

## SYLLABI FOR ICAR'S ALL INDIA ENTRANCE EXAMINATION FOR ADMISSION TO MASTER DEGREE PROGRAMMES AND ICAR-JRF (PGS)

### Code 01: MAJOR SUBJECT GROUP - PLANT BIOTECHNOLOGY

(Subjects: 1.1: Plant Biochemistry/ Bio. Chem. 1.2: Plant Biotechnology & Molecular Biology/Biotechnology, 1.3: Plant Physiology/Crop Physiology)

- UNIT-I: Basic Sciences & General Agriculture:** Importance of agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, and mango. Major soils of India; role of NPK and their deficiency symptoms. General structure and function of cell organelles; mitosis and meiosis; Mendelian genetics. Elementary knowledge of growth, development, photosynthesis, respiration and transpiration; Elements of economic botany. General structure and function of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Organic farming; biofertilizers; biopesticides. Recombinant DNA technology; transgenic crops. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India. Elements of statistics.
- UNIT-II: Plant Biochemistry:** Importance of biochemistry in agriculture. Acid-base concept and buffers; pH. Classification, structure and metabolic functions of carbohydrates, lipids and proteins. Structure and function of nucleic acids. Enzymes: structure, nomenclature, mechanism of action; vitamins and minerals as coenzymes and cofactors. Metabolic pathways: glycolysis, TCA cycle, fatty acid oxidation, triglyceride biosynthesis. Electron transport chain; ATP formation. Photosynthesis: C-3, C-4 and CAM pathways. Nitrate assimilation; biological nitrogen fixation. Colorimetric and chromatographic techniques
- UNIT-III: Plant Biotechnology and Molecular Biology/Biotechnology:** Characteristics of prokaryotic and eukaryotic organisms; differences between fungi, bacteria, mycoplasmas and viruses. Physical and chemical basis of heredity; chromosome structure. DNA replication, transcription and translation; genetic code; operon concept. Genetic engineering; restriction enzymes; vectors; gene cloning; gene transfer. Plant cell and tissue culture; micro-propagation; somaclonal variation. Transformation; recombination; Heterosis. General application of biotechnology. Molecular and immunological techniques. Concept of bioinformatics, genomics and proteomics
- UNIT-IV: Plant Physiology/ Crop Physiology:** Plant physiology– importance in agriculture. Seed germination, viability and vigour. Photosynthesis- significance of C-3, C-4 and CAM pathway; photorespiration and its implications. Translocation of assimilates; dry matter partitioning; Harvest index of crops. Growth and development; growth analysis; crop-water relationship. Plant nutrients and their functions. Phytohormones and their physiological role. Photo-periodism, vernalisation; pollination/ fertilization in flowering plants. Post-harvest physiology and its significance.

### Code 02: MAJOR SUBJECT GROUP - PLANT SCIENCES

(Subjects: 2.1: Plant Breeding & Genetics, 2.2: Plant Pathology, 2.3: Agricultural Microbiology/Microbiology, 2.4: Seed Science & Technology, 2.5: Plant Genetic Resources)

- UNIT-I:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, potato and mango. Major soils of India, role of NPK and their deficiency symptoms.
- UNIT-II:** Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management.
- UNIT-III:** Characteristics of prokaryotic and eukaryotic organisms, differences between fungi, bacteria, mycoplasmas and viruses; physical and chemical basis of heredity; chromosome structure; genes/operon concept; protein biosynthesis; transformation, recombination, Heterosis; Elements of economic botany; integrated diseases management; sterilisation, disinfection and pasteurization; Koch's postulates; aetiological agents

of rusts, smuts, powdery/downy mildews, wilts, yellows, mosaic, necrosis, enations, blights and witches-broom; pH, buffer, vitamins, role of plant hormones in seed germination and dormancy; pollination/fertilization in flowering plants; methods of seed testing; breeders, foundation and certified seeds; seed production in self and cross pollinated crops, nitrate assimilation; biological nitrogen fixation and other uses of microorganisms in agriculture.

**UNIT-IV:** Food and industry; composting and biogas production. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India.

### Code 03: MAJOR SUBJECT GROUP - PHYSICAL SCIENCE

(**Subjects: 3.1:** Agricultural Meteorology/ Agrometero **3.2:** Soil Science & Agricultural Chemistry/ Soil Conservation and Water Management/ SWC/ Irrigation and Water Management, **3.3:** Agricultural Physics, **3.4:** Agricultural Chemicals, **3.5:** Environmental Science.)

**UNIT-I:** Importance of Agriculture in national perspective; basic principles of crop production, diversification, diversification of Agriculture, principle of nutrient and water management, package of practices for rice, wheat sorghum, maize, chickpea, pigeon pea, potato, sugarcane, groundnut, major vegetable crops. Role of essential plant nutrients, their deficiency symptoms and management options. Structure and function of plant cells, cell division, Basic concept of plant physiology relating to crop production-Biochemical compounds viz, carbohydrates, proteins, enzymes, fats, liquid vitamins and their function, developmental programmes relating to rural upliftment and livelihood security; organisational set up of agricultural education research and extension and future strategies for up gradation.

**UNIT-II:** Volumetric and gravimetric analysis including complexometric methods, periodic classification of element, Basic principle of instrumental analysis including spectro-photometry (Absorption and emission spectrography), Atomic structure –elementary concept of radioactivity, element and compound common ion effect, solubility product—hydrolysis of salts, buffer solution indicates equivalent weights and standard solution.

Elementary concepts of organic compounds- nomenclature and classifications including hydrocarbons, alcohol, aldehydes, acids and esters, carbohydrates, fats and liquids, amino acids, nucleic acids. Pesticides, their classification and uses; biopesticides and botanical pesticides.

**UNIT-III:** Soil as a medium for plant growth, composition of earth's crust, weathering of rocks and minerals, components of soil- their importance, soil profile, soil partials- physical mineralogical and chemical nature. Mechanical analysis, Stokes law, assumptions, limitations and applications. Soil, physical properties- density, porosity, texture, soil structure and their brief descriptions. Rheological properties in soils, calculations of porosity and bulk density. Soil air-Aeration, causes of poor aeration, factors affecting aeration, importance for plant growth. Soil temperature - sources and losses of soil heat. Factors affecting soil temperature, its importance in plant growth. Soil water- structure of water, soil-water-energy relationship, classifications, surface tension and movement in soil. Soil colloids- properties, structure of silicate clay minerals, sources of negative charges, properties, kaolinite, illite, montmorillonite and vermiculite clay minerals, milli-equivalent concept , cation exchange capacity, anion exchange capacity, buffering of soils. Problem soils- acid, saline, sodic and acid sulphate soils – their characteristics, formation, problems and management. Irrigation, water quality and its evaluation. Waterlogged soils- basic features, distinction with upland soils.

