

Recruitment for the posts of Agricultural Development Officer, Assistant Agricultural Engineer and Junior Engineer (Agriculture)

Syllabus for the Recruitment Test, 2021



सत्यमेव जयते

Department of Agriculture
Government of Assam



Assam Agricultural University

Jorhat 785013

SYLLABUS FOR THE POST OF AGRICULTURAL DEVELOPMENT OFFICER

1. AGRONOMY

1. Fundamentals of Agronomy

Agronomy and its scope, seeds and sowing, tillage and tilling, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and

methods, quality of irrigation water, logging. Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides-classification, selectivity and resistance, allelopathy. Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

2. Introductory Agrometeorology & Climate Change

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

3. Crop Production Technology

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

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, oilseeds-rape seed, mustard and sunflower; sugar crops-sugarcane; medicinal and aromatic crops-mentha, lemon grass and citronella, Forage crops-berseem, lucerne and oat.

4. Farming System and Sustainable Agriculture 1(1+0)

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

5. Principles of Organic Farming

Organic farming, principles and its scope in India; Initiatives taken by Government (central/ state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production;

Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products

6. Geoinformatics, Nano-technology and Precision Farming

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

2. GENETICS AND PLANT BREEDING

1. Fundamentals of Genetics

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; 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 mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique, mutagenic agents and induction of mutation. Qualitative & Quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operons.

2. Principles of Seed Technology

Seed and seed technology: introduction, definition and importance. 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. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds 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.

3. Fundamentals of Plant Breeding

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 improvement 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 prebreeding; 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.

4. Crop Improvement – I (*Kharif*)

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and horticultural crops; Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters; Important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

5. Crop Improvement – II (*Rabi*)

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.

3. SOIL SCIENCE & AGRICULTURAL CHEMISTRY

1. Fundamentals of Soil Science

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil; Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistence and plasticity; Elementary knowledge of soil taxonomy classification and soils of India; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth, Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids - inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation; soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and microorganisms, their beneficial and harmful effects; Soil pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

2. Manures, Fertilizers and Soil Fertility Management

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Fertilizer recommendation approaches. 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.

4. ENTOMOLOGY

1. Fundamentals of Entomology 4(3+1)

History of Entomology in India. Major points related to dominance of Insecta in Animal kingdom. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Structure of male and female genital organ. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine)

and reproductive system, in insects. Types of reproduction in insects. Major sensory organs like simple and compound eyes, chemoreceptor.

Insect Ecology: Introduction, 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.

Categories of pests. Concept of IPM, Practices, scope and limitations of IPM. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Chemical control importance, hazards and limitations. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation. Insecticides Act 1968-Important provisions. Application techniques of spray fluids. Symptoms of poisoning, first aid and antidotes.

Systematics: Taxonomy –importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigonidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

2. Pests of Crops and Stored Grains and their Management

General account on nature and type of damage by different arthropods pests. Scientific name, order, family, host range, distribution, biology and bionomics, nature of damage, and management of major pests and scientific name, order, family, host range, distribution, nature of damage and control practice other important arthropod pests of various field crop, vegetable crop, fruit crop, plantation crops, ornamental crops, spices and condiments. Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain. Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage and fundamental principles of grain store management.

3. Management of Beneficial Insects

Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Role of pollinators in cross pollinated plants.

Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac- products. Identification of major parasitoids and predators commonly being used in biological control.

Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

5. AGRICULTURAL ECONOMICS

1. Fundamentals of Agricultural Economics

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, 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: concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply. Market structure: meaning and types of market, basic features of perfectly competitive and imperfect markets. Price determination under perfect competition; short run and long run equilibrium of firm and industry, shut down and break even points. 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 socioeconomic 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, supply, general price index, inflation and deflation. Banking: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. Agricultural and public finance: meaning, micro v/s macro finance, need for agricultural finance, public revenue and public expenditure. Tax: meaning, direct and indirect taxes, agricultural taxation, VAT. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning.

