

COURSE CURRICULUM FOR UNDERGRADUATE PROGRAMME IN AGRICULTURE

**as per
ICAR Sixth Deans Committee guidelines
and
NEP-2020 framework**

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



**University of Lucknow
Lucknow, Uttar Pradesh-226007**

ACADEMIC PROGRAMME

Course structure and credit Allocation

B.Sc. (Hons) Agriculture

S. No	Paper Code	Course Title	Mark Distribution			Credit Hours	Total Credit Hours
			T	I	P		
FIRST YEAR							
Semester I							
1.	AGRNG-101	Induction cum Foundation Course (Deekshaarambh)	-	-	-	1 week Non-gradial	21(11+10)
2.	AGRNG-102	Introductory Mathematics	75	25	-	1 (1+0) Non-gradial	
3.	AGRSEC-101	Mushroom Production Technology	-	-	100	2(0+2)	
4.	AGSEC-102	Beneficial Insect Farming	-	-	100	2(0+2)	
5.	AGR-101	Communication Skills	50	20	30	2(1+1)	
6.	AGR-102	Fundamentals of Agronomy	50	20	30	3(2+1)	
7.	AGR-103	Fundamentals of Soil Science	50	20	30	3(2+1)	
8.	AGR-104	Fundamentals of Horticulture	50	20	30	3(2+1)	
9.	AGR-105	Farming Based Livelihood Systems	50	20	30	3 (2+1)	
10.	AGR-106	Rural Sociology and Educational Psychology	75	25	-	2 (2+0)	
11.	AGR-107	National Service Scheme (NSS-I)/ National Cadet Corps (NCC-I)	-	-	100	1(0+1)	
Semester II							
1	AGRSEC-201	Poultry Production Technology	-	-	100	2(0+2)	21(10+11)
2	AGRSEC-202	Post-Harvest Processing Technology	-	-	100	2(0+2)	
3	AGR-201	Personality Development	50	20	30	2(1+1)	
4	AGR-202	Environmental Studies and Disaster Management	50	20	30	3(2+1)	
5	AGR-203	Soil Fertility Management	50	20	30	3(2+1)	
6	AGR-204	Fundamentals of Entomology	50	20	30	3(2+1)	
7	AGR-205	Livestock and Poultry Management	50	20	30	2(1+1)	
8	AGR-206	Fundamentals of Plant Pathology	50	20	30	3(2+1)	
9	AGR-207	NSS-II/ NCC-II	-	-	100	1(0+1)	
10	AGRNG-201	Introductory Biology	75	25	-	2(0+0) Non-gradial	

SECOND YEAR							
Semester III							
1	AGRSEC-301	Organic Production Technology	-	-	100	2(0+2)	21(09+12)
2	AGR-301	Entrepreneurship Development and Business Management	50	20	30	2(1+1)	
3	AGR-302	Physical Education, First Aid and Yoga Practices	-	-	100	2(0+2)	
4	AGR-303	Principles of Genetics	50	20	30	2(1+1)	
5	AGR-304	Crop Production Technology-I (Kharif crops)	50	20	30	3(2+1)	
6	AGR-305	Production Technology of Fruit and Plantation Crops	50	20	30	2(1+1)	
7	AGR-306	Fundamentals of Extension Education	50	20	30	2(1+1)	
8	AGR-307	Fundamentals of Nematology	50	20	30	2(1+1)	
9	AGR-308	Insect Ecology and Integrated Pest Management	50	20	30	2(1+1)	
10	AGR-309	Principles and Practices of Natural Farming	50	20	30	2(1+1)	
Semester IV							
1	AGRSEC-401	Biofertilizer and Biopesticide Production	-	-	100	2(0+2)	21(12+09)
2	AGR-401	Agricultural Informatics and Artificial Intelligence	50	20	30	3(2+1)	
3	AGR-402	Production Technology of Vegetables and Spices	50	20	30	2(1+1)	
4	AGR-403	Principles of Agricultural Economics and Farm Management	75	25	-	2(2+0)	
5	AGR-404	Crop Production Technology-II (Rabi Crops)	50	20	30	3(2+1)	
6	AGR-405	Farm Machinery and Power	50	20	30	2(1+1)	
7	AGR-406	Water Management	50	20	30	2(1+1)	
8	AGR-407	Problematic Soils and their management	50	20	30	2(1+1)	
9	AGR-408	Basics of Plant Breeding	50	20	30	3(2+1)	