**UNIT-IV:** Essential plant nutrients- criteria of essentiality, functions for plant growth, mechanisms for movement and uptake of ions in soils and plants, Forms of nutrients in soils, deficiency symptoms on plants, luxury consumption, nutrient interactions and chelated micronutrients. Soil fertility, evaluation and management for plant growth, soil testing and fertilizer recommendations. Soil classifications- diagnostic surface and sub-surface horizons, soil survey- types, objectives, uses, land capability classifications. Remote sensing and its application in agriculture, SIS, GIS and GPS- basic features and uses in agriculture, Elementary concepts of radio isotopes and uses in agriculture. Soil micro-organisms, Classifications and their roles. Organic matter- decomposition, C:N ratios, mineralization and immobilization processes, humus, role of organic matter in soil quality. Soil erosion, types and control measures. Fertilizers and manures- classifications, NPK fertilizers, their reactions in soils, green manuring, recycling of organic wastes, composting. Soil and water pollution- sources, brief idea about different pollutants in soils and their managements.

#### Code 04: MAJOR SUBJECT GROUP - ENTOMOLOGY AND NEMATOLOGY

(Subjects: 4.1: Agricultural/ Horticultural Entomology, 4.2: Nematology, 4.3: Apiculture, 4.4: Sericulture, 4.5: Plant Protection.)

- UNIT-I:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, cole crops, mango, grapes, banana, oilseeds other than groundnut, soybean and mustard. Major soils of India, role of NPK and their deficiency symptoms. Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; Major cropping systems (rice-wheat cropping, crop rotations, mixed cropping); soil degradation-soil salinity and acidity and management; some aspects of post-harvest technology; varietal improvement; importance of Heterosis in crop production; crop protection principles in field and storage. Major insect pests and diseases of agricultural crops like rice, cotton, pulses, oilseed crops like groundnut, soybean and mustard, vegetables like tomato, cole crops; fruit crops like mango and banana and their management principles. Transgenic crops. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India; Elements of statistics.
- UNIT-II:** Classification of animal kingdom up to class; distinguishing characters up to orders in class Insecta; general organization of an insect external morphology with special reference to lepidopteran larvae, coleopteran adults; and honeybee; metamorphosis and moulting; different physiological systems; insect-plant relationship; insect pests of agricultural and horticultural crops, and their stored/processed products, insect vectors of plant diseases- identification, biology, nature of damage, and their management tactics; and pests of household, medical and veterinary importance and their control; useful and beneficial insects like honeybee, lac insect, silkworm and pollinators; Nematode taxonomy, biology of important plant parasitic nematodes and their control; entomopathogenic nematodes, basic principles of insect and nematode pest management-cultural, biological, insecticidal, quarantine, and regulatory aspects; insecticide classification and insecticide resistance management; and insect protective transgenic crops.

#### Code 05: MAJOR SUBJECT GROUP - AGRONOMY

(Subjects: 5.1: Agronomy/Forage Production/ 5.2: Tea Husbandry)

- UNIT-I: General:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, rapeseed and mustard, potato. Major soils of India, role of NPK and their deficiency symptoms. Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics: elementary knowledge of photosynthesis; respiration, photorespiration and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Important rural development programmes in India; organisational set up of agricultural research, education and extension in India; Elements of statistics.
- UNIT-II: Principles of Agronomy, Crop ecology and geography and Agricultural Meteorology:** Agronomy – meaning and scope, National & International agricultural research institutes in India, Agro climatic zones of India, Tillage, crop stand establishment and planting geometry and their effect on crop, Physiological limits of crop yield and variability in relation to ecological optima, organic farming, Precision farming, Integrated farming systems, Principles of field experimentation. Principles of crop ecology and crop adaptation, climate shift and its ecological implications, Agro-ecological regions in India, Geographical distribution of crop plants, Greenhouse effect, Climatic factors and their effect on plant processes and crop productivity, Role of GIS and GPS in agriculture. Weather & climate, Earth's atmosphere, Solar radiation, Atmospheric temperature and global warming. Crops and atmospheric humidity, Weather forecasting.
- UNIT-III: Field crops:** Origin, distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of cereals ( rice, wheat, maize, sorghum, pearl millet, minor millets, barley), pulses (chickpea, lentil, peas, Pigeon pea, mungbean, urdbean), oilseeds (groundnut, sesame, soybean, rapeseed & mustard, sunflower, safflower, linseed), fibre crops (cotton, jute, sun hemp), sugar crops(sugarcane), fodder & forage crops (sorghum, maize, napier, berseem, Lucerne, oats), medicinal & aromatic plants (menthe, lemon grass and isabgol) and commercial crops(potato, tobacco).

- UNIT-IV: Weed management:** Principles of weed management, Classification, biology and ecology of weeds, crop weed competition and allelopathy, concepts and methods of weed control, Integrated weed management, Classification, formulations, selectivity and resistance of herbicides, Herbicide persistence in soil and plants, Application methods and equipments, Weed flora shifts in cropping systems, Special and problematic weeds and their management in cropped and non-cropped situations, Weed management in field crops.
- UNIT-V: Water management:** Principles of irrigation, Water resources and irrigation development in India, Water and irrigation requirements, Concepts and approaches of irrigation scheduling, Methods of irrigation, Measurement of irrigation water, application, distribution and use efficiencies, Conjunctive use of water, Irrigation water quality and its management, water management in major field, crops (rice, wheat, maize, groundnut, sugarcane) Agricultural drainage.
- UNIT-VI: Soil fertility and fertilizer use:** Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, Indicators of soil fertility and productivity, Fertilizer materials and their availability to plants, slow release fertilizers, Nitrification inhibitors, Principles and methods of fertilizer application, Integrated nutrient management, site specific nutrient management.
- UNIT-VII: Dryland Agronomy:** Characteristics of Dryland farming and delineation of Dryland tracts, constraints of Dryland farming in India, Types of drought and their management, contingency crop planning and mid-season corrections for aberrant weather and its recycling. Watershed management.
- UNIT-VIII: Problem soils :** Problem soils and their distribution in India, Characteristics and reclamation of these soils, Crop production techniques in problem soils.
- UNIT-IX: Sustainable land use systems:** Sustainable agriculture: parameters and indicators, Conservation agriculture, safe disposal of agri-industrial waste for crop production, Agro-forestry systems, shifting cultivation, Alternate land use systems, Wastelands and their remediation for crop production.