2. Agricultural Finance and Co-Operation

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks, Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports- Bank norms – SWOT analysis.

Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

3. Agricultural Marketing, Trade and Prices

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.

4. Farm Management, Production and Resource Economics

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a

farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage. Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises. Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts.

Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises. Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance – weather based crop insurance, features, determinants of compensation. Concepts of resource economics, differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

6. AGRICULTURAL ENGINEERING

1. Introductory Soil and Water Conservation Engineering

Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

2. Farm Machinery and Power

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, 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.

3. Renewable Energy and Green Technology

Classification of energy sources, contribution of these of sources in agricultural sector, Familiarization with biomass utilization for biofuel production and their application, Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application, Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

4. Protected Cultivation and Secondary Agriculture

Greenhouse technology: Introduction, Types of Green Houses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes. Greenhouse equipments, materials of construction for traditional and low cost greenhouses. Irrigation systems used in greenhouses, typical applications, passive solar greenhouse, hot air greenhouse heating systems, greenhouse drying. Cost estimation and economic analysis.

Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation. Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, recirculatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

7. PLANT PATHOLOGY

1. Fundamentals of Plant Pathology

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Causes / factors affecting disease development: disease triangle and tetrahedron and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes.

Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions, sub-divisions, orders and classes.

Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.

Viruses: nature, structure, replication and transmission. Study of phanerogamic plant parasites.

Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, Anguina, Radopholus etc.)

Growth and reproduction of plant pathogens. Liberation / dispersal and survival of plant pathogens. Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants. Epidemiology: Factors affecting disease development. Principles and methods of plant disease management. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

2. Diseases of Field & Horticultural Crops & their Management-I

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

Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt. Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic. Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight; Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight; Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

3. Diseases of Field & Horticultural Crops & their Management-II

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

Field Crops:

Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle;

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

Sunflower: Sclerotinia stem rot and Alternaria blight; 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; Pea: downy mildew, powdery mildew and rust.

Horticultural Crops:

Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl.

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

Cucurbits: downy mildew, powdery mildew, wilt; 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.

4. Principles of Integrated Pest and Disease Management

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis.

Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the insect pests and disease management. Survey surveillance and forecasting of Insect pest and diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for Insect pest and disease. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes. Case histories of important IPM programmes.

8. HORTICULTURE

1. Fundamentals of Horticulture

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; Seed dormancy, Seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture. Irrigation – methods, Fertilizer application in horticultural crops.

2. Production Technology for Fruit and Plantation Crops

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.

3. Production Technology for Vegetable and Spices

Importance of vegetables & 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, Chilli, Capsicum, Cucumber, Melons, Gourds, Pumpkin, French bean, Peas; Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Raddish, Beetroot; Tuber crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables).

4. Production Technology for Ornamental Crops, MAPs and Landscaping

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers. Production technology of important cut flowers like rose, gerbera, carnation, liliium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions. Production technology of important medicinal plants like ashwagandha, asparagus, aloe, costus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver. Processing and value addition in ornamental crops and MAPs produce.

5. Post-harvest Management and Value Addition of Fruits and Vegetables

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

9. FOOD SCIENCE & TECHNOLOGY

1. Principles of Food Science and Nutrition

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.); Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/ modified diets, Menu planning, New trends in food science and nutrition.

10. AGRICULTURAL EXTENSION and COMMUNICATION

1. Fundamentals of Agricultural Extension Education

Education: Meaning, definition & 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.); various extension/ agriculture development programmes launched by ICAR/Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, 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 Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; 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.

2. Rural Sociology & Educational Psychology

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension, Social Ecology, Rural society, Social Groups, Social Stratification, Culture concept, Social Institution, Social Change & Development. Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

3. Entrepreneurship Development and Business Communication

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs; SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development, Impact of economic reforms on Agribusiness/ Agrienterprises, Entrepreneurial Development Process; Business Leadership Skills; Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for agrientrepreneurship and rural enterprise.

