Models; Concepts, Input-output files, Limitation, Advantages and Application of models for understanding plant processes, Sensitivity, Verification, Calibration and Validation	7
17 - 19	**IT and IoT Applications in Agriculture**	IT Applications & their role in Agriculture with emphasis on Computation of Water and Nutrient Requirement of Crop; IoT - Definition, Benefits/ Applications/ Uses in Agriculture: Precision Farming, Agricultural Drones, Smart Greenhouses, Drones; Challenges.	7

Continued…

20 - 21	**Computer-controlled Devices; Smartphone Apps and Geospatial Technology**	Computer-controlled Devices (Automated systems) for Agri-input management- Examples of Automation Devices: Robotics Application in Planting, Drones for Irrigation, Harvest Automation Tools, Automated Tractors etc., AWS - Automatic Weather Station, AIS - Automatic Irrigation System. Smartphone Mobile Apps in Agriculture- Introduction- Irrigation Systems, Fertilizer Application, Pest and Disease Management; Seeding and Planting, Harvesting Systems; Weather Forecasting, Soil Testing and Analysis, Crop Management, Market Prices; Farm Management, Financial & Insurance Services. Geospatial Technology (*in brief*) – Introduction, Techniques, Components and Uses for generating valuable agri-information.	7
22 - 23	**Decision Support System (DSS)**	DSS: Introduction, Concepts, Components, Types and Applications in Agriculture.	7
24 - 25	**Agriculture Expert System (AES)**	AES: Introduction, Concepts, Components and Applications in Agriculture- Soil Information Systems for supporting farm decisions.	7
26 - 27	**Contingent Crop Planning using IT Tools**	Preparation of Contingent Crop Planning and Crop Calendars: Introduction, Definition, Benefits, Steps to prepare Contingent Crop Planning & Calendars using IT Tools.	7
28 - 30	**Digital India and Schemes to promote Digitalization of Agriculture in India**	Digital India and Schemes to promote Digitalization of Agriculture in India; Digital Agriculture in India: Status, Challenge, Digital India and Initiatives in Agriculture Sector. Digital Agriculture or NeGP-A 2.0	8
31- 32	**Introduction to and Uses of Artificial Intelligence (Overview)**	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.	8
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [VAC-242]

Exercise No.	Exercise Title
1 - 2	Study of computer components, accessories, practice of important DOS command Introduction to different Operating systems- such as Windows, Unix/ Linux; Creating files and folders, Files Management.
3 - 4	Use of ~ MS-WORD: Creating files and folders; Files management and MS-POWERPOINT: Presentation for creating, editing and presenting scientific documents. MS-EXCEL: Mathematical calculations; Preparation of Spread sheets; Use of statistical tools; Writing expressions; Creating graphs; Analysis of scientific data.
5	MS-ACCESS: Creating Database; Preparing queries and reports.
6	Demonstration of Agri-information system(s)
7 - 8	Introduction of Programming Languages & Program in C-Language: a) Program to enter name and print name b) Program to calculate sum and subtraction of numbers c) Program to calculate Area of Circle d) Program to calculate Area of Triangle e) Program to calculate Area of Rectangle
9	Introduction to Internet, World Wide Web (WWW) and its components.
10 - 11	Hands-on Practice on Crop Simulation Models (CSM): CROPWAT 8.0/ DSSAT/ Crop-Info/ CropSyst/ Wofost/ etc. Computation of water and nutrient requirements of crop using CSM and IT tools.
12	Use of Smartphone Apps (developed by SAUs) and other devices in agro-advisory and dissemination of market information
13	Introduction to Geospatial Technology (Use of Open-source GIS Tools)
14	Study/ Demonstration of general AR/VR tools (as available)
15	Hands-on Practice on Decision Support System (DSS);
16	Introduction to India Digital Ecosystem of Agriculture (IDEA)

Suggested Readings [VAC-242]:

1. Fundamentals of Computer by V. Rajaraman, PHI Learning.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C.J. Date, Pearson Education, N. Delhi.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K. *et al.*, Jain Brothers Publication.
6. Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013.
7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa Publ.
8. Agricultural Informatics and Artificial Intelligence for B.Tech.(Agril Technology) by Prashant Publ.

