

## **Distribution of Courses, Syllabii and Credits for B.Sc. (Hons.) Agriculture**

### **4<sup>th</sup> Semester**

Sl. No.	Course No.	Title of Course	Credit(s)
1	AGR 251	Crop Production Technology III ( <i>Rabi</i> crops)	2(1+1)
2	AMP 252	Agro-meteorology and Climate Change	2(1+1)
3	SST 253	Principles of Seed Technology	3(2+1)
4	GPB 254	Crop Improvement I ( <i>Rabi</i> crops)	2(1+1)
5	ACSS 255	Manures, Fertilizers and Soil Fertility Management	3(2+1)
6	PPA 256	Diseases of Field and Horticultural Crops and their Management II	2(1+1)
7	AEC 257	Agricultural Marketing, Trade and Prices	3(2+1)
8	AST 258	Elementary Statistics	3(2+1)
9	HORT 259	Production Technology of Fruit and Plantation Crops	2(1+1)
10	EC 260-266	Elective Course	3(2+1)
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		1	

**AGR 251      Crop production Technology III (*Rabi* Crops)**

**2(1+1)**

## **Theory**

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of *rabi* and summer crops:

Tuber crop: Potato

Oilseed crops: Sesame, Groundnut, Soybean, Safflower

Forage crops: Maize, Sorghum, Oat, Berseem, Lucerne, Cowpea, Ricebean, Napier and Clusterbean

## **Practical**

Field preparation, sowing of *rabi* / summer tuber, oilseed and forage crops, and inter / mixed cropping; Calculations on seed rate and fertilizers, top dressing of fertilizers, identification of weeds and their control measures, important intercultural operations and water management in *rabi* / summer crops; Morphological and yield attributing characteristics, estimation of yield, harvesting, threshing, winnowing and storage of *rabi* / summer field crops; Cost of cultivation; Crop distribution in West Bengal and its ecological regions; Study of crop varieties and important agronomic experiments at experimental farms; Visit to research stations for related *rabi* / summer crops and multiple cropping.

## **Theory**

Meaning and scope of agricultural meteorology. Earth atmosphere—its composition, extent and structure; Atmospheric weather variables; Atmospheric Pressure, its variation with height; Wind—types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant; Short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature; Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation—process of precipitation, types of precipitation such as rain, snow, sleet and hail, cloud classification; Artificial rainmaking. Monsoon- its importance in Indian agriculture. Weather hazards—Droughts, floods, frost, tropical cyclones and extreme weather conditions such as heat wave and cold wave. Agriculture and weather relations; Climate normals for rice, wheat, mustard, potato, jute and gram crop. Weather forecasting—types of weather forecast and their uses, Climate change, climatic variability, global warming, causes of climate change and its impact on agriculture.

## **Practical**

Visit to Agrometeorological Observatory--Site selection, exposure of instruments and weather data recording. Measurement of albedo and sunshine duration. Computation of radiation intensity using bright sunshine hour data. Measurement of maximum and minimum air temperature—its tabulation, trend and variation analysis. Measurement of soil temperature. Determination of vapour pressure, relative humidity and dew point temperature. Measurement of wind speed and wind direction. Preparation of wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation. Computations of evapotranspiration.

## **Theory**

Definition of seed and its importance; seed structure and development; role of seed; Type of seed(Orthodox and Recalcitrant). Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production. Seed quality: Definition, Characters of good quality seed, different classes of seed. Basic principles of seed production. Foundation and certified seed production of Rice, Maize, Greengram, Black gram, Rapeseed-Mustard, Sorghum, Pea and Tomato. Seed certification: Objectives, Agencies, Phases of certification, procedure for seed certification, field inspection. Seed Act, Powers and Functions of Seed Inspector, offences and penalties, Seed control order 1983. Varietal Identification through Grow Out Test and Electrophoresis, Molecular and Biochemical test. Detection of genetically modified crops, Transgene contamination in non-GM crops, GM crops and organic seed production.

Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

## **Practical**

Seed production in major cereals: Rice, Maize and Sorghum. Seed production in major pulses: Mung, Blackgram, Greengram, Pea. Seed production in major oilseeds: Rapeseed-Mustard. Seed production of Tomatoes. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test and electrophoresis. Seed certification: Procedure, Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

**Theory**

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology of *rabi* crops. Ideotype concept and climate resilient crop varieties for future.