AGRSEC-301
ORGANIC PRODUCTION TECHNOLOGY
Credit Hours: 2(0+2)

Objectives:

- To create awareness about organic farming.
- To equip learners with the knowledge and skills necessary to practice sustainable agriculture and the production of healthy organic food.
- To introduce the concept of organic ecosystem and learn about biological magnification and its significance in present day scenario.
- To inculcate the importance of doing organic farming as the responsibility of every human being so as to ensure food safety, nutritional security and food security for the present as well as future generation
- To achieve sustainable development for every nation.

Practical:

Preparation of enriched compost, vermicompost; Production of different composts including vermicompost. bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling; Efficient use of Biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and phosphate solubilizing bacteria (PSB) cultures in field; Visit to organic farms.

Suggested Readings:

- Organic Farming for Sustainable Agriculture by Dahama A. K. Agrobios Publication.
- Organic Farming: Theory and Practices by Palanippan, S.P. and Anaadurai, K.
- Organic Farming in India, Problems and Prospects by Thapa, U. and Tripathi, P.
- Trends in Organic Farming in India by Agrobios Publication
- Handbook of Organic Farming.
- Recent Developments in Organic farming by Gulati and Barik
- Sharma A. 2002. Handbook of Organic Farming, Agrobios Publication
- Singh SP. (Ed.) 1994. Technology for Production of Natural Enemies, PDBC, Bangalore.
- Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
- Trivedi RN. 1993. A Textbook of Environmental Sciences, Anmol Publications Pvt. Ltd.

AGR-301
ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS COMMUNICATION
Credits Hours:2(1+1)

Objectives:

- To provide student an insight into the concept and scope of entrepreneurship.
- To expose the student to various aspects of establishment and management of a small business unit.
- 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 and 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/ agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings:

- Charantimath P.M., 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
- Desai V., 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
- Gupta CB. 2001. Management Theory and Practice. Sultan Chand & Sons.
- Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
- Khanka SS. 1999. Entrepreneurial Development. S. Chand & Co.

- Mehra P., 2016, Business Communication for Managers. Pearson India, New Delhi.
- Pandey M. and Tewari D., 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
- Singh D. 1995. Effective Managerial Leadership. Deep and Deep Publishers.
- Singhal R.K., 2013, Entrepreneurship Development and Management, Katson Books.
- Tripathi PC and Reddy PN. 1991. Principles of Management. Tata McGraw Hill.

AGR-302
PHYSICAL EDUCATION, FIRST AID AND YOGA PRACTICES
Credit Hours: 2 (0+2)

Objectives:

- To make the students aware about Physical Education, First Aid and Yoga Practices
- 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: Introduction, history and types of Yog.

Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhas tasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhhdhanurasan, 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 to respiratory system; First aid related to heart, blood and circulation; First aid related to wounds and injuries; First aid related to bones, joints muscle related injuries; First aid related to nervous system and unconsciousness; First aid related to gastrointestinal tract; First aid related to skin and burns; First aid related to Poisoning; First aid related to bites and stings; First aid related to sense organs, handling and transport of injured traumatized persons; Sports injuries and their treatments.

Suggested Readings:

1. Swasthya Evam Sharirik Shiksha by Dr. Rajesh Pratap Singh, by Rishab Books New Delhi
2. Sharirik Shiksha ki Adunik Prawatiya by Dr. Rajesh Pratap Singh, by University publication, New Delhi
3. Uppal AK & Gautam GP (2008). Health and Physical Education. Friends Publication. New