4. Communication Skills and Personality Development

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

1. Fundamentals of Plant Biochemistry and Biotechnology

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Poly saccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

2. Fundamentals of Crop Physiology

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview; Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C₃, C₄ and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

3. Agricultural Microbiology

Introduction. Microbial world: Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination transformation, conjugation and transduction, plasmids, transposon.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

4. Environmental Studies and Disaster Management

Multidisciplinary nature of environmental studies Definition, scope and importance.

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution: definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards.

Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster Management

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

12. STATISTICS, COMPUTER APPLICATION AND IPR

1. Statistical Methods

Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 × 2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

2. Agri-Informatics

Introduction to Computers, Operating Systems, definition and types, Applications of MSOffice for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture, World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology 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 using IT tools.

SYLLABUS FOR ASSISTANT AGRICULTURAL ENGINEER

A) FARM POWER & MACHINERY

Farm Machinery and Equipment

Objectives of farm mechanization. Classification of farm machines. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics. Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Hitching systems and controls. Draft measurement of tillage equipment : Earth moving equipment - their construction & working principles viz Bulldozer, Trencher, Elevators etc.; sowing, planting & transplanting equipment – their calibration and adjustments. Fertilizer application equipment. Weed control and Plant protection equipment - sprayers and dusters, their calibration, selection, constructional features of different components and adjustments

Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Crop harvesting machinery : mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment. Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment - potato, groundnut etc., Cotton picking & Sugarcane harvesting equipment. Principles of fruit harvesting tools and machines. Horticultural tools and gadgets. Testing of farm machine. Test codes & procedure. Interpretation of test results. Selection and management of farm machines for optimum performance.

Farm Power

Sources of farm power -conventional & non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. Study of engine components their construction, operating principles and functions. Engine systems : valves & valve mechanism. Fuel & air supply, cooling, lubricating, ignition, starting and electrical systems. Study of constructional details, adjustments & operating principles of these systems. IC engine fuels - their properties & combustion of fuels, gasoline tests and their significance, diesel fuel tests and their significance, detonation and knocking in IC engines, study of properties of coolants, anti-freeze and anti-corrosion materials, lubricant types & study of their properties. Engine governing systems.

Tractor Systems and Controls

Study of transmission systems, clutch, gear box, differential and final drive mechanism. Familiarization of brake mechanism. Ackerman and hydraulic steering and hydraulic systems. Tractor power outlets: P.T.O., belt pulley, drawbar, etc. Tractor chassis mechanics and design for tractor stability. Ergonomic considerations and operational safety.

Renewable Energy Sources

Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, uses and safety/environmental aspects of different renewable energy devices like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays; Brief introduction to wind energy, hydroelectric energy, ocean energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

Field Operation and Maintenance of Tractors and Farm Machinery

Introduction to tractor maintenance procedure and trouble shooting. Scheduled maintenance after 10,50,100,250,500 and 1000 hrs. of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance and workshop requirements.

B) PROCESSING AND FOOD ENGINEERING

Engineering Properties of Biological Materials and Food Quality

Importance of engineering properties of biological materials, Study of different physical and thermal characteristics of important biological materials like shape, size, volume, density, roundness, sphericity, surface area, specific heat, thermal conductivity, thermal diffusivity, etc. measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition. Rheological characteristics like stress, strain time effects, rheological models and their equations. Aerodynamic characteristics and frictional properties. Application of engineering properties in handling processing machines and storage structures. Concept, objectives

and need of quality, quality control, methods of quality control, sampling; purpose, sampling techniques, requirements and sampling procedures for liquid, powdered and granular materials, sensory quality control, panel selection methods, interpretation of sensory results in statistical quality control, TQM and TQC, consumer preferences and acceptance, Food Laws and Regulations in India. Food grades and standards BIS, AGMARK, PFA, FPO, CAC (Codex Alimentarius Commission), sanitation in food industry, GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.