#### **Code 06: MAJOR SUBJECT GROUP - SOCIAL SCIENCES**

(Subjects: 6.1: Agricultural Economics, 6.2: Agriculture Extension Education/ Communication Development, 6.3: Dairy Economics, 6.4: Dairy Extension Education)

- UNIT-I:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato and mango. Major soils of India, role of NPK and their deficiency symptoms. Structure and function of cell organelles, mitosis and meiosis; Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Important rural development programmes in India; organisational set up of agricultural research, education and extension in India; Elements of statistics. Measures of central tendency and dispersion, regression and correlation; concept of probability, sampling techniques and tests of significance.
- UNIT-II:** Theory of consumer behaviour, theory of demand, elasticity of demand, indifference curve analysis, theory of firm, cost curves, theory of supply, price determination, market classification, concept of macroeconomics, money and banking, national income. Agricultural marketing—role, practice, institutions, problems and reforms, role of capital and credit in agriculture, crop insurance, credit institutions, cooperatives, capital formation in agriculture, agrarian reforms, globalization, WTO & its impact on Indian agriculture.
- UNIT-III:** Basic principles of farm management, concept of farming system and economics of farming systems, agricultural production economics—scope and analysis, factor-product relationship, marginal cost and marginal revenue, farm planning and budgeting, Agricultural finance: nature and scope. Time value of money, Compounding and discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's, 5C's and 7 P's of credit, repayment plans. History of financing agriculture in India. Commercial banks, nationalization of commercial banks. Lead bank scheme, regional rural banks, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank, role of capital and credit in agriculture; credit institutions, co-operatives and agrarian reforms in India.

- UNIT-IV:** Extension Education- concept, meaning, principles, philosophy, scope and importance; Extension programme planning and evaluation- steps and principles, models of organizing agricultural extension; historical development of extension in USA, Japan and India. Rural development, meaning, importance and problems; Rural development programmes in India- Pre-independence era to recent ones; Extension teaching methods, definition and concept of sociology, differences between rural & urban communities, social stratification., social groups, social organization and social change. Rural leadership, educational psychology- learning and teaching, role of personality in agricultural extension Indian rural system- its characteristics; value system, cost and class; structure and customs; rural group organization and adult education.
- UNIT-V:** Communication, principles, concepts, process, elements and barriers in teaching methods. Different kinds of communication methods and media and AV aids/materials. Media mix, Campaign, Cyber extension- internet, cybercafé, Kisan Call Centers, teleconferencing, agriculture journalism, diffusion and adoption of innovations- adopter categories, capacity building of extension personnel and farmers- training to farmers, women and rural youth.

### **Code 07: MAJOR SUBJECT GROUP - STATISTICAL SCIENCES**

**(Subjects: 7.1: Agricultural Statistics, 7.2: Statistics, 7.3: Computer Application, 7.4: Bioinformatics)**

- UNIT-I:** Agriculture: Importance of Agriculture/Forestry/Livestock in national economy. Basic principles of crop production. Major diseases and pests of crops. Elementary principles of economics and agri-extension. Important rural development programmes in India. Organizational set up of Agricultural research, education and extension in India.
- UNIT-II:** Mathematics: Real and complex numbers; polynomial and roots; de Moivre's theorem and its applications.
- Elements of set theory- De Morgan's laws; vector space, linear independence, orthogonality; matrices- addition and multiplication, rank of a matrix, determinants, inverse of a matrix, solution of a system of linear equations, characteristic roots and vectors; convergence of infinite sequences and infinite series- tests for convergence, absolute convergence; co-ordinate geometry in two dimensions - line, circle, parabola, ellipse and hyperbola;
- Differential calculus: limits, differentiation of function of a single variable; Taylor's and Maclaurin's theorems, mean-value theorem; maxima and minima; indeterminate form; curvature, asymptotes, tracing of curves, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians. Integral calculus: integration by simple methods, standard forms, simple definite integrals, double integrals, change of order of integration, Gamma and Beta functions, application of double integrals to find area. Ordinary differential equations: differential equations of first order, Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, methods of finding complementary functions and particular integrals.
- Calculus of finite differences, interpolation; numerical differentiation and integration, difference equations; solution of simple non-linear equations by numerical methods like Newton- Raphson method.
- UNIT-III:** Introduction: Statistics – definition, use and limitations; Frequency Distribution and Curves; Measures of Central Tendency: Arithmetic mean; Geometric mean, Harmonic mean, Median, Mode; Measures of Dispersion: Range, Mean deviation, Quartile deviation, Variance and Coefficient of Variation; Probability: Definition and concepts, law of addition and multiplication, conditional probability, Bayes' theorem; Binomial, multinomial, Poisson and normal distribution; Introduction to Sampling: Random Sampling; Standard Error; Tests of Significance - Types of Errors, Null Hypothesis, Level of Significance, Testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples; Student's t-test for Single Sample, Two Samples and Paired t test. F test; Chi-Square Test for goodness of fit and independence of attributes; Correlation and Regression and associated tests of significance. Experimental Designs: basic principles, Analysis of variance, Completely Randomized Design (CRD), Randomized Block Design (RBD).

**UNIT-IV:** Computers: input, output devices, memory, hardware, software; Classification, booting computer. Viruses, worms and antivirus. Operating System- some DOS commands, FORMAT, DIR, COPY, PATH, MD, CD and DELTREE. Types of files. WINDOWS: Desktop and its elements, WINDOWS Explorer, working with files and folders; setting time and date. Anatomy of WINDOWS. Applications – MSWORD: Word processing features- Creating, Editing, Formatting and Saving; MSEXCEL: Electronic spreadsheets, concept, packages. Creating, editing and saving a spreadsheet. In-built statistical and other functions. Excel data analysis tools, Correlation and regression, t-test for two-samples and ANOVA with one-way classification. Creating graphs. MS Power Point and its features. MSACCESS: Concept of Database, creating database; Computer programming: Flow charts and Algorithms, Programming languages- BASIC, FORTRAN and C. Internet: World Wide Web (WWW), Concepts, web browsing and electronic mail. Bioinformatics - NCBI Genebank sequence database- primary and secondary database.