**Practical**

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli, Onion; Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops

**Theory**

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Integrated nutrient management.

Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano fertilizers  
Soil amendments, Fertilizer Storage, Fertilizer Control Order.

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

**Practical**

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of available N in soils. Estimation of available P in soils. Estimation of available K. Estimation of available S in soils. Estimation of available Ca and Mg in soils. Estimation of available Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

## **Theory**

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

### *Field Crops:*

Wheat: rusts, loose smut, karnal bunt and alternaria blight;

Sugarcane: red rot, smut, grassy shoot and ratoon stunting;

Sunflower: Sclerotinia stem rot and Alternaria blight, Rhizopus head rot;

Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot;

Gram: wilt, grey mould and Ascochyta blight;

Lentil: rust and wilt; Cotton: anthracnose, vascular wilt, and black arm, leaf curl;

Pea: downy mildew, powdery mildew and rust.

### *Horticultural Crops:*

Mango: anthracnose, malformation and powdery mildew, canker;

Citrus: canker and gummosis;

Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab; Peach: leaf curl.

Strawberry: leaf spot; Potato: early and late blight, leaf roll and mosaic, Scab;

Cucurbits: downy mildew, powdery mildew;

Onion and garlic: purple blotch, and Stemphylium blight;

Chillies: anthracnose and fruit rot, wilt and leaf curl;

Turmeric: leaf spot Coriander: stem gall

Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

## **Practical**

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

## **Theory**

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

## **Practical**

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



## **Theory**

Introduction to Statistics and its applications. Graphical representation of data. Frequency distribution. Measures of central tendency & dispersion. Definition of Probability, Addition and Multiplication theorem (with proof). Simple problems on probability. Binomial and Poisson Distribution. Normal Distribution. Definition of correlation, Scatter diagram, Karl Pearson's coefficient of correlation. Linear regression equation. Selection of random sample using simple random sampling with and without replacement. Introduction to test of significance, based on  $\tau$ ,  $t$ ,  $F$  and chi square statistics, chi-square test for goodness of fit and independence of attributes in contingency tables. Analysis of variance, one way and two way classification data analysis. Uniformity trial and fertility contour map. Principles of experimental designs, analysis of field data by three basic designs, viz., CRD, RBD and LSD.

## **Practical**

Formation of Frequency tables. Graphical presentation of data. Measures of central tendency & dispersion (Ungrouped and grouped data). Measures of Skewness and Kurtosis. Simple correlation and regression analysis. Selection of random sample using simple random sampling with and without replacement. Test of significance, based on  $\tau$ ,  $t$ ,  $F$  and chi square statistics, chi-square test for goodness of fit and independence of attributes in contingency tables. Analysis of variance, one way and two way classification data analysis. Lay-out and analysis of field data by three basic designs, viz., CRD, RBD and LSD.

## **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, citrus, grape, guava, litchi, papaya, sapota, apple, pear, peach, walnut, almond and; minor fruits- date, ber, pineapple, pomegranate, jackfruit, strawberry, plantation crops-coconut, arecanut, cashew, tea, coffee & 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.

**Elective Courses for B.Sc. (Hons.) Agriculture**

**Semester IV**

**EC 260      Hill, Dryland and Coastal Agriculture      (2+1)**

**Theory**

Concept of hill agriculture, distribution in West Bengal, soil and climate, terrace cultivation, *jhum* cultivation, traditional farming, cropping system, agronomic management including irrigation, soil and water conservation methods; Concept of dryland agriculture, distribution in West Bengal, soil and climate, moisture stress and drought, cropping system, agronomic management including choice of crops / varieties, moisture conservation, irrigation scheduling, use of indicator plants and anti-transpirants; drought avoidance / mitigation practices, contingent crop planning; Concept of coastal agriculture, distribution in West Bengal, soil and tidal water management, cropping system, agronomic management including choice of crops / varieties, irrigation and drainage; rice-cum-fish culture, shelterbelts.

**Practical**

Sowing and management of rainfed *rabi* crops including use of mulches and anti-transpirants; Calculation on drought indices and water use efficiency; Making contour bunds against slopes; Calculation on scheduling of irrigation for different crops; Determination of quality of irrigation water; Preparation of contingent crop planning schedule for early, mid-season and terminal droughts in dryland areas, and storm-affected areas of coastal region; Visit to local rice-cum-fish culture farm

**Theory**

Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cyanobacterial biofertilizers- *Anabaena*, *Nostoc*, *Hapalosiphon* and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Production technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

**Practical**

Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, P-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.