Refrigeration and Air Conditioning

Principles of refrigeration, second law of thermodynamics applied to refrigeration, Carnot cycle, reversed Carnot cycle, coefficient of performance, unit of refrigeration. Refrigeration in food industry, types of refrigeration system, mechanical vapour compression, vapour absorption system, components of mechanical refrigeration, refrigerant, desirable properties of ideal refrigerant, Centrifugal and steam jet refrigeration systems, thermoelectric refrigeration systems, vortex tube and other refrigeration systems, ultra-low temperature refrigeration, cold storages, insulation material, design of cold storages, defrosting. Thermodynamic properties of moist air, perfect gas relationship for approximate calculation, adiabatic saturation process, wet bulb temperature and its measurement, psychrometric chart and its use, elementary psychrometric process. Air conditioning – principles- Type and functions of air conditioning, physiological principles in air conditioning, air distribution and duct design methods, fundamentals of design of complete air conditioning systems – humidifiers and dehumidifiers – cooling and calculations, types of air conditioners – applications.

Agricultural Structures and Environmental Control

Planning and layout of farmstead. Physiological reactions of livestock to solar radiation and other environmental factors, livestock production facilities, BIS. Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc. Design and construction of rural grain storage system Engineering for rural living and development, rural roads, their construction cost and repair and maintenance. Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system; sewage system, its design, cost and maintenance, design of septic tank for small family. Estimation of power requirement for domestic and irrigation, source of power supply, use of alternate source of energy, electrification of rural housing. Scope, importance and need for environmental control, renewable and non-renewable resources and their equitable use, concept of eco system, biodiversity of its conservation, environmental pollution and their control, solid waste management system, BOD and COD of food plant waste, primary and secondary treatment of food plant waste.

Crop Process Engineering

Scope and importance of food processing, principles and methods of food processing. Processing of farm crops; cereals, pulses, oil seeds, fruits and vegetables and their products for food and feed. Processing of animal products, Principal of size reduction, grain shape, size reduction machines; crushers, grinders, cutting machines etc. - operation, efficiency and power requirement – Rittinger's, Kick's and Bond's equation, fineness modulus. Theory of mixing, types of mixtures for dry and paste. materials, rate of mixing and power requirement, mixing index. Theory of separation, size and un sized separation, types of separators, size of screens, sieve analysis, capacity and effectiveness of screens, pneumatic separation. Theory of filtration, study of different types of filters, rate of filtration, pressure drop during filtration. Scope & importance of material handling devices, study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, pneumatic conveying, gravity conveyor- design consideration, capacity and power requirement.

Drying and Storage Engineering

Moisture content and methods for determination, importance of EMC and methods of its determination, EMC curve and EMC model, principle of drying, theory of diffusion, mechanism of drying- falling rate, constant rate, thin layer, deep bed and their analysis, critical moisture content, drying models, calculation of drying air temperature and air flow rate, air pressure within the grain bed, Shred's and Hukill's curve, different methods of drying including puff drying, foam mat drying, freeze drying, etc. Study of different types of dryers- performance, energy utilization pattern and efficiency, study of drying and dehydration of agricultural products. Types and causes of spoilage in storage, conditions for storage of perishable products, functional requirements of storage, control of temperature and relative humidity inside storage, calculation of refrigeration load; modified atmospheric storage and control of its environment, air movement inside the storage, storage of grains: destructive agents, respiration of grains, moisture and temperature changes in stored grains; conditioning of

environment inside storage through natural ventilation, mechanical ventilation, artificial drying, grain storage structures such as Bukhari, Morai, Kothar, silo, CAP, warehouse - design and control of environment. Storage of cereal grains and their products, storage of seeds, hermetically sealed and air-cooled storages-refrigerated, controlled atmosphere, modified atmospheric and frozen storages. Storage condition for various fruits and vegetables under cold and CA storage system. Economic, aspects of storage.