#### **Code 08: MAJOR SUBJECT GROUP - HORTICULTURE**

**(Subjects: 8.1:** Horticulture, **8.2:** Vegetable Crops/ Sci, Olericulture, **8.3:** Pomology Fruit Sc., Fruit and Orchard crops, Management of Plantation Crops, Fruit Breeding **8.4:** Post-harvest Technology of Horticultural Crops/ PHM, **8.5:** Floriculture & Landscaping, **8.6:** Spices and Plantation Crops/Medicinal and Aromatic Plants)

**UNIT-I:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato and mango. Major soils of India, role of NPK and their deficiency symptoms. Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India; Elements of statistics.

**UNIT-II:** Layout and establishment of orchards; pruning and training; propagation, climatic requirement and cultivation of fruits like mango, banana, citrus, guava, grape, pineapple, papaya, apple, pear, peach and plum; cultivation of plantation crops like coconut and cashew nut and spices like black pepper, coriander, turmeric, important physiological disorders; major vegetable crops of tropical, subtropical and temperate regions like cole crops (cauliflower, cabbage and knol khol), cucurbits (pumpkin, bottlegourd, bittergourd, luffa, muskmelon and watermelon, cucumber), root crops (radish, tapioca sweet potato and potato), leafy vegetables (fenugreek and spinach); solanaceous crops (tomato, chillies and brinjal); techniques for raising the nursery; nutritive value of fruits and vegetables and their role in human nutrition; basic physiology of ripening in fruits and vegetables and their products; type of fruits and vegetable products and control of fungal and bacterial diseases; major floricultural crops grown in India for commercial purposes like rose, carnation, chrysanthemum, marigold, tuberose, gladiolus, orchids; establishment and maintenance of lawns, trees, shrubs, creepers, hedges and annuals; type of gardens, methods of crop improvement; male sterility and incompatibility; pure line and pedigree selection; backcross, mass selection; heterosis; plant nutrients, deficiency symptoms of nutrients, manures and fertilisers, systems of irrigation, management of important pests and diseases of fruits and vegetables.

#### **Code 09: MAJOR SUBJECT GROUP - FORESTRY/AGROFORESTRY & SILVICULTURE**

**(Subjects: 9.1:** Forest Products, **9.2:** Silviculture, **9.3:** Forestry including Tree Genetic Resource, **9.4:** Agroforestry, **9.5:** Forestry/Env. Mgt, NRM)

**UNIT-I:** Importance of Agriculture/Forestry/Livestock in national economy. Basic principles of crop production. Important rural development programmes in India Elementary principles of economics and agri-extension. Organizational set up of Agricultural Research, education and extension in India. Major diseases and pests of crops. Elements of statistics.

**UNIT-II:** Forest- importance, types, classification, ecosystem, biotic and abiotic components, ecological succession and climax, nursery and planting technique, social forestry, farm forestry, urban forestry, community forestry, forest management, silvicultural practices, forest mensuration, natural regeneration, man-made plantations, shifting cultivation, taungya, dendrology, hardwoods, softwoods, pulpwoods, fuelwoods, multipurpose tree species, wasteland management. Agroforestry – importance and land use systems, forest soils, classification and conservation, watershed management, forest genetics and biotechnology

and tree improvement, tree seed technology, rangelands, wildlife – importance, abuse, depletion, management, major and minor forest products including medicinal and aromatic plants, forest inventory, aerial photo interpretation and remote sensing, forest depletion and degradation – importance and impact on environment, global warming, role of forests and trees in climate mitigation, tree diseases, wood decay and discolouration, tree pests, integrated pest and disease management, biological and chemical wood preservation, forest conservation, Indian forest policies, Indian forest act, forest engineering, forest economics, joint forest management and tribology.

### **Code 10: MAJOR SUBJECT GROUP - AGRICULTURAL ENGINEERING AND TECHNOLOGY**

(**Subjects:** 10.1: Soil & Water Conservation Engg./Water Resource Engg., 10.2: Irrigation & Drainage Engg., 10.3: Post Harvest Engg./Food Engg./Agril. Processing and Structure 10.4: Farm Implements & Machinery/ Farm Power and Machinery/ FP & Equip. 10.5: Bio-energy including Renewable Energy Mgt., Agril/ Irri. Water Mgmt.

- UNIT-I :** Elementary Statistics and theory of probability, differential and integral calculus, linear algebra and Fourier series, differential equations, vector algebra & vector calculus, elementary numerical analysis.
- UNIT-II:** Electric motors: Types, performance, selection, installation and maintenance, measuring instruments, fundamentals of computers, power distribution.
- UNIT-III:** Thermodynamic principles; fluid mechanics, theory of machines
- UNIT-IV:** Soil mechanics, soil classification, compaction & shear strength of soils, engineering mechanics, strength of materials
- UNIT-V:** Importance of farm equipment and role of mechanization in enhancing productivity & profitability of Indian agriculture; analysis of forces, design and production of farm machinery and power units; mechanics of tillage & traction operation, repair and maintenance of farm machines and equipment, farm engines; tractors and power tillers; tractor stability and operators comfort; field capacity and cost analysis; test codes and procedure; safety and ergonomic principles. Role of energy in economic development; solar, wind and bio-energy; biogas plants & gasifiers; biofuels from biomass; collection, characterization and storage of biomass, solar cookers & solar refrigerators.
- UNIT-VI:-**Biochemical and engineering properties of biological materials; quality control & safety of raw and finished products. Principles, practices and equipments for drying, milling, separation and storage of agricultural produce and by-products; material handling equipment and operations; farmstead planning; heating & cooling load calculation; seed processing practices and equipments; food preservation methods and products development; refrigeration and air conditioning; cold stores; waste management, cost analysis & food processing plants layout, feasibility reports
- UNIT-VII:** Surveying and leveling; hydrology, water resources in India; efficiency in water use; irrigation system and equipment; water conveyances and associated efficiency; soil-plant-water relationship; estimation of evaporation and water requirements of crop; water harvesting and use, farm ponds and reservoirs, command area development, land use capability classification, ground water development, wells and pumping equipment, soil erosion and its control, land shaping and grading equipment and practices, hydraulic structures, drainage of irrigated and humid areas; salt balance and reclamation of saline and alkaline soils.