- ***Online Resources: (VAC-242)***

  - https://en.wikipedia.org/wiki/Computer
  - https://www.javatpoint.com/computer
  - https://iasri.icar.gov.in/
  - https://www.nrsc.gov.in/EO_Agr_Objective?language_content_entity=en
  - https://www.agrimoon.com
  - https://www.agriinfo.in
  - https://eagri.org
  - https://www.agriglance.com
  - https://agritech.tnau.ac.in
  - https://loksabhadocs.nic.in/Refinput/New_Reference_Notes/English/Agriculture_and_Digital_India.pdf
  - https://www.investindia.gov.in/team-india-blogs/digitalisation-agriculture-india
  - http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Session-11-Preparation-of-Contingent-Crop-Planning-and-Crop-Calendars-Using-IT-Tools.pdf
  - https://optimizeias.com/indias-digital-ecosystem-for-agriculture/
  - https://www.igi-global.com/chapter/introduction-to-agricultural-information-systems/266572#:~:text=Agricultural%20Information%20Systems%3A%20Information%20system,knowledge%20utilization%20by%20agricultural%20producers.
  - https://cropcalendar.apps.fao.org/#/home
  - http://www.irdindia.in/journal_ijrdmr/pdf/vol4_iss1/7.pdf
  - https://learn.microsoft.com/en-us/office365/servicedescriptions/office-applications-service-description/office-applications
  - https://ebooks.inflibnet.ac.in/hsp16/chapter/application-of-software-in-statisticalanalysis-i-microsoft-excel/
  - http://eagri.org/eagri50/STAM102/index.html
  - https://edu.gcfglobal.org/en/internetbasics/using-a-web-browser/1/
  - https://www.javatpoint.com/what-is-world-wide-web
  - https://www.mdpi.com/journal/agriculture/special_issues/Decision_Support_Systems_Application
  - https://apps.gov.in/ministry/ministry-agriculture
  - http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Session-11-Preparation-of-Contingent-Crop-Planning-and-Crop-Calendars-Using-IT-Tools.pdf
  - https://apps.mgov.gov.in/apps_by_category;jsessionid=8206D0DAE69F48FB50962462A8922C23?name=Agriculture

➢ ***Tools available for Student for Academic Purpose only: (VAC-242)***

1. DSSAT (Decision Support System for Agrotechnology Transfer)
- Purpose: A comprehensive crop modeling tool.
- Use: Simulates plant growth, development, and yield for various crops under different management and environmental conditions.
- Download: https://dssat.net/

2. APSIM (Agricultural Production Systems Simulator)
- Purpose: A powerful plant simulation tool.
- Use: Models the effects of environmental variables like soil, climate, and management strategies on plant growth and crop yield.
- Download: https://www.apsim.info/

3. Open Sim Root
- Purpose: A root growth modeling software.
- Use: Helps understand plant root growth processes, interactions with soil, and how they respond to environmental conditions.
- Download: Available as open-source software via research platforms like Git Hub. https://gitlab.com/rootmodels/OpenSimRoot

4. Virtual Plant
- Purpose: A tool for visualizing and modeling plant metabolic and regulatory networks.
- Use: Helps in understanding complex plant processes such as gene regulation, metabolic pathways, and how they respond to environmental conditions.

  Download: https://sourceforge.net/projects/virtualplant/

5. R Studio (with Bioconductor and Plant Modeling Libraries)
- Purpose: A programming environment for statistical computing.
- Use: Using plant modeling libraries like plant and photosynthesis, researchers can model plant growth, carbon assimilation, and nutrient cycling.
- Download: https://posit.co/downloads/

6. WOFOST (World Food Studies)
- Purpose: A plant process and crop growth simulation model developed by the FAO.
- Use: Helps in understanding crop development, photosynthesis, and biomass accumulation under different environmental and management conditions.
- Download: https://www.wur.nl/en/research-results/research-institutes/environmental-research/facilities-tools/software-models-and-databases/wofost/downloads-wofost.htm

7. Green Lab
- Purpose: A plant growth model focused on plant architecture and functional growth processes.
- Use: Simulates plant organ development and growth processes, integrating functional and structural aspects of plant behavior.
- Download: https://greenlab.cirad.fr/GLUVED/html/P3_Tools/Tool_simul_003.html

Semester	**:**	**IV**	
Course No.	**:**	**AGRO-244**	**Credit Hrs : 3 (1+2)**
Course Title	**:**	**Crop Production Technology-II (*Rabi* Crops)**	

SYLLABUS

Objectives : (i) To impart basic and fundamental knowledge on principles and practices of *Rabi* crop production,

(ii) 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, Barley and *Rabi* sorghum, **Pulses** - Chickpea, Lentil, Peas and French bean; **Oilseeds** – Rapeseed, Mustard, Sunflower, Safflower and Linseed; **Sugar crops** - Sugarcane and Sugar beet; **Medicinal and Aromatic crops** - Mentha, Lemon grass and Citronella, and **Forage crops** - Berseem, Lucerne and Oat.

PRACTICAL

Identification of major *rabi* crops and their seeds, Study of sowing methods of Wheat and planting method of Sugarcane, Demonstration of mechanization in crop cultivation practices in *rabi* crops, Identification of weeds in *rabi* season crops, study of morphological characteristics of *rabi* crops, Calculations of plant population, seed rate and fertilizers doses, Study of yield contributing characters of *rabi* crops, study of 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.

Allotment of 2 R area to each student for undertaking various cultural operations as part of Practical Work Experience, specifically for raising *rabi* crop(s) on the allotted plot, to be carried-out concurrently with the above-mentioned practical sessions.