Dairy and Food Engineering

Dairy development in India. Engineering, thermal and chemical properties of milk and milk products, unit operation of various dairy and food processing systems, process flow charts for product manufacture, working principles of equipment for receiving, pasteurization sterilization, homogenisation, filling & packaging, butter manufacture, dairy plant design and layout, composition and proximate analysis of food products. Deterioration in products and their controls. Physical, chemical and biological methods of food preservation, changes undergone by the food components during processing, evaporation, drying, freezing juice extraction, filtration, membrane separation, thermal processing, plant utilities requirement. Practical: Study of a composite pilot milk processing plant & equipments; Study of pasteurisers; Study of sterilizers; Study of homogenisers; Study of separators; Study of butter churners; Study of evaporators; Study of milk dryers; Study of freezers; Design of food processing plants & preparation of layout; Visit to multiproduct dairy product; Determination of physical properties of food products; Estimation of steam requirements; Estimation of refrigeration requirements in dairy & food plant; Visit to Food industry.

C) SOIL AND WATER ENGINEERING

Soil and Water Conservation Structures

Introduction; classification of structures, functional requirements of soil erosion control structures; flow in open channels-types of flow, state of flow, regimes of flow, energy and momentum principles, specific energy and specific force; hydraulic jump and its application, type of hydraulic jump, energy dissipation due to jump, jump efficiency, relative loss of energy; runoff measuring structures-parshall flume, H - flume and weirs; straight drop spillway - general description, functional use, advantages and disadvantages, structural parts and functions; components of spillway, hydrologic and hydraulic design, free board and wave free board, aeration of weirs, concept of free and submerged flow, structural design of a drop spillway-loads on headwall, variables affecting equivalent fluid pressure, determination of saturation line for different flow conditions, seepage under the structure, equivalent fluid pressure of triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension; chute spillway general description and its components, hydraulic design, energy dissipaters, design criteria of a SAF stilling basin and its limitations, drop inlet spillway- general description, functional use, design criteria; design of diversions; small earth embankments-their types and design principles, farm ponds and reservoirs, cost estimation of structures.

Irrigation Engineering

Irrigation Engineering: Irrigation, impact of irrigation on Human Environment, some major and medium irrigation schemes of India, purpose of irrigation, sources of irrigation water, present status of development and utilization of different water resources of the country; Measurement of irrigation water, weir, notches, flumes and orifices and other methods; water conveyance, design of irrigation field channels, underground pipe conveyance system, irrigation structures, channel lining; land grading, different design methods and estimation of earth work and cost; soil water plant relationship, soil water movement, infiltration, evapotranspiration, soil moisture constants, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface irrigation methods of water application, border, check basin, furrow and contour irrigation; sprinkler and drip irrigation method, merits, demerits, selection and design; Participatory irrigation management. Economics of water resources utilization.

Groundwater, Wells and Pumps

Occurrence and movement of ground water, aquifer and its types, classification of wells, steady and transient flow into partially, fully and non-penetrating and open wells, familiarization of various types of bore wells common in the state, design of open well, groundwater exploration techniques, methods of drilling of wells, percussion, rotary, reverse rotary, design of assembly and gravel pack, installation of well screen, completion and development of well, groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's etc. Theis recovery method, well interference, multiple well systems, surface and subsurface exploitation and estimation of ground water potential, quality of ground water, artificial groundwater recharge planning, modelling, ground water project formulation. Pumping Systems: Water lifting devices; different types of pumping machinery, classification of pumps, component parts of centrifugal pumps; pump selection,

installation and troubleshooting; design of centrifugal pumps, performance curves, effect of speed on head capacity, power capacity and efficiency curves, effect of change of impeller dimensions on performance characteristics; hydraulic ram, propeller pumps, mixed flow pumps and their performance characteristics; priming, self-priming devices, rotodynamic pumps for special purposes such as deep well turbine pump and submersible pump.

Drainage Engineering

Drainage, objectives of drainage, familiarization with the drainage problems of the state, Surface drainage, drainage coefficient, types of surface drainage, design of open channel, sub-surface drainage purpose and benefits, investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc., types and use of subsurface drainage system, Design of surface drains, interceptor and relief drains. Derivation of ellipse (Hooghoudt's) and Ernst's drain spacing equations. Design of subsurface drainage system. Drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains. Drainage structures. Vertical drainage. Bio-drainage. Tile Drains. Drainage of irrigated and humid areas. Salt balance, reclamation of saline and alkaline soils. Leaching requirements, conjunctive use of fresh and saline waters. Economic aspects of drainage.