### **Code 11: MAJOR SUBJECT GROUP - WATER SCIENCE AND TECHNOLOGY**

(**Subject:** 11.1: Water Science and Technology)

- Unit-I:** Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato and mango. Major soils of India, role of NPK and their deficiency symptoms. Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics; elementary knowledge of photosynthesis; respiration, and transpiration; structure and functions of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Pests and diseases of major crops and their management, important rural development programmes in India; organizational set up of agricultural research, education and extension in India.

- Unit-II:** Water resources of India, surface and groundnut resources, rainfall, rainfall-runoff relations, measurement and estimation of runoff, irrigation development in India, command area development, watershed management principles, government schemes in watershed management program, water harvesting structures including farm ponds, water quality including physical, chemical and biological properties.
- Unit-III:** Physical properties of soils—texture, structure, density and consistency, infiltration, field capacity, permanent wilting point, available water hydraulic conductivity, soil water flow including Darcy's law, mechanical analysis, chemical properties of pH, EC, atoms, molecules, colloids, clay mineral, major and trace elements, salinity and sodicity, cation exchange capacity, evaporation, evapotranspiration, water requirements of crop, plant growth process, soil and water conservation practices and tillage.
- Unit-IV:** Simultaneous and quadratic equations, differentiation and integration, differential equations, elements of statistics, frequency distribution, probability concepts, basic concepts of economics, energy, horse power, efficiency of machines, concepts of fluid flow, hydrostatic pressure, surface tension, irrigation water distribution and control, irrigation methods, irrigation efficiencies, irrigation scheduling, water lifting devices and pumps, construction of wells, drainage principles and applications, surface drainage, subsurface drainage, water pricing, water laws and irrigation acts.

### Code 12: MAJOR SUBJECT GROUP - HOME SCIENCE

(Subjects: 12.1: Food & Nutrition, 12.2: Human Development & Family Studies/Child Development, 12.3: Home Management/Family Resource Management, 12.4: Clothing & Textile, 12.5: Home Science Extension/ Education/ Sociology)

- UNIT-I:** Importance of agriculture in national economy; basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, tomato, and mango. Major soils of India; role of NPK and their deficiency symptoms. General structure and function of cell organelles; mitosis and meiosis; Mendelian genetics. Elementary knowledge of growth, development, photosynthesis, respiration and transpiration; Elements of economic botany. General structure and function of carbohydrates, proteins, nucleic acids, enzymes and vitamins. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management. Organic farming; biofertilizers; biopesticides. Recombinant DNA technology; transgenic crops. Natural Resources: forest, water, mineral, food, energy and land resources. Ecosystems. Biodiversity & its conservation. Environmental pollution. Environmental ethics. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India. Elements of Statistics.
- UNIT-II: Food & Nutrition.** Elements of Human Nutrition i.e. Food groups and the nutrients contributed by each group to the diet, composition and nutritive value of foods; food processing and preservation, meal planning i.e. principles menu planning for normal individuals for different age groups and at different stages of life, diet therapy, institutional food management, community nutrition and health, food related laws, policy and programmes in India. Organic and genetically modified foods.
- UNIT-III: Human Development & Family Studies/Child Development.** Introduction to child/human development -meaning, concept, principles, prenatal development (conception to child birth), care of new born, pre-natal and post natal care of mother, development of child in early and late childhood, early childhood education, adolescence, development and relationship with peers & family, marriage and family dynamics, meaning, definition of family life cycle, family welfare programmes in India, community education, child studies methods, participation in pre-school/crèche.
- UNIT-IV: Home Management/ Family Resource Management:** Concept and principles of management, management process, work, work environment, work simplification, fundamentals of housing, principles of design & home furnishing-selection, care and maintenance of accessories, equipments, furniture, paintings, family finance/economics and consumer education. Functional interiors for special needs.
- UNIT-V: Clothing & Textiles:** Introduction to clothing construction- sewing machine its parts and use, preparation of fabric for lay out textile fibre-classification, processing/manufacturing method, clothing need of family members, household textile and consumers, weaving and hosiery, traditional textiles and embroideries of India, care of clothing and textile finishes, dyeing & printing. Organic dyes.
- UNIT-VI: Home Science Extension Education.** Introduction to Home Science Education communication and



extension methods, programme planning & evaluation, entrepreneurial education, projected and non-projected aids (audio-visual aids) rural development programmes in India. Empowerment of women.

### Code 13: MAJOR SUBJECT GROUP - ANIMAL BIOTECHNOLOGY

(Subjects: 13.1: Animal Biotechnology, 13.2: Vety/Animal Biochemistry)

- UNIT-I:** Structure of prokaryotic and eukaryotic cells, cell wall, membranes, cell organelles, organization and functions, chromosome structure and functions, cell growth division and differentiation. Sub unit structure of macromolecules and supermolecular systems. Self assembly of sub units, viruses, bacteriophage, ribosomes and membrane systems.
- UNIT-II:** Scope and importance of biochemistry in animal sciences, cell structure and functions. Chemistry and biological significance of carbohydrates, lipids, proteins, nucleic acids, vitamins and hormones. Enzymes—chemistry, kinetics and mechanism of action and regulation. Metabolic inhibitors with special reference to antibiotics and insecticides. Biological oxidation, energy metabolism of carbohydrates, lipids, amino acids and nucleic acids. Colorimetry, spectrophotometry, chromatography and electrophoresis methods.
- UNIT-III:** Chemistry of antigens and antibodies and molecular basis of immune reaction, radio-immune assay and other assays. Chemistry of respiration and gas transport, water and electrolyte metabolism. Deficiency diseases, metabolic disorders and clinical biochemistry. Endocrine glands, biosynthesis of hormones and their mechanism of action.
- UNIT-IV:** History of molecular biology, biosynthesis of proteins and nucleic acids, genome organization, regulation of gene expression, polymerase chain reaction, basic principles of biotechnology applicable to veterinary science gene sequence, immunodiagnosics, animal cell culture, *in vitro* fertilization. Sub-unit vaccines: Principles of fermentation technology. Basic principles of stem cell and animal cloning.