TEACHING SCHEDULE

THEORY [AGRO-244]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 3	**Cereals –** Wheat, Barley, *Rabi* Sorghum	Origin, Geographical distribution, Economic importance, Soil and climatic requirements, Varieties/ Hybrids, Cultural practices: Land preparation, Seeds and Sowing, Irrigation and Nutrient Management, Intercultural operations including weed management, Plant Protection (Major pests and diseases and their management), Harvesting, Yield and Crop specific post-harvest processing	25
4 - 6	**Pulses –** Chickpea, Lentil, Pea, French bean		20
7 - 9	**Oilseeds –** Rapeseed, Mustard, Sunflower, Safflower and Linseed		25
10 - 11	**Sugar crops –** Sugarcane and Sugar beet		10
12 - 14	**Medicinal and Aromatic crops –** Mentha, Lemon grass and Citronella		10
15 - 16	**Forage crops –** Berseem, Lucerne and Oat		10
		Total =	**100**

PRACTICAL [AGRO-244]

Part-I (Practical/ Demonstration Sessions)	
Exercise No.	**Exercise Title**
1	Identification of major *rabi* crops and their seeds.
2	Study of sowing methods of Wheat.
3	Study of planting method of Sugarcane.
4	Demonstration of mechanization in crop cultivation practices in *rabi* crops.
5 - 6	Identification of weeds and use of herbicides in *rabi* crops.
7	Study of morphological characteristics of *rabi* crops.
8 - 9	Calculations of plant population, seed rate and fertilizers doses.
10	Study of yield contributing characters of *rabi* crops.
11	Study of maturity signs and juice quality analysis of Sugarcane.
12 - 13	Study of important agronomic experiments of *rabi* crops at experimental farms.
14	Study of *rabi* forage experiments.
15 - 16	Visit to Research Stations of related *rabi* crops.

Continued…

Part-II (Work Experience)	
Exercise No.	**Exercise Title**
Allotment of 2 R area to each student towards carrying-out various following agronomic operations for raising *rabi* crop(s) in the allotted plot in parallel mode with Part-I:	
1 - 2	Study of package of practices of given *rabi* crop(s): (sown/planted as timely, late and rainfed crops).
3 - 4	Preparation of calendar of operations for *rabi* crops.
5	Study of preparatory, secondary tillage and seed bed preparation for *rabi* crops.
6	Seed treatment and sowing of *rabi* crops.
7	Study of integrated nutrient management of *rabi* crops.
8	Study of water management in *rabi* crops.
9 - 10	Measurement of growth and yield contributing characters of *rabi* crops.
11	Study of interculturing and weed management in *rabi* crops.
12	Study of integrated insect pest and diseases management in *rabi* crops.
13	Study of crop maturity signs and harvesting methods of *rabi* crops.
14	Threshing, drying, winnowing, storage and preparation of produce for marketing of *rabi* crops.
15	Economic analysis of allotted *rabi* crop(s) cultivation (Cost of cultivation).
16	Preparation of a *rabi* crop production report/dossier-based on field observations.

Suggested Readings [AGRO-244]:

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. UAS, Bangalore. 2011. Package of Practices. UAS, Bangalore.
8. Rajendra Prasad. 2002. Text Book of Field Crops Production, ICAR, New Delhi.
9. S.R. Reddy. 2004. Agronomy of Field crops, Kalyani Publishers, Ludhiana.
10. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production, South Asian Publishers, New Delhi.

Semester	**: IV**		
Course No.	**: AGRO-245**	**Credit Hrs.**	**: 2(1+1)**
Course Title	**: Water Management**		

SYLLABUS

Objectives : (i) To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development,

(ii) To study different methods of irrigation and water management practices of both field and horticultural crops and drainage,

(iii) 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- Soil-plant-atmosphere continuum (SPAC), Soil moisture – Distribution of soil moisture, Soil moisture constants and Types of soil water; Water budgeting – rooting characteristics – moisture extraction pattern, effect of moisture stress on crop growth; Evaporation, transpiration, evapotranspiration and crop water requirement, Consumptive use of water, Potential evapotranspiration (PET); Effective rainfall; Different approaches of scheduling of irrigation; Methods of irrigation: surface and sub-surface; Pressurized irrigation methods *viz.,* sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Irrigation efficiency, water use efficiency and conjunctive use of water and measures to increase water use efficiency; Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); Agricultural drainage, types of drainage, effects of drainage on soil, ill effects of excess of water on soil and Water management in problematic soils; 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.

TEACHING SCHEDULE

THEORY [AGRO-245]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Irrigation	Irrigation: Definition and Objectives, Importance Function of water for plant growth	4
2	Water Resources of India	Water resources and irrigation development for different crops in India	6
3 - 4	Soil Plant-Water Relationships	Soil-Plant-Atmosphere Continuum (SPAC), Soil moisture: Distribution of soil moisture, Soil moisture constants and Types of soil water	14
5	Water Budgeting	Water budgeting: Rooting characteristics-Moisture extraction pattern, Effect of moisture stress on crop growth	8
6	Evapotranspiration and CWR	Evaporation, Transpiration, Evapotranspiration and Crop water requirement, Consumptive use of water, Potential evapotranspiration (PET); Effective rainfall	8
7	Scheduling of Irrigation	Different approaches of scheduling of irrigation	6
8	Methods of Irrigation with Layouts	Surface and sub-surface methods with their Layouts	6
9 - 10	Pressurized Irrigation Systems	Sprinkler and drip irrigation, their suitability, Comparison, Merits and limitations, Fertigation, Economic use of irrigation water	10
11	Irrigation Efficiency	Irrigation Efficiency, Water use efficiency and Conjunctive use of water and measures to increase water use efficiency	8
12	Water Quality for Irrigation	Irrigation water quality and its management.	6
13	Water Management of different Crops	Water management of different crops - (Rice, Wheat, Maize, Groundnut, Sugarcane, Mango, Banana and Tomato)	6
14 - 15	Drainage	Agricultural drainage, Types of drainage, Effects of drainage on soil, Ill effects of excess of water on soil and water management in problematic soils	12
16	Irrigation Automation	Irrigation automation, Artificial intelligence and Climate-based irrigation practices and its management.	6
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [AGRO-245]