Delhi

4. Balayan D (2007). Swasthya Shiksha Evam Prathmik Chikitsa. Khel Sahitya. Delhi.
5. Barrow Harold M., Man and movements principles of Physical Education, 1978.
6. Difiore, J. (1998). Complete guide to postnatal fitness. London: A & C Black.
7. Dynamics of fitness. Madison: W.C.B Brown.
8. General methods of training. by - Hardayal Singh
9. Sharirik Shiksha, Dr. Rajesh Pratap Singh, Yogesh Kumar & Suneel Kumar by Khel Shahitay Kendra, New Delhi
10. Giam, C.K &The, K.C. (1994). Sport medicine exercise and fitness. Singapore: P.G. Medical Book. McGlynn, G., (1993)
11. Kamlesh M.L., Physical Education, Facts and foundations, Faridabad Publications
12. Krishana Murthy V. and Paramesara Ram, N. "Educational Dimensions of Physical. Education", 2nd Revised edition, Print India, New Delhi 1990.
13. Methodology of training. by – Harre
14. Fitness and Health Education, by Dr. Rajesh Pratap Singh, Shree Publisher and Distributer, New Delhi.
15. Health Education, Hygeine, First Aid and Sports Injuries by Dr. Neeraj Pratap Singh and Dr. Ajay Dubey, Sports Publication, New Delhi.
16. HathYogaPradipika-Kaivalyadham
17. Asana,Pranayama,Mudra,Bandha
18. Other central/state universities/ MOOC platforms such as SWAYAM in India and abroad

AGR-303
PRINCIPLES OF GENETICS
Credits Hours: 2 (1+1)

Objective:

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, 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. Probability and Chi-square. Dominance relationships, Epistatic interactions with example.

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 and CIB technique, mutagenic agents and induction of mutation; Qualitative and quantitative traits, polygenes and continuous variations, multiple factor hypothesis; Cytoplasmic inheritance; Genetic disorders; Nature, structure and replication of genetic material; Protein synthesis; Transcription and translational mechanism of genetic material; Gene concept: Gene structure, function and regulation, Lac and Trp operons.

Practical:

Study of microscope, Stud 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 and three 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. Principles of Genetics: Gardner, Simmons and Snustad.
3. Genetics: M. W. Strickberger.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky

AGR-304
CROP PRODUCTION TECHNOLOGY-I (KHARIF CROPS)
Credits Hours: 3(2+1)

Objectives:

- To impart basic and fundamental knowledge on principles and practices of kharif crop production.
- 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 the following Kharif crops:

Cereals- rice, maize, sorghum, pearl millet and finger millet

Pulses- pigeonpea, mungbean and urdbean

Oilseeds- groundnut, and soybean

Fibre crops- cotton and jute

Forage crops- sorghum, cowpea, cluster bean and napier

Practical:

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

Suggested readings:

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Ka Publishers, New Delhi.
2. Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. 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.

AGR-305
PRODUCTION TECHNOLOGY OF FRUIT AND PLANTATION CROPS
Credit Hours: 2 (1+1)

Objectives:

- To understand the economic significance and scope of fruits and plantation crops in India.
- To understand the production technology and cultivation techniques of fruits and plantation crops.

Theory:

Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks; Production technologies for the cultivation of major fruits- mango, banana, guava and papaya; Production technologies for the cultivation of the following:

Major fruits- citrus, grape, litchi, sapota and apple, pear, peach, walnut, almond

Minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry

Plantation crops- coconut, arecanut, cashew, tea, coffee and rubber.

Practical:

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops. Description and identification of fruit. Preparation of plant bio regulators and their uses, important pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchards.

Suggested Readings:

1. Nijar 1985. Fruit breeding in India, Oxford & IBH Publishing Co. New Delhi
2. Anil Kumar Shukla 2004. Fruit breeding approaches & Achievements. International Book Distributing Co. New Delhi. Kumar, N. 1997. Breeding of Horticultural Crops, Principles and Practices. New India Publishing Agency, New Delhi.
3. Singh, B.D. 1983. Plant Breeding Principles and methods. Kalyani Publishers, New Delhi.
4. Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I. 1997. Introduction to spices, Plantation crops and Aromatic plants. Oxford & IBH, New Delhi.
5. Thampan, P.K. 1981. Handbook of Coconut Palm. Oxford IBH, New Delhi. Nair 1979. Cashew. CPCRI, Kerala Wood, GAR, 1975.
6. Cacao. Longmen, London Ranganadhan, V. 1979. Handbook of Tea Cultivation. UPASI Tea Research Station, Cinchona.
7. Thompson, P.K. 1980. Coconut. Oxford & IBH Publishing Co. Ltd., New Delhi.