### Code 14: MAJOR SUBJECT GROUP - VETERINARY SCIENCE

(Subjects: 14.1:VeterinaryAnatomy( & Histology) 14.2:VeterinaryObstetrics & Gynaecology, Reproductive Biology/ Ani. Reproduction 14.3:Vety. Medicine (Clinical and Preventive), 14.4: Veterinary Parasitology, 14.5: Veterinary Pharmacology and Toxicology, 14.6: Veterinary Pathology 14.7: Epidemiology/ Wild Life Science/ Wild Life Health Mgt. 14.8: Vety.Virology, 14.9: Vety. Immunology, 14.10: Veterinary Microbiology/ Bacteriology, 14.11: Veterinary Surgery / & Radiology 14.12: Veterinary Public Health)

- UNIT I: Anatomy and Physiology.** Structure of cells, cell organelles, chromosome structure and functions, cell growth, division and differentiation and functions. Structure and function of basic tissues-epithelium, connective tissue, muscle and nervous tissue. Gross Morphology, Histology and physiology of mammalian organs and systems, major sense organs and receptors, circulatory system. Digestion in simple stomached animals, birds and fermentative digestion in ruminants, Kidney and its functions-respiratory system-animal behaviour-growth-influence of environment on animal production-biotechnology in animal production and reproduction-electrophysiology of different types of muscle fibres. Exocrine and endocrine glands, hormones and their functions, blood composition and function. Homeostasis, osmoregulation and blood clotting. Gametogenesis and development of urogenital organs. Boundaries of body cavities. Pleural and peritoneal reflections.
- UNIT-II: Veterinary Microbiology (Bacteriology, Virology, Immunology), Veterinary Pathology, Parasitology.** Classification and growth characteristics of bacteria, important bacterial diseases of livestock and poultry, general characters, classification of important fungi. Nature of viruses, morphology and characteristics, viral immunity, important viral diseases of livestock and poultry. Viral vaccines. Antigen and antibody, antibody formation, immunity, allergy, anaphylaxis, hypersensitivity, immunoglobulins, complement system. Etiology of diseases and concept, extrinsic and intrinsic factors, inflammation, degeneration, necrosis, calcification, gangrene, death, atrophy, hypertrophy, benign and malignant tumours in domestic animals. General classification, morphology, life cycle of important parasites, important parasitic diseases (Helminths, Protozoa and Arthropods) of veterinary importance with respect to epidemiology, symptoms, pathogeneses, diagnosis, immunity and control.
- UNIT-III: Veterinary Medicine, Epidemiology, Veterinary Surgery and Veterinary Obstetrics & Gynaecology including Reproduction.** Clinical examination and diagnosis, Etiology, epidemiology, symptoms, diagnosis, prognosis, treatment and control of diseases affecting different body systems of various species

of domestic animals, epidemiology— aims, objectives, ecological concepts and applications. General surgical principles and management of surgical cases. Types, administration and effects of anaesthesia. Principles and use of radiological techniques in the diagnosis of animal diseases.

Estrus and estrus cycle in domestic animals, Synchronization of estrus, fertilization, pregnancy diagnosis, parturition, management of postpartum complications dystokias and its management, fertility, infertility and its management, artificial insemination.

**UNIT-IV: Veterinary Public Health, Veterinary Pharmacology & Toxicology.** Zoonotic diseases through milk and meat, Zoo animal health. Source and nature of drugs, pharmacokinetics, Chemotherapy-sulpha drugs, antibiotics, mechanism and problem of drug resistance. Drug allergy, important poisonous plants, toxicity of important agro-chemicals and their detoxification, drugs action on different body systems.

#### **Code 15: MAJOR SUBJECT GROUP - ANIMAL SCIENCES**

(**Subjects: 15.1:** Animal Husbandry/Animal Sci./Dairy Sci, **15.2:** Animal Genetics & Breeding, **15.3:** Animal Nutrition/Feed/Fodder Tech., **15.4:** Vety/Animal Physiology, **15.5:** Livestock Production & Management, **15.6:** Livestock Products Technology & Meat Science Tech., **15.7:** Poultry Science, **15.8:** Animal Husbandry/ Veterinary Extension Education **15.9:** Livestock/Animal Husbandry/ Veterinary Economics **15.10:** Bio-Statistics).

**UNIT-I: Animal Genetics and Breeding-** Principles of animal genetics, cell structure and multiplication. Mendel's laws, principles of population genetics, concept of heredity, heterosis and mutation, principles of evolution, principles of molecular genetics, genetic code, quantitative and qualitative traits. Selection of breeding methods in livestock and poultry. Population statistics of livestock.

**UNIT-II: Animal Nutrition, Feed Technology, Animal Physiology.** General nutrition, proximate principles, carbohydrates, proteins and fats their digestion and metabolism in ruminants and non-ruminants. Energy partition- measures of protein quality. Water, minerals, vitamins and additives, feeds and fodders and their classification. Common anti-nutritional factors and unconventional feeds. Hay and silage making. Grinding, chaffing, pelleting, roasting, feed block. Feed formulation principles. Digestion- control motility and secretion of alimentary tract. Mechanism, natural and chemical control of respiration, gaseous exchange and transport, high altitude living, physiology of work and exercise. Cardiac cycle, natural control of cardiovascular system. Smooth and skeletal muscle contraction. Blood coagulation. Physiology of immune system. Male and female reproduction including artificial insemination, in-vitro fertilization, cryo-preservation. Excretory system.

**UNIT III: Animal Husbandry, Dairy Science, Livestock Production and Management, Animal Product Technology & Meat Science and Poultry Science.** General concepts of livestock production and management, status of dairy and poultry industry, impact of livestock farming in Indian agriculture. Livestock housing, production and reproduction management, lactation management, breeding programmes for livestock and poultry. Composition, quality control and preservation of livestock products, methods of processing and storage livestock products. International Trade/WTO/IPR issues related to livestock products.

**UNIT IV: Veterinary Extension.** Concept of sociology, differences between rural, tribal and urban communities, social change, factors of change. Principles and steps of extension education, community development— aims, objectives, organizational set up and concept evolution of extension in India, extension teaching methods. Role of livestock in economy. Identifying social taboos, social differences, obstacles in the way of organizing developmental programmes. Concept of marketing, principles of co-operative societies, animal husbandry development planning and programme, key village scheme, ICDD, Gosadan, Goshala, Role of Gram Panchayat in livestock development. Basics of statistics, data analysis and computational techniques.