Exercise No.	Exercise Title
1	Determination of bulk density by field method
2	Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter
3	Determination of field capacity by field method
4	Determination of permanent wilting point
5 - 6	Measurement of irrigation water by using water measuring devices *viz.,* flumes, orifices and weirs; Calculation of irrigation water requirement (Problems)
7	Determination of infiltration rate
8	Demonstration of surface irrigation methods
9	Demonstration of drip irrigation system
10	Demonstration of sprinkler irrigation system
11	Demonstration of filter cleaning, fertigation, injection and flushing of laterals
12 - 13	Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability
14	Use of artificial intelligence (AI) in irrigation management
15	Visit to Farmer's field and cost estimation of drip irrigation system
16	Visit to Irrigation Research Centre/ Command Area.

Suggested Readings [AGRO-245]:

1. Rao, Y.P. and Bhaskar, S.R. Irrigation Technology- Theory and Practice. Agrotech Publishing Academy, Udaipur.
2. Dilip Kumar Mujmdar. Irrigation Water Management: Principles and Practices. Prentice Hall of India Pvt. Ltd.
3. Patil, S.V and 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.

Semester : **IV**		
Course No. : **GPB-242**	**Credits** : **3(2+1)**	
Course Title : **Basics of Plant Breeding**		

SYLLABUS

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; Plant genetic resources, its utilization and conservation. Domestication, Acclimatization and Introduction. Centers 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, abiotic stresses and quality. Participatory Plant Breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeder's 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.

TEACHING SCHEDULE

THEORY [GPB-242]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	**Plant Breeding: Concept, Historical Development and Role**	Definition, Aims and general objectives of Plant Breeding; History of Plant Breeding, Landmarks of Plant Breeding; Eminent Global and Indian Plant Breeders, Major achievements and Future Prospects; Genetics in relation to Plant Breeding	3
2	**Modes of Reproduction and Apomixis**	Definitions- Sexual, Asexual, Apomixes and their Significance in Plant Breeding; Types of Pollination and Mechanisms promoting self and cross pollination; Differences between self- and cross-pollinated crops with their genetic consequences	4
3	**Self-Incompatibility**	Definitions, Classification/Types- Heteromorphic SI, its features & example, distyly, tristyly; Homomorphic SI, i.e. Gametophytic SI and Sporophytic SI, features and examples, Differences; Utilization of self-incompatibility in Plant Breeding	4
4	**Male Sterility**	Definitions, Types- GMS, CMS, CGMS, Thermosensitive MS, Photosensitive MS, Transgenic MS, Chemical hybridizing agents; Significance of MS in crop improvement	4
5	**Plant Genetic Resources**	Definition of PGR, its utilization and conservation. Gene pool, Kinds of germplasm, Gene pool concept, Genetic erosion, Germplasm collection and conservation, Types and Methods.	3
6	**Centres of Origin/ Diversity,**	Vavilov's Concept, Primary & Secondary Centres, Distribution of species (in brief)	3
7	**Components of Genetic Variation**	Components: Definitions and Features of Additive, dominance and epistatic genetic variance; Phenotypic variance and its components; Environmental variance vs. Genetic variance; Heritability: Definition, Concept and Types- Narrow and Broad sense heritability; Methods of estimating, Factors affecting heritability; Genetic Advance: Definition and its Measurement, GA as % of mean, Application in Plant Breeding (in brief).	4

Continued….

8	**Pre-breeding and Universal Plant Breeder's Equation**	Pre-breeding: Concept/Definition, Importance/ Need, Sources, Steps (in brief); Universal Plant Breeder's Equation: ($R = i \times h^2 \times \sigma_p$) Concept, Components, Significance and Factors influencing Response to selection/ Effect on genetic gain (in brief).	3
9	**Breeding Methods in Self-pollinated Crops: Overview**	List of Breeding Methods in Self-pollinated Crops; Genetic basis; Domestication & Acclimatization: Definitions, Concept, Factors affecting acclimatization; Plant Introduction- Definitions, Purpose, Types i.e. Primary and Secondary; Merits & Limitations.	4
10	**Mass Selection**	Genetic basis; Positive & Negative selection; Procedure/Scheme; Advantages & Limitations; Achievements.	5
11	**Pure Line Selection**	Definition, Concept & importance; Procedure of pure line development; Advantages, disadvantages; Achievements	
12	**Hybridization Techniques**	Definition & Objectives; Types of crosses; Floral biology; Steps in hybridization	5
13	**Handling of Segregating Population (Pedigree, Bulk, SSD)**	Concept, Detailed procedure/scheme, Application, Merits, Demerits, Achievements of ~ Pedigree method-, Bulk method-, Single Seed Descent method (rapid generation advancement)-	
14	**Backcross Method**	Definition of Backcross, its objective, requirements and application; Step-wise Procedures for transfer of dominant & recessive genes; its merits, demerits, achievements.	4
	Multiline Concept	Definition; Development; Advantage, e.g.	
15	**Population Genetics and Hardy-Weinberg Law**	Concept of Population Genetics- Definitions- Random mating population, Gene and Genotypic frequencies; Hardy-Weinberg Law/ Equilibrium: Statement, its validity, Factors affecting gene frequency	4
16	**Breeding Methods in Cross-pollinated Crops: Overview & Selection Concept**	List of Breeding Methods in Cross-pollinated Crops; Genetic basis; Recurrent selection concept (in brief)	2

Continued….