**Theory**

**An Introduction to agrochemicals:** their type and role in agriculture, effect of pesticides on environment, soil, human and animal health, merits and demerits of pesticide uses in agriculture; concept of pesticide residue analyses; management of pesticide residues for sustainable agriculture.

**Herbicides:** major classes, chemical properties and use of some important herbicides; Fate of herbicides in the environment.

**Fungicides:** classification; Inorganic fungicides - characteristics, preparation and use of sulphur and copper, Mode of action- Bordeaux mixture and copper oxychloride; Organic fungicides - Mode of action – Dithiocarbamates - characteristics, preparation and use of Zineb and Maneb. Systemic fungicides: Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim - characteristics and use.

**Insecticides:** introduction and classification; Inorganic and organic insecticides; Organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids, Neonicotinoids, IGRs, Reduced risk insecticides; Fate of insecticides in soil & plant; plant and animal systemic insecticides - their characteristics and uses.

**Practical**

Sampling of pesticides, Pesticides application technology to study about various pesticides appliances; Calculation of doses of pesticides to be used; To study and identify various formulations of insecticide available in market; Identification of agro-chemicals using TLC: Preparation of TLC plate, spotting and development, visualization and calculation of  $R_f$ ; Determination of copper content in copper oxychloride; Determination of thiram content. Determination of ziram content; Determination of alachlor content.

**EC 263**

**Chemicals and Bio-fungicides in Plant Disease Management**

**3(2 +1)**

**Theory**

Chemicals in plant disease control, viz., fungicides, bactericides, nematocides and antiviral chemicals. History and development of chemicals, advantages and disadvantages of chemicals.

Chemical nature, characteristics and classification of fungicides. Formulation of different fungicides-types, uses, advantages, adjuvant, stickers and spreaders. Mode of action and application of different fungicides and phytotoxicity of fungicides.

Chemical nature, characteristics and mode of action and application of different antibiotics. Antibiotics resistance in Plant pathogens.

New molecules in plant disease management.

General account of plant protection appliances. Development of fungicidal resistance.

# Biofungicide part to be included shortly and will be intimated in due time

**Practical**

Acquaintance with formulation of different fungicides and plant protection appliances. Studies on fungicides application equipment-types of sprayers, dusters and nozzles. Poisoned food technique. Preparation of different concentrations of chemicals based on active ingredients against pathogens; Minimum inhibitory concentration (MIC) of different antibiotics against plant pathogenic bacteria.

**Theory**

Photosynthesis – biological redox process, site of occurrence, Chemistry and biosynthesis of chlorophyll and carotenoids Light absorption and energy conversion, chemistry of reaction center complex, structure of photosystems including PS I and PS II, Lateral heterogeneity, Experimental evidences of Z-scheme, Photosynthetic electron transport and inhibitors, , oxidation of water. chemiosmotic hypothesis and binding change mechanism of ATP synthesis C-linked reactions in C<sub>3</sub>, C<sub>4</sub> and CAM plants and their regulation, photorespiratory cycle, Response of C<sub>3</sub> and C<sub>4</sub> plants to future climatic events.

Overview of nitrate uptake, reduction and nitrogen fixation. chemistry of NR and NiR, regulation of NR, interaction between NO<sub>3</sub> assimilation and carbon metabolism.

DNA as genetic material, Central dogma; replication, transcription and translation- Molecular mechanism and sequential events, discussion on enzymes/ protein factors involved, structural features of t-RNAs, : Genetic code – characteristics, wobble base pairing : post transcriptional and post translational processing, inhibitors.

**Practical**

Estimation of starch; extraction and estimation of phenolics from plant materials; colorimetric and titrimetric estimation of vitamin C in fruits and vegetables; extraction and estimation of chlorophyll, carotenoids, lycopene, curcumin etc. from plant materials, Determination of Michaelis-Menten constant. Estimation of some enzyme activities.

**EC 265**

**Agricultural Journalism**

**3(2+1)**

**Theory**

Agricultural Journalism: The nature and scope of agricultural journalism, characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism. Newspapers and magazines as communication media: Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines. The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources. Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions. Editorial mechanics: Copy reading, headline and title writing, proof reading, lay outting.

**Practical**

Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proofreading, layouting. Testing copy with a readability formula. Visit to a publishing office.



**Theory**

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries. Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behavior analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.