#### **Code 16: MAJOR SUBJECT GROUP - FISHERIES SCIENCE**

(**Subjects: 16.1:** Fisheries Sciences/Fish Hydrology/Fish Environment/Fish IT, **16.2:** Fisheries Resource Management/Fish Processing Management, **16.3:** Inland Aquaculture/Mariculture/Freshwater culture. **16.4:** Fish Processing Technology, **16.5:** Aquatic/Fish Biology/ Fish Physio. & biochem. **16.6:** Fish Microbiology/Fish Pathology/ Aquatic Animal Health Mgt. **16.7:** Fisheries Extension, **16.8:** Aquatic Env. Management, **16.9:** Fish

Post-Harvest Technology **16.10:** Fish Genetics/ Breeding / Biotechnology, **16.11:** Fish Nutrition & Feed Tech.  
**16.12:** Fish Business Management/ Fish. Economics)

**UNIT-1: Fishery resources and management.** Classification and taxonomical characteristics of cultivable fisheries, crustaceans and molluscs. Fresh water, brackish water and marine fishery resources of India, marine fisheries of the world. Estuarine, lacustrine, brackish water and pond ecosystem. Population dynamics, fish stock, abundance methods and analysis. Conservation and management of fishery resources. Fisheries legislations and law of the Seas. Impact of over exploitation and climate change on fisheries resources.

**UNIT-2: Fish aquaculture.** Reproduction and breeding behaviour in fishes and shellfishes, brood stock improvement, maturity and fecundity studies. Induced spawning methods and seed production, natural fish seed collection and rearing methods. Types of eggs and development of larval stages of fin fishes and shellfishes. Preparation and management of fresh water and brackish water fishponds. Cultivable species identification, introduction of exotic fishes in India. Culture methods: Pen and cage culture practices, trap and shrimp hatchery management, basic aspects of biotechnology in relation to fisheries.

**UNIT-3: Ecology of water bodies.** Important limnological, oceanographical and biological parameters in relation to fisheries of lotic and lentic waters, biological productivity and its impact on fisheries. Environmental impact assessment on fisheries in lentic and lotic waters. Biological parameters including energy flow, community ecology and aquatic association, biodiversity and its conservation, aquatic pollution and its management

**UNIT-4: Harvest and post harvest technology.** Common crafts and gears used for fish capture. Boat building material and demerits of wood, steel, aluminum, Ferro cement and FRP. Different types of fibres and netting materials and their characteristics, preservation of netting, parts of a trammel net, purse-scene, gill net and tuna long line. Food chemistry, fundamentals of microbiology. General methods of fish preservation and fishery by products. Canning and packaging techniques, processing and product development techniques.

**UNIT-5: Fisheries economics, extension & statistics.** Introduction to fishery economics and concepts of cooperative, marketing and banking management. Supply v/s demand economics of hatchery management and fish culture operations. Profit maximization. Problems in estimating costs and returns in fisheries. WTO agreements in Fisheries sector, intellectual property rights (IPR) and international fish trade; Fisheries extension methods. Training and education needs in fisheries. Communication concepts, Modern tools of fishery extension education, participatory rural appraisal (PRA), Rapid rural appraisal (RRA), role of women in fisheries; Basics of statistics in fisheries and computer science.

### **Code 17: MAJOR SUBJECT GROUP - DAIRY SCIENCE**

(Subjects: **17.1:** Dairy Microbiology, **17.2:** Dairy Chemistry)

**Unit-I:** Chemical composition of various food of plant and animal origin, structure and functions of food constituents, additives, preservatives, flavours and antioxidants, composition and physico-chemical and nutritional properties of milk and colostrum, chemistry of milk, constituents, nutrients and milk products. Test for the quality of milk, butter, ghee, milk powder etc., adulterants, neutralizers and preservatives, their detection, heat stability of milk.

**Unit II:** Introduction to dairy microbiology – Milk production hygiene and critical risk factors affecting microbiological quality on-farm; Microorganisms associated with milk and their classification based on growth temperature – psychrotrophs, mesophiles, thermotolerants and thermophiles; Microbial metabolites and their role in spoilages - souring, curdling, gassiness, ropiness, proteolysis, lipolysis, abnormal flavour and colour; Antimicrobial systems in raw milk; Microbiological grading of raw milk; Microflora of mastitic milk and its importance in dairy industry; Food poisoning, food infections, zoonotic infections and other milk borne diseases and their control.

**Unit-III:** Composition and chemistry of cream, butter, ghee, ice-cream, cheese, condensed and dried milks, infant food, spoilage of ghee and use of antioxidants, chemistry of milk fermentation, chemistry of rennin coagulation of milk and changes occurring during ripening of cheese, physico-chemical changes in the manufacture and storage of milk powder, lactose, crystallization and its significance, physicochemical changes during the manufacture of indigenous milk products, quality standards of dairy products.

**Unit IV:** Bacteriological aspects of milk processing - Thermization, pasteurization, boiling, sterilization, UHT, bactofugation, and membrane filtration; Microbiological quality of cream, butter, ice-cream, concentrated dairy products, dried milks, infants milk foods, indigenous dairy products; Factors affecting the microbiological quality of these products during production, processing, handling, storage and distribution; Enumeration, isolation and identification of conventional and emerging dairy pathogens, detection of microbial toxins, drug residues in milk and their public health importance; Microbial defects associated with dairy products and their control; Microbiology of dairy starters; Classification, genetic aspects and carbohydrate metabolism of Lactic Acid Bacteria (LAB); Preservation, propagation and quality control of dairy starters and their inhibition by antibiotic residues, detergents, sanitizers, bacteriophages etc.; Microbiology of fermented milks, cheeses and application of probiotic concept in dahi, yoghurt, Kefir, Kumiss, Bulgarian milk, cultured buttermilk, leben, yakult, cheddar and processed cheese; Dairy plant hygiene and sanitation - Microbiology of air, water, equipments, packaging materials, personnel, disposal of dairy waste; Microbiological standards for milk and milk products - PFA, BIS, Codex/ ISO standards (ISO 9001: 2001/ISO 22000:2005).

### **Code 18: MAJOR SUBJECT GROUP - DAIRY TECHNOLOGY**

(Subjects: 18.1: Dairy Technology, 18.2: Dairy Engineering)

**UNIT-I:** Principles and processes of food preservation, non-conventional sources, processing of fluid milk, Computerization and Automatic Process Controls in Milk Processing. HACCP Concepts in Fluid Milk Processing. Advances in Centrifugal Separation and Bactofugation. Manufacture of various types of dairy products and changes occurring during manufacture and storage and their defects. Sensory evaluation and judging of milk and milk products, types of packaging materials and their properties, packing forms and operations, problems in food packaging, recent advances in packaging dairy and food products. Intelligent Food Packaging. Nutritional Labeling of Food Products. Application of Membrane Processing in Milk Processing.