17	**Population Movement Schemes**	Ear-to-Row method, Modified Ear-to-Row, Recurrent selection schemes/methods: its types; Procedure/cycles and applications	4
18	**Heterosis and Inbreeding Depression**	Definitions and Types; Genetic basis/ Theories of heterosis; Estimation of heterosis; Effects of inbreeding	5
19-20	**Development of Inbred lines and Hybrids, Composite and Synthetic Varieties**	Development of Inbred lines: Selfing procedures; Application in F_1 development. Hybrids, Composite and Synthetics: Definitions; Characteristics of Hybrid; Steps for development; Merits, demerits and achievements	4
21-22	**Breeding Methods in Asexually Propagated Crops**	List of breeding methods for asexually propagated crops. Clone; Clonal selection: Definitions, Features of clonal crops; Procedure of clonal selection, its merits and demerits; Steps/procedure of Hybridization in clonal crops	4
23-24	**Wide Hybridization**	Definitions; Types; Main features; Interspecific and Intergeneric crosses/ hybridization, their examples; Incompatibility Pre- & Post-fertilization Barriers Overcoming Techniques; Achievements	4
25-26	**Polyploidy in relation to Plant Breeding**	Polyploidy: Definitions of Haploid, Monoploid, Diploid, Polyploid, Genome, Heteroploidy, Aneuploidy, Euploidy; Types of Aneuploidy & Polyploidy, their applications in crop improvement, Examples; Effects of polyploidy and Limitation	4
27	**Mutation Breeding-Methods and Uses**	Definitions; Need (Conditions in which it is rewarding) & Usefulness; Mutation induction (Physical & Chemical Mutagens); Procedure for seed and vegetatively propagated crops, applications, its merits, demerits and achievements	4

Continued….

28	**Breeding for Important Biotic Stresses**	Breeding for Disease Resistance: Introduction, Mechanisms of disease resistance, Types of genetic resistance; Gene-for-gene hypothesis; Genetics of resistance sources of resistance Breeding methods and Practical achievements. Breeding for Insect Resistance: Introduction, Mechanisms/ Categories of insect resistance, Genetics and resistance sources, Breeding Strategy, Practical achievements.	5
29	**Breeding for Important Abiotic Stresses & Quality**	Breeding for Drought Resistance: Drought: Mechanism, Sources/ Basis, Breeding methods. Breeding for Salinity Resistance: Screening techniques, Breeding for salt tolerance, breeding approaches, Breeding for Quality: Introduction, Quality traits, Nutrition and nutrients, Nutritional quality of cereals and pulses, Breeding methods; Screening techniques, Breeding for low toxic substances; Practical achievements of all above approaches.	5
30	**Participatory Plant Breeding**	Concept and evolution; Objectives; Types of PPB; Applications in Farmer-centric breeding	3
31	**Variety Release and Notification**	Definitions, History, Process of Variety Release and Notification.	3
32	**Intellectual Property Rights; Plant Breeders' and Farmer's Rights**	Definitions, Types and Forms of IPRs, Patenting, Plant Breeders' and Farmer's Rights. (in brief)	3
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [GPB-242]

Exercise No.	Exercise Title
1	Study and Use of Plant Breeder's Kit.
2	Study of germplasms of various crops.
3	Study of floral structures of self-pollinated and cross-pollinated crops.
4	Emasculation and hybridization techniques in self-pollinated crops: Green gram, Black gram, Rice, Wheat, Groundnut and Soybean.
5	Emasculation and hybridization techniques in self-pollinated crops: Sesame, Chickpea, Okra, Tomato, Brinjal and Chilli.
6	Emasculation and hybridization techniques in cross-pollinated crops: Maize, Bajra, Sunflower, Papaya and Sugarcane.
7	Emasculation and hybridization techniques in often cross-pollinated crops: Cotton, Sorghum, Pigeon pea and Safflower.
8	Handling of segregating populations; Consequences of inbreeding on genetic structure of resulting populations.
9	Study of male sterility systems.
10	Methods of calculating mean, range, variance, standard deviation and heritability.
11	Experimental Designs used in plant breeding experiments and Analysis of Randomized Block Design.
12	To work-out the mode of pollination in a given crop and the extent of natural out-crossing.
13	Prediction of performance of double cross hybrids.
14	Maintenance of breeding records and data collection.
15	Screening tests for biotic stresses.
16	Screening tests for abiotic stresses.

Suggested Readings [GPB-242]:

1. Plant Breeding Principles and Methods, B.D. Singh, Kalyani Publication, New Delhi.
2. Essentials of Plant Breeding. Phundan Singh, Kalyani Publication, New Delhi.
3. Principles and Practices Plant Breeding. J.R. Sharma, McGraw Hill Publishing Company Limited, New Delhi.
4. Plant Breeding Theory and Practices. V.L. Chopra, Oxford and IBH Publishing Company, New Delhi.
5. Introduction to Plant Breeding. R.C. Choudhary, Oxford and IBH Publishing Company, New Delhi.