Soil and Water Conservation Engineering

Introduction; soil erosion - causes, types and agents of soil erosion; water erosion - forms of water erosion, mechanics of erosion; gullies and their classification, stages of gully development; soil loss estimation - universal soil loss equation and modified soil loss equation, determination of their various parameters; erosion control measures – agronomical measures - contour cropping, strip cropping, mulching; mechanical measures - terraces – level and graded broad base terraces and their design, bench terraces & their design, layout procedure, terrace planning, bunds - contour bunds, graded bunds and their design; gully and ravine reclamation - principles of gully control - vegetative and temporary structures; wind erosion - factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind erosion control measures - vegetative, mechanical measures, wind breaks & shelter belts, sand dunes stabilization; sedimentation - sedimentation in reservoirs and streams, estimation and measurement, sediment delivery ratio, trap efficiency; characteristics of contours and preparation of contour maps; land use capability classification; grassed water ways and their design; introduction to water harvesting techniques; introduction to stream water quality and pollution.

Watershed Hydrology

Introduction; hydrologic cycle; precipitation - forms, rainfall measurement, mass curve, hydrograph, mean rainfall depth, frequency analysis of point rainfall, plotting position, estimation of missing data, test for consistency of rainfall records; interception; infiltration; evaporation; evapo-transpiration - estimation and measurement; geomorphology of watersheds - stream number, stream length, stream area, stream slope and Horton's laws; runoff - factors affecting, measurement; stage and velocity, rating curve, extension of rating curve; estimation of peak runoff rate and volume; rational method, Cook's method, SCS method, Curve number method; hydrograph; components, base flow separation, unit hydrograph theory - unit hydrograph of different durations, dimensionless unit hydrograph, distribution hydrograph, synthetic unit hydrograph, uses and limitations of unit hydrograph; head water flood control - methods, retards and their location; flood routing – graphical methods of reservoir flood routing; hydrology of dry land areas - drought and its classification; introduction to watershed management and planning.

D) GENERAL AGRICULTURAL ENGINEERING

Food Packaging Technology

Factors affecting shelf life of food material during storage; spoilage mechanism during storage; definition, requirement, importance and scope of packaging of foods; types and classification of packaging system; advantage of modern packaging system. Different types of packaging materials used. Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging. Packaging requirement & their selection for the raw & processed foods. Advantages & disadvantages of these packaging materials; effect of these materials on packed commodities, Package testing, Printing, labelling and lamination. Economics of packaging; performance evaluation of different methods of packaging food products; their merits and demerits; scope for improvements; disposal and recycle of packaging waste.

Design and Maintenance of Greenhouse

History and types of greenhouse; importance, function and features of green house; scope and development of greenhouse technology. Location, Planning and various component of greenhouse; design criteria and calculation; constructional material and methods of construction; covering materials and its characteristics, solar heat

transfer, solar fraction for green house, steady state analysis of greenhouse, Greenhouse heating, cooling, shedding and ventilation systems; Carbon Dioxide generation and monitoring and lighting systems, instrumentation & computerized environmental Control Systems. Watering, fertilization, root substrate and its pasteurization, containers and benches, plant nutrition. Alternative cropping systems; plant tissue culture, chemical growth regulation; disease control; integrated pest management; postproduction quality and handling Cost analysis of greenhouse production; Applications of greenhouse & its repair & maintenance.

Waste and By-Product Utilization

Types and formation of byproducts and waste; magnitude of waste generation in different food processing industries; concept scope and maintenance of waste management and effluent treatment, Temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, Waste utilization in various industries, furnaces and boilers run on agricultural wastes and byproducts, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization, waste treatment and disposal, design, construction, operation and management of institutional community and family size biogas plants, concept of vermi-composting, Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation, Secondary treatments: Biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors, lagoons, Tertiary treatments: Advanced waste water treatment process-sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal, Assessment, treatment and disposal of solid waste; and biogas generation.