**UNIT-II:** Materials and sanitary features of the dairy equipments. Homogenizer- Theory of Homogenization. Triplex pump, Lubrication of the Homogenizer, care and Management of homogenizer, Homogenizer Accessories and Standards for Homogenizer. Pasteurizer- Pasteurizer construction & Principle Materials used in Construction of Pasteurizers. High temperature short time Pasteurizer, care of Pasteurizer, Reaction Kinetics, Sterilizer, Mixing & agitation equipments, principles of evaporation, drying. Atmosphere concentration, Vacuum Pan, Fluidization. Care of Vacuum Pan, Atmospheric Drum Dryer. Spray Dryer principles of dairy plant layout and design, Functional Design, space requirement of Milk Plant, problem through computers, centralized dispersal of data processing, d-BASE-III, Lotus 1-2-3 to graphics, Fortran.

**UNIT-III:** Fluid mechanics- properties of fluids, Bernoulli's equation and its applications, hydraulic systems Types of Pumps, Sanitary pumps, Standards for Centrifugal and Positive Rotatory Type of pumps, Selection of Pumps. Care and Upkeep of Pumps dimensional analysis, refrigeration and air-conditioning. Artificial Refrigeration, Compression Refrigeration System, Refrigeration Accessories. Calculation of size of Refrigeration Machine Requirements. Heat-transfer and thermodynamics; mechanical separations, Rittinger's and Kick's laws, Engineering of mechanics, theory of machine, strength of materials, Hook's law, materials of fabrications, machine tools, Electrical Engg., Electromagnetic induction, Magnetic-Hysteresis loop (BH Curve), AC fundamentals.

### **Code 19: GROUP - FOOD SCIENCE TECHNOLOGY**

(Subject: 19.1: Food Science & Technology)

**UNIT-I:** General chemistry of food constituents, physical properties of foods, properties of cottoldal systems, gels and emulsions. Minerals in foods, physicochemical changes in foods during processing and storage, functions of food nutrients, dietary allowances and nutritional requirements. Metabolism of carbohydrates, lipids and protein. Biological value and PER. Food additives, contaminants and anti-nutritional factors. Food flavors and puff-flavors. National and international food standards, modern analytical techniques in food analysis.

**UNIT-II:** Engineering properties of food materials, System analysis, mass and energy balance, Principles operations and equipment for food materials flow handling, cleaning, dehusking, sorting and grading; peeling, size reduction, mixing and forming, bakery foods manufacture, extrusion, separation, filtration and membrane

processes, expression, baking roasting, frying, extraction and leaching, crystallization, distillation, blanching, pasteurization, sterilisation, evaporation, drying, freezing, packing, heat exchanging, dairy specific operations. Process equipment design, heat and mass transfer, equipment for steam generation, compressed air, refrigeration and air conditioning, water and waste water treatment, biochemical engineering and thermo bacteriology. Automation, on-line data acquisition and process control. Food plant layout and design. Energy audit.

**UNIT-III:** Preparation and manufacturing technology of cereals and bakery products, beef, pork, poultry, fish & sea foods and egg, sausages and table ready meats, dairy products, fresh fruits, fresh vegetables, processed fruits, processed vegetables, Post Harvest Handling and storage of Fruits and Vegetables. Sugars, sweets, fats and oils, fermented foods, alcoholic and non-alcoholic beverages, indigenous foods, fast, readymade and fashion foods. Dehydration and concentration methods, irradiation, microwave and solar processing of foods, food by-products & downstream processing, flavoring and pigment technology. Judging of food products, food plant management and legal aspects, food plant safety, risk and hazards. Effluent treatment and environment pollution, waste solids upgrading and treatment, food storage, functions of packaging, packaging operations, types of containers, FFS, hermetics closures, canning packaging materials and package testing, transportation and marketing food products.

**UNIT -IV:** Role of intrinsic and extrinsic properties of food in relation to microbial growth. Microbiology of fruits, fruit products, vegetables, soft drinks, bakery products, milk and milk products, milk, fish, egg and marine produces. Spoilage of foods, food pathogens and their toxins in relation to human health. Food preservation by sugar, salt, chemicals, heat, cold, irradiation, dehydration and packaging. Microbiology of fermented foods and beverages and factors affecting their quality. Methods for microbiological examination of foods, food hygiene and safety regulations. Water quality and waste disposal in food industry.

#### **CODE 20: GROUP- AGRI-BUSINESS MANAGEMENT**

(**Subjects: 20.1:** Agri-Business Management, **20.2:** Agricultural Marketing & Cooperation)

**UNIT-1:** Social, political and economic structure in rural India. Importance of agriculture/forestry/ horticulture/ livestock in national economy. Cultivation of major cereal crops, legume crops, vegetable crops, fruits and their importance in human diet. Major soils of India, essential plant nutrients, their role, deficiency symptoms and sources. Pests and diseases of major crops, vegetables, fruits and their management. Forestry production, pests and diseases management of major trees grown in India. Watershed management. Organizational set up of agricultural research, education and extension in India. Elements of statistics.

**UNIT-2:** Farm equipments and Farm Machinery in India, sources of energy and power on farms. Irrigation and drainage systems. Basics of post-harvest technology, Basics of energy in agriculture.

**UNIT-3:** Basics of veterinary, gynaecology, veterinary microbiology, veterinary pathology and Parasitology, veterinary surgery, veterinary public health, veterinary pharmacology and toxicology.

**UNIT-4:** Basics of human food and nutrition, human/child development, home and family resource management, clothing and textile.

**UNIT-5: Quantitative ability:** Test the ability of candidates to make mathematical calculations under stress conditions. All these calculations will be based on analytical skills of the candidates with understanding of mathematics at Intermediate level.

**UNIT-6: Communicative ability:** Test English comprehension wherein the knowledge of language skills are tested as to how effectively the candidate communicates his thoughts and ideas.

**UNIT-7: Data Interpretation:** Calculations requiring skills of interpretation of facts and figures. The questions can be posed as graphs, tables and charts.

**UNIT-8: Logical reasoning:** Evaluating logical thinking capacity by providing various options.

**UNIT-9:** Agricultural Marketing and Cooperation: Fundamentals of managerial economics, market structure conduct and performance, agricultural marketing concepts- functions and institutions, trade in agriculture sector; principles of corporation; cooperatives in India; agribusiness institutions in India; entrepreneurship development.

Besides above, any other topic of scientific, social and educational importance can also be included. Around 20–25% questions shall be related to agriculture and agriculture related science subjects including recent developments.