Semester	**:**	**IV**	
Course No.	**:**	**HORT-243**	**Credit Hrs. : 2(1+1)**
Course Title	**:**	**Production Technology of Vegetables and Spices**	

SYLLABUS

Objectives : (i) To educate about the different forms of classification of vegetables,
(ii) To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices,
(iii) 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, 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 of important Vegetables 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, ginger, 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 Spices Gardens.

TEACHING SCHEDULE

THEORY [HORT-243]

Lecture No.	Topic with Subtopics	Weightage (%)
1	**Introduction:** Importance of vegetables and spices in human nutrition and national economy; Kitchen gardening	10
Brief about origin, area, climate, soil, improved varieties and cultivation practices such as- time and method of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of the following important crops:		
2 - 3	Solanaceous vegetables: Tomato, Chilli, Brinjal, Capsicum and Potato	10
4	Other vegetables: Okra, French bean and Pea	10
5	Cucurbitaceous vegetables: Cucumber, Bitter gourd, Bottle gourd and Pumpkin	10
6	Cole crops: Cabbage, Cauliflower and Knol-khol	5
7	Bulb and Root crops: Onion and Garlic	5
8	Root and Tuber crops: Radish, Carrot, Beetroot, Cassava	5
9	Leafy vegetables: Amaranthus and Palak	5
10	Perennial vegetables: Moringa and Curry leaf	5
11 - 14	Spices: Black pepper, Nutmeg, Cinnamon, Clove, Cardamom, Turmeric and Ginger	20
15	Seed spices: Coriander, Cumin, Fenugreek and Fennel	10
16	Tamarind and Herbal spices	5
	Total =	**100**

TEACHING SCHEDULE

PRACTICAL [HORT-243]

Exercise No.	Exercise Title
1	Identification of Vegetables crops and their seeds
2	Identification of Spices crops and their seeds
3	Description of varieties of Vegetable crops
4	Description of varieties of Spice crops
5	Propagation methods -Rapid multiplication techniques
6	Nursery raising
7	Direct seed sowing and transplanting
8	Study of morphological characters of different vegetables
9	Study of morphological characters of different spices
10	Fertilizers applications
11	Propagation and raising of nursery of vegetables
12	Propagation and raising of nursery of spices
13	Harvesting and preparation for market of vegetables
14	Harvesting and preparation for market of spices
15	Economics of vegetables cultivation
16	Economics of spices cultivation
17	Visit to Spice Gardens

Suggested Readings [HORT-243]:

SN.	Title of Book	Authors
1.	Vegetables	B. Choudhary
2.	Vegetable Crops	T.K. Bose, M.G. Som and T. Kabir
3.	Vegetable, Tuber and Spices	S. Thamburaj
4.	Production Technology of Vegetable Crops	S.P. Singh
5.	Vegetables – Production Technology Astral International	Haldavnekar, P.C.; Parulekar, Y.R.; Mali, P.C. and Haldankar, P.M.
6.	Major Spices of India	J.S. Pruthi
7.	Minor Spices and Condiments	J.S. Pruthi
8.	Introduction to Spices and Plantation Crops	N. Kumar and others
9.	Spice Crops Vol.I and Vol. II	Parthasarathi and Others

Semester	**:**	**IV**		
Course No.	**:**	**SOIL-243**	**Credit Hrs.**	**: 2(1+1)**
Course Title	**:**	**Problematic Soils and their Management**		

SYLLABUS

Objectives : (i) To acquaint the students about various problem soils like, degraded soils, acid soils, saline soils, alkali soils, eroded soils, sub-merged soils and polluted soils.

(ii) To impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification.

(iii) 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, Bioremediation 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, Mg, Na, CO_3, HCO_3, Cl, SAR and RSC), Determination of Nitrate (NO_3^-) from irrigation water, Determination of dissolved Oxygen and free Carbon dioxide levels in water samples.

TEACHING SCHEDULE

THEORY [SOIL-243]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1-2	**Soil Quality and Soil Health**	Importance and Concept, Definitions, Need and Difference between them; Soil Quality Indicators- Physical, Chemical and Biological indicators; Characteristics of healthy soils.	10
3	**Distribution and Categorization of Problematic Soils**	Distribution and extent of problematic soils in World, India and Maharashtra. Categorization of problem soils based on soil chemical and physical properties. Agro-ecological and Management Implications (*in brief*).	6
4-5	**Saline, Saline-sodic and Sodic Soils**	Physical, Chemical and Biological Characteristics of each of these Problem Soils, Reasons for their formation, Effects on plant growth, Reclamation and Management (*in detail*).	10
5	**Calcareous Soils**		10
6-7	**Acid and Acid Sulphate Soils**		10
8-9	**Eroded and Compacted Soils**		10
10-11	**Polluted and Contaminated Soils**	Polluted and Contaminated Soils – (Pesticide contamination, Heavy metal contamination), their Properties, Effect on plant growth, Reclamation and Management.	10
12	**Mined soils**	Mined soils- (Coal and Oil-mined), Riverine soils, Water logged soils- their Features, Effect on plant growth.	8
13	**Quality and Standards of Irrigation Water**	Quality and Standards of Irrigation Water and its suitability for irrigation. Utilization of saline and sewage water in Agriculture.	8
14	**Remote Sensing and GIS**	Remote Sensing and GIS in Diagnosis and Management of problem soils.	6