AGR-306
FUNDAMENTALS OF EXTENSION EDUCATION
Credit Hours: 2 (1+1)

Objectives:

- Highlight the importance of agricultural extension education.
- Identify various agriculture and rural development programs launched by the Government of India.
- Categorize types of extension teaching methods.
- Discuss the significance and models of communication.
- Describe the adoption process, stages, and adopter 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.); Re-organised 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 programme- 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; 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 programmes; 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 (New 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. Jaliha, K.A. and Veerabhadraiah, V., 2007, Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.
4. Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G.L., Textbook 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). Textbook 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

AGR-307
FUNDAMENTALS OF NEMATOLOGY
Credits Hours: 2(1+1)

Objectives:

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

Theory:

Introduction- History of phyto-nematology, habitat and diversity, economic importance of nematodes; General characteristics of plant parasitic nematodes.

Nematode- definition, general morphology and biology; Classification of nematodes up to family level with emphasis on groups containing economically important genera; 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 and coconut.

Different methods of nematode management: Cultural, physical, biological, 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, Picking and counting of plant parasitic nematode; Identification of economically important plant nematodes upto generic level with the help of keys and description: *Meloidogyne*, *Pratylenchus*, *Heterodera*, *Tylenchulus*, *Xiphinema*, and *Helicotylenchus*; Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops; Methods of application of nematicides and organic amendments.

Suggested readings:

1. Textbook on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj
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. Economic Nematology-Edited by J.M. Webster

AGR-308
INSECT ECOLOGY AND INTEGRATED PEST MANAGEMENT
Credits Hours: 2(1+1)

Objective:

By the end of the course, the students will be able to know the influence of ecological factors on insect development and distribution, understand components of integrated pest management, know the classification of insecticides, and their use in pest management, and understand the mass multiplication techniques of major bio-agents.

Theory:

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

Pest surveillance: Types and pest forecasting; Categories of pests; Natural and applied pest control; IPM- Introduction, importance, scope, concepts, principles, tools and limitations of IPM; Host plant resistance; Cultural, mechanical, physical and legislative methods of pest control- parasitoids, predators and plant pathogens such as bacterial, fungi and viruses; Chemical control- importance, hazards and limitations; Classification of insecticides, toxicity of insecticides and formulations of insecticides, Examples of important insecticide groups: Botanical insecticides- neem based products; Cyclodienes, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotiny insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazines, Thiourea derivatives, Pyridine azomethines, Pyrroles etc, Nematicides, Rodenticides, Acaricides and Fumigants; Insecticides Act 1968- important provisions; Application techniques of spray fluids; Phytotoxicity of insecticides; Symptoms of poisoning, first aid and antidotes; Recent methods of pest control; Repellants, antifeedants, hormones, attractants, gamma radiation and genetic control.

Practical:

Visit to meteorological observatory/automatic weather reporting station; Terrestrial and pond ecosystems of insects; Behaviour of insects and orientation (repellency, stimulation, deterrence); Distribution patterns of insects, sampling techniques for the estimation of insect population and damage; Pest surveillance through light traps, pheromone traps and field incidence; Practicable IPM practices- Mechanical and physical methods, Cultural and biological methods; Chemical control – Insecticides and their formulations; Pesticide appliances, insecticide application techniques, calibration of plant protection appliances, Calculation of doses/concentrations of insecticides; Compatibility of pesticides and Phytotoxicity of insecticides IPM case studies– Cotton, Sugarcane, Mango/Citrus/Pomegranate; Identification of common phytophagous mites and their morphological characters; Identification of rodents, bird pests, their damage and management; Biopesticides used in IPM with mass multiplication of NPV and Entomopathogenic fungi; Visit to vermiculture unit.