Continued…

15	**Bioremediation of Problem Soils**	Bioremediation of Problem Soils and their Types, Multipurpose tree species (MPTs): Bioremediation through MPTs.	6
16	**Land Classifications**	Land Capability Classification and Land Suitability Classification: Definitions, Concept and Purpose of LCC; Classes; Subclasses and Units; Factors used in Suitability Evaluation; their Comparison.	6
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [SOIL-243]

Exercise No.	Exercise Title
1	Visit to salt affected area and collection of salt affected soils
2	Preparation of saturation paste extract of salt affected soils
3	Determination of pHe and ECe of salt affected soils
4-5	Determination of soil exchangeable cations (Ca, Mg, Na and K) and computation of SAR and ESP
6	Determination of gypsum requirement of alkali/sodic soils
7	Determination of calcium carbonate from soil
8	Determination of lime requirement of acidic soil
9	Determination of redox potential in soil
10	Collection of irrigation water samples from bore well, well or canal
11	Determination of pH and EC from irrigation water
12	Determination of cations (Ca, Mg, Na and K) from irrigation water by complexometric method
13	Determination of anions (CO_3, HCO_3, and Cl) from irrigation water and computation of RSC and SAR
14	Determination of nitrate from irrigation water
15	Determination of dissolved oxygen from water sample
16	Determination of free CO_2 levels in water sample by direct titrimetric methods.

Suggested Readings [SOIL-243]:

1. Richards, L.A. (1954). Diagnosis and Improvement of Saline and Alkali soils. United States Department of Agriculture.
2. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali Soils of India, ICAR, AGROBIOS (India).
3. Indian Society of Soil Science (2002). Fundamentals of Soil Science. IARI, New Delhi.
4. Maliwal, G.L. and Somani, L.L. (2010). Nature Properties and Management of Saline and Alkali Soils. Agrotech Publishing Academy, Udaipur.
5. Abrol, I.P., Yadav, J.S.P. and Masood, F.I. (1988). Salt-Affected Soils and their Management. FAO Soils Bulletin 39. Food and Agriculture Organization of the United Nations, Rome.
6. Tyagi, N.K. and Minhas, P.S. (1998). Agricultural Salinity Management in India. Published by CSRI, Karnal.
7. Twenty-five Years of Research on Management of Salt Affected Soils and Use of Saline Water in Agriculture. 1998. Published by CSRI, Karnal.
8. Cirsan J. Paul, (1985). Principles of Remote Sensing. Longman, New York.
9. Yaduvanshi, N.P.S. (2008). Chemical Changes and Nutrient Transformation in Sodic/Poor Quality Irrigated Soils. Published by CSRI, Karnal.
10. FAO United Nations' Soils Portal: https://www.fao.org/soils-portal/soil-management/management-of-some-problem-soils/

Semester : IV		
Course No. : EXTN-241	**Credit Hrs. : 2(1+1)**	
Course Title : Fundamentals of Extension Education		

SYLLABUS

Objectives :
(i) To state the importance of Extension Education in Agriculture,
(ii) To familiarize with the different types of agriculture and rural development programmes launched by the Govt. of India,
(iii) To classify the types of extension teaching methods,
(iv) To elaborate the importance and different models of communication,
(v) To explain the process and stages of adoption along with adopter's 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.);

Reorganized Extension System (T&V system)-; various extension/ agriculture development programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and Poverty alleviation programmes- ITDA, IRDP/ SGSY/ NRLM.

Women Development Programmes - RMK, MSY etc. New trends in Agriculture Extension: Privatization Extension, Cyber Extension/ e-Extension, Market-led Extension, Farmer-led Extension, Expert systems, etc. Rural Development: Concept, meaning, definition; Various rural development programmes launched by Govt. of India. Community Development - Meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: Concept and definition, Types of leaders in rural context;

Methods of Identification of Rural Leader. Extension Administration: Meaning and concept, Principles and functions. Monitoring and Evaluation: Concept and definition, Monitoring and evaluation of extension programmes; Transfer of Technology (TOT): 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.

TEACHING SCHEDULE

THEORY [EXTN-241]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	**Education**	Meaning, Definition, Scope, Importance and Types	5
2	**Extension Education**	Meaning, Definition, Scope and Process, Objectives and Principles of Extension Education	10
3	**Extension Programme Planning**	Meaning, Process, Principles and Steps in Programme Development.	5
4 - 5	**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.)	10
6	**Reorganized Extension System**	T & V system, Various Extension/ Agriculture Development Programmes launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.)	10
7	**Social Justice and Poverty Alleviation Programmes**	ITDA, IRDP/ SGSY/ NRLM. Women Development Programme- RMK, MSY etc.	5

Continued…

8	**New Trends in Agriculture Extension**	Privatization Extension, Cyber Extension/ e-Extension, Market-led Extension, Farmer-led extension, Expert systems, etc.	5
9	**Rural Development**	Concept, Meaning, Definition; Various rural development programmes by the Govt. of India.	5
10	**Community Development**	Meaning, Definition, Concept and Principles, Philosophy of Community Development	5
11	**Rural Leadership**	Concept and Definition, Types of leaders in rural context; Method of identification of Rural Leader.	5
12	**Extension Administration Monitoring and Evaluation**	Meaning and Concept, Principles and Functions. Concept and Definition, Monitoring and Evaluation of Extension Programmes	5
13	**Transfer of Technology**	Concept and Models, Capacity building of Extension Personnel	5
14	**Extension Teaching Methods**	Meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (News and Social Media), Media mix strategies	10
15	**Communication**	Meaning, Definition; Principles and Functions of Communication, Models and Barriers to communication. Agriculture Journalism – (Overview)	10
16	**Diffusion and Adoption of Innovation**	Concept and Meaning, Process and Stages of adoption, Adopter categories.	5
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [EXTN-241]

Exercise No.	Exercise Title
1	Study of University Extension System
2	Organizing Group Discussion- Exercise
3	Identification of Rural Leaders in village situation
4	Preparation and use of AV aids and Extension Literature (Leaflet, Booklet, Folder, Pamphlet etc.)
5	Presentation Skills exercise and Micro-teaching
6	Writing for Print / Electronic / Social Media
7	Writing of News Story
8	Writing and documentation of Success Story
9	Study of structure and functioning of DRDA/ PRI and other development departments at district level
10	Study of structure and functioning of Department of Agriculture
11	Study of structure and functioning of FPO/ FPC
12	Identification and documentation of ICT tools used for Transfer of Technologies
13	Handling and use of Information Technology tools
14	Visit to NGO/FO/FPO and learning from their experience in rural development
15	Visit to Village: PRA techniques and their application in village development planning
16	Visit to Community Radio/ Television Studio
	Developing Script for Radio/ Television

Suggested Readings [EXTN-241]:

1. Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Adivi Reddy, A. (2001) Extension Education, Sree Lakshmi Press, Bapatla.
3. Dahama, O.P. and Bhatnagar, O.P. (1998) Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
4. Jalihal, K.A. and Veerabhadraiah, V. (2007) Fundamentals of Extension Education and Management in Extension, Concept Publishing Company, New Delhi.
5. Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House, Mumbai.
6. Sagar Mondal and Ray, G.L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.
7. Rathore, O.S. *et al.* (2012) Handbook of Extension Education, Agrotech Publishing Academy, Udaipur.
8. Dudhani, C.M.; Hireyenkatgoudar, L.V., Manjunath, L.; Hanchinal, S.N. and Patil, S.L. (2004). Extension Teaching Methods and Communication Technology, UAS, Dharwad.
9. Sandhu, A.S. (1993). Textbook on Agricultural Communication: Process and Methods. Oxford and IBH Publishing Pvt. Ltd., New Delhi.
10. Singh, A.K., Lakhan Singh, R. and Roy Burman (2006). Dimensions of Agricultural Extension. Aman Publishing House, Meerut.

B.Sc. (Hons.) Agriculture

List/ Bouquet of Skill Enhancement Courses (SECs)

[in continuation of the SECs' Syllabi prescribed under I, II and III semesters]

Sr. No.	Course No.	Course Title	Credit Hrs.
1.	**SEC-xxx**	Biofertilizer and Biopesticide Production	2(0+2)
2.	**SEC-xxx**	Mushroom Production Technology	2(0+2)
3.	**SEC-xxx**	Seed Production Technology	2(0+2)
4.	**SEC-xxx**	Post-harvest Processing Technology	2(0+2)
5.	**SEC-xxx**	Beneficial Insect Farming	2(0+2)
6.	**SEC-xxx**	Horticulture Nursery Management	2(0+2)
7.	**SEC-xxx**	Plantation Crops Production and Management	2(0+2)
8.	**SEC-xxx**	Poultry Production and Management Technology	2(0+2)
9.	**SEC-xxx**	Processing of Milk and Milk Products	2(0+2)
10.	**SEC-xxx**	Agrotourism	2(0+2)
11.	**SEC-xxx**	Plantation Crop Production and Processing	2(0+2)
12.	**SEC-xxx**	Agriculture Waste Management	2(0+2)
13.	**SEC-xxx**	Organic Production Technology	2(0+2)
14.	**SEC-xxx**	Fodder Production Technology	2(0+2)
15.	**SEC-xxx**	Marketing and Export of Agricultural Produce	2(0+2)
16.	**SEC-xxx**	Processing of Farm Waste into Organic Inputs	2(0+2)
17.	**SEC-xxx**	Vermicompost Production Technology	2(0+2)
18.	**SEC-xxx**	Apiculture - Commercial Bee Keeping	2(0+2)
19.	**SEC-xxx**	Production Technology of Bioagents	2(0+2)

Note: (i) Skill Enhancement Courses can be added/ offered as per the facilities and resources available at the respective University/ College based on the relevance to the region and the UG degree subject.

(ii) The host University/ College may also choose suitable SEC courses from those listed under other UG degree programs.

(iii) Above list/ bouquet of SEC courses is an indicative list and subject to modification as applicable therein.

(iv) In case of unavailability of the detailed course-wise syllabus/ teaching schedules of any of above SEC courses, the same can be primarily developed and followed at College/ University level in the current academic year. However, the same can be obtained from the respective UG Degree Coordinator/ Discipline Coordinators and can be followed w.e.f. AY, 2025-26.