Suggested Readings:

1. Metcalf, R.L. and Luckman W.H. 1982. Introduction to Insect Pest Management. Wiley Inter

- Science publishing, New York.
2. G.S. Dhaliwal and Ramesh Arora 2001. Integrated Pest Management. Concepts and Approaches. Kalyani publishers, New Delhi.
 3. Larry P. Pedigo. 1991. Entomology and Pest Management. Larry P. Pedigo. 1991. Mac Millan publishing company, New York.
 4. Yazdani G. S. and Agarwal M.L. 1979. Elements of Insect Ecology. Naroji publishing house, New Delhi.
 5. Hufakar C.V. Ecological Entomology
 6. Clark L.R., Gier P.W., Rughas R.D. and Marris R.F. The Ecology and Insect Population.
 7. Odum E.P. Fundamentals of Insect Ecology
 8. Gupta S. K. Plant Mites of India, 1995
 9. Satyendra Kumar Singh, Ravi Shanker Verma, R Kumar and N K Shah.2024 Insect Ecology and Pest Management. S R Scientific Publication

AGR-309
PRINCIPLES AND PRACTICES OF NATURAL FARMING
Credits Hours: 2 (1+1)

Objectives:

- To provide comprehensive understanding and knowledge to students about natural farming
- To teach students the concept, need and principles of native ecology-based production under natural farming
- 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 footprints, 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 to 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; Evaluation of ecosystem services in natural farming (crop, field and system).

Suggested Readings:

1. Nalini S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road,

- Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
2. Shamasastri R. 1915. Kautilya's Arthashastra.
 3. Ayachit SM. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
 4. Nalini S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 94pp.
 5. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
 6. HLPE. 2019. Agro-ecological 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>.
 7. 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
 8. UK Behera. 2013. A textbook of Farming System. Agrotech Publishing House, Udaipur.
 9. (ISBN: 978-81-8321-309-7)
 10. Hill S.B and Ott. P. (eds.). 1982 Basic Techniques in Ecological Farming Berkhauser Verlag, Basel, Germany, 366 pp.
 11. 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
 12. Boeringa R. (ed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
 13. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
 14. Fukuoka M. 1978. The One-Straw Revolution: An Introduction to Natural Farming. Rodale Press, Emmaus, PA. 181 pp
 15. Fukuoka M. 1985. The Natural Way of Farming: The Theory and Practice of Green Philosophy. Japan Publications, Tokyo, 280 pp.
 16. Hill S.B. and Ott P. (eds.). 1982. Basic Techniques in Ecological Farming. Berkhauser Verlag, Basel, Germany, 366 pp.
 17. INFRFC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
 18. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
 19. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, OtthoHeldringstraat.
 20. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)
 21. Plenty For All: Natural Farming A To Z PRAYOG PARIWAR METHODOLOGY by Prof. Shripad A. Dabholkar and Prayog Pariwar (2021)
 22. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021)
 23. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
 24. कमलागतप्राकृतककृततःआचार्यदेवव्रत,pp1-166.

Semester IV

S. No.	Code	Course Title	T	I	P	Credit hour
1	AGRSEC-401	Biofertilizer and Biopesticide Production	-	-	100	2(0+2)
2	AGR-401	Agricultural Informatics and Artificial Intelligence	50	20	30	3(2+1)
3	AGR-402	Production Technology of Vegetables and Spices	50	20	30	2(1+1)
4	AGR-403	Principles of Agricultural Economics and Farm Management	75	25	-	2(2+0)
5	AGR-404	Crop Production Technology-II (Rabi Crops)	50	20	30	3(2+1)
6	AGR-405	Farm Machinery and Power	50	20	30	2(1+1)
7	AGR-406	Water Management	50	20	30	2(1+1)
8	AGR-407	Problematic Soils and their Management	50	20	30	2(1+1)
9	AGR-408	Basics of Plant Breeding	50	20	30	3(2+1)
		Total				21(12+9)

AGRSEC-401
BIOFERTILIZER AND BIOPESTICIDE PRODUCTION
Credits Hours:2(0+2)

Objectives:

- To exploit the microbial diversity in various agro-ecologies for bio-fertilizer and bio- pesticides application in diversified systems.
- To improve bio-fertilizer and bio-pesticides technology to ensure high quality and improved delivery.

Practical

Biofertilizer organisms, their laboratory characterization, sub-culturing and mother culture development; Fermentation technology demonstration, production of bacterial broth in pilot scale fermenters; Biofertilizer product formulations and quality analysis methods. Study biopesticide organisms, laboratory culturing, mass cultivation using solid state fermentation, liquid fermentation and spore harvesting methods and product formulation; Visit to beneficial insect rearing laboratory and handling of insects including demonstration on tricho-cards production. Extraction of neem seed kernel extracts and neem oil; Production of botanical extracts and product formulation using emulsifiers; Study effect of various botanical extracts on insect pests; Preparation of Bordeaux mixture and copper fungicides; Isolation and purification of important biopesticides: *Trichoderma*, *Pseudomonas*, *Bacillus*, *Metarhizium* etc. and its production; Identification of important botanicals; Visit to biopesticide laboratory in nearby area; Field visit to explore naturally infected cadavers; Identification of entomopathogenic entities in field condition; Quality control of biopesticides; Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, phosphate-solubilizers and cyanobacteria; Mass multiplication and inoculum production of biofertilizers; Isolation of AM fungi- Wet sieving method and sucrose gradient method; Mass production of AM inoculants.

Suggested Readings:

1. Alexander M. 1977. Soil Microbiology. John Wiley.
2. Bhattacharyya, P. and Srivastava, B. 1995. Biofertilizer Technology, Marketing and Usage- A Source Book-cum-glossary. FDCO, New Delhi.
3. Subba Rao, N.S. Biofertilizers in Agriculture and Forestry. 1993. Oxford and IBH. Publ. Co., New Delhi.
4. Burges, H.D. and Hussey, N.W. (1971). Microbial Control of Insects and mites. Academic Press, New York.
5. Burges, H.D. Formulation of microbial pesticides – Kluwersep, ACB, Dordrecht-ISBN. 0412 625 202.
6. Coppel H.C. and J.W. Martin. (1977). Biological control of insect pest suppression. Springail.
7. Bach P. 1964. Biological control of Insect Pest and Weeds Chapman and Hall, New York.
8. Gautam, R.D. (2006). Biological suppression of insect pests. Kalyani Publisher, New Delhi.
9. Huffaker, C.B. and Messenger, P.S. (1976). Theory and Practice of Biological control. Academic Press, New York.
10. Ignacimuthu, S.S. and Jayaraj, S. (2003). Biological Control of Insect Pests. Phoenix Publ. New Delhi.
11. Saxena, A.B. (2003). Biological Control of Insect Pests. Anmol Publ. New Delhi.

AGR-401
AGRICULTURAL INFORMATICS AND ARTIFICIAL INTELLIGENCE
Credits Hours:3 (2+1)

Objectives:

- To familiarize students with fundamental concepts of computer applications in agriculture, including multimedia, database management, mobile app utilization, and decision-making processes.
- To provide basic knowledge of computer with applications in Agriculture.
- To make the 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 database, Uses of DBM Sin Agriculture, Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/ output operations.

e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture.

Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management.

Smart phone 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.

Practical:

Study of computer components, accessories, practice of important DoS Commands; Introduction to 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 as scientific documents, MS-EXCEL for creating a spread sheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: Creating database, preparing queries and reports, demonstration of agri-information system; Introduction to World Wide Web (WWW) and its components; Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++,

Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/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 to Geospatial Technology; Hands on practice on preparation of Decision Support System; Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA)

Suggested Readings:

1. Fundamentals of Computer by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
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.

AGR-402
PRODUCTION TECHNOLOGY OF VEGETABLES AND SPICES
Credits Hours: 2 (1+1)

Objectives:

- To educate about the different forms of classification of vegetables
- To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices.
- 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 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, Radish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak, Perennial vegetables).

Practical:

Identification of vegetables and spice crops and their seeds; Nursery raising; Direct seed sowing and transplanting; Study of morphological characters of different vegetables and spices; Fertilizer applications; Harvesting and preparation for market; Economics of vegetables and spices cultivation.

Suggested readings:

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

AGR-403
PRINCIPLES OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT
Credits Hours: 2(2+0)

Objectives:

- To aware the students about broad areas covered under agricultural Economics and farm management.
- 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, equi-marginal utility principle; Consumer's equilibrium and derivation of demand curve, concept of consumer surplus.

Elasticity of demand: Concept and measurement of price elasticity, income elasticity and cross elasticity Production: process, creation of utility, factors of production, input output relationship

Laws of returns: Law of variable proportions and law of returns to scale.

Cost: Cost concepts, short run and long run cost curves.

Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply

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

AGR-404
CROP PRODUCTION TECHNOLOGY-II (RABI CROPS)
Credits Hours: 3(2+1)

Objectives:

- To impart basic and fundamental knowledge on principles and practices of rabi crop production.
- 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, oilseed- rapeseed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops- mentha, lemon grass and citronella, Forage crops- berseem, lucerne and oat.

Practical:

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

Suggested readings:

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

AGR-405
FARM MACHINERY AND POWER
Credits Hours:2(1+1)

Objective:

To enable the students to understand the need of farm power, basic principles and parts of IC engine, different tillage, sowing, intercultural, plant protection equipment, working principles of threshers, harvesting of field and horticultural crops.

Theory:

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system: clutch, gear box, differential and final drive of a tractor, Tractor types, Cost analysis of tractor power and attached implement, Criteria for selection of tractor and machine implements. Familiarization with Primary and Secondary Tillage implement, implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practical:

Study of different components of I.C. engine; To study air cleaning and cooling system of engine; Familiarization with clutch, transmission, differential and final drive of a tractor; Familiarization with lubrication and fuel supply system of engine; Familiarization with brake, steering, hydraulic control system of engine; Learning of tractor driving; Familiarization with operation of power tiller, implements for hill agriculture; Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow; Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and transplanter; Familiarization with different types of sprayers and dusters; Familiarization with different inter-cultivation equipment; Familiarization with harvesting and threshing machinery; Calculation of power requirement for different implements.

Suggested readings:

1. Jagdiswar Sahay – Elements of Agricultural Engineering
2. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi
3. Jain, S.C. and C.R. Rai. Farm Tractor and maintenance and repair. Standard Publishers, 1705- B, Naisarak. Delhi- 110006
4. Ojha, T.P. and A.M. Michael, A.M. Principles of Agricultural Engineering. Vol. I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005

AGR-406
WATER MANAGEMENT
Credits Hours: 2(1+1)

Objectives:

- To study the important properties of soil affecting water availability for crops
- To study different methods of irrigation and water management practices for field and horticultural crops
- To study the soil moisture conservation practices, management of rainwater, watershed and command areas.

Theory:

Irrigation: Definition and objectives, importance 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); Agricultural drainage; Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops., drip, sprinkler; Layout of underground pipeline system.

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 and weirs; 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; Determination of EC, pH, carbonates, bio-carbonates, Ca^{++} and Mg^{++} in irrigation water (quality parameters).

Suggested readings:

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Aca Udaipur.
2. Dilip Kumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt.
S.V. Patil & Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish 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.

AGR-407
PROBLEMATIC SOILS AND THEIR MANAGEMENT
Credits Hours: 2(1 + 1)

Objectives:

- To learn about various problem soils like degraded soils, acid soils, saline soils, alkali soils, eroded soils, submerged soils, polluted soils.
- To impart knowledge about remote sensing, GIS, multipurpose tree and land capability classification.
- 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 with special reference to Assam and Northeastern Region; 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; Management of riverine soils, waterlogged soils, contaminated soils (pesticide contamination, heavy metal contamination), mined soils (coal mined, oil mined).

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 pH 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, CO₃, HCO₃, Cl, SAR and RSC), Determination of nitrate (NO₃⁻) in irrigation water; Determination of dissolved oxygen and free carbon dioxide levels in water samples

Suggested readings:

1. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices. AGROBIOS (India).
2. Osman, Khan Towhid, 2018, Management of Soil Problems. Springer publication
3. Indian Society of Soil Science, 2002. Fundamentals of Soil Science. IARI, New Delhi.
4. Brady Nyle C and Ray R Well, 2014. Nature and properties of soils. Pearson Education Inc., New Delhi.
5. Cirsan J. Paul, 1985, Principles of Remote Sensing. Longman, New York
6. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, New Delhi

AGR-408
BASICS OF PLANT BREEDING
Credits Hours: 3(2+1)

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; Domestication, acclimatization and introduction; Centres of origin/diversity, Components of genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self-pollinated crops-mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept, Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross-pollinated crops, modes of selection; 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; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding- methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding; Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights.

Practical:

Plant Breeder's kit, Study of germplasm of various crops, Study of floral 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.

Suggested Readings:

1. Principles of Plant Breeding (1st and 2nd Edition) by RW Allard
2. Plant Breeding: Principles and 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