Development of Processed Products and Equipments

Applications of unit operations to the food industry, analytical processing concepts with regards to mass and energy balances, equipment involved in the commercially important food processing methods and unit operations; value addition to cereals like rice, wheat etc. Parboiling of rice, quality of processed products of rice & wheat. Processing of pulses, spices and condiments; extruded food product, fermented food product, frozen and dried product, technology of meat, fish and poultry products, technology of milk and milk products. Technology of oilseeds and fat products, snack foods, Fruits and vegetables product: candy, nutraceuticals, food product development trends, food additives and labeling. Process equipment for thermal processing-evaporation, dehydration, drying, blanching, pasteurization, distillation; mechanical separation-filtration, sieving, centrifugation, sedimentation; mechanical handling-conveying and elevation; size reduction and classification-mixing; kneading, blending.

Food Processing Plant Design and Layout

Meaning and definition of plant layout. Objectives and principles of layout. Types of layout. Salient features of processing plants for cereals, pulses oilseeds, horticultural and vegetable crops, poultry, fish and meat products, milk and milk products. Location selection criteria, selection of processes, plant capacity, project design, flow diagrams, selection of equipments, process and controls, handling equipments, plant layout, Plant elevation, requirement of plant building and its components, labour requirement, plant installation, power and power transmission, sanitation. Cost analysis, preparation of feasibility report.

Micro Irrigation Systems Design

Past, present and future need of micro-irrigation systems, Role of Govt. for the promotion of micro-irrigation in India, Merits and demerits of micro-irrigation system, Types and components of micro-irrigation system, Micro-irrigation system- design, design synthesis, installation, and maintenance. Sprinkler irrigation - types, planning factors, uniformity and efficiency, laying pipeline, hydraulic lateral, sub-mains and main line design, pump and power unit selection. Drip irrigation – potential, automation, crops suitability. Fertigation – Fertilizer application criteria, suitability of fertilizer compounds, fertilizer mixing, injection duration, rate and frequency, capacity of fertilizer tank. Quality control in micro-irrigation components, design and maintenance of polyhouse; prospects, waste land development – hills, semi-arid, coastal areas, water scarce areas, Benefit and Cost analysis.

Watershed Planning and Management

Watershed management - problems and prospects; watershed based land use planning, watershed characteristics – physical and geomorphologic, factors affecting watershed management, hydrologic data for watershed planning, watershed delineation, delineation of priority watershed, water yield assessment and measurement from a watershed; hydrologic and hydraulic design of earthen embankments and diversion structures; sediment yield estimation and measurement from a watershed and sediment yield models; rainwater conservation

technologies - in-situ and storage, design of water harvesting tanks and ponds; water budgeting in a watershed; effect of cropping system, land management and cultural practices on watershed hydrology; evaluation and monitoring of watershed programmes; people's participation in watershed management programmes; planning and formulation of project proposal; cost benefits analysis of watershed programmes; optimal land use models; case studies.

Minor Irrigation and Command Area Development

Major, medium and minor irrigation projects – their comparative performance; development and utilization of water resources through different minor irrigation schemes. Basic concepts of command area – definition, need, scope, and development approaches: historical perspective, command area development authorities; Interaction/collaboration of irrigation water use efficiency and agricultural production. Planning and execution of on farm development activities within the scope of command area development; Use of remote sensing techniques for command area development; case studies of some selected commands; Farmers participation in command area development.

Environmental Engineering

Importance of safe water supply system. Domestic water requirements for urban and rural areas. Sources of Water supply. Intakes and transportation of water. Drinking water quality. Indian Standards of drinking water. Introduction to water treatment. Importance of sanitation. Domestic waste water: quantity, characteristics, disposal in urban and rural areas. Sewer: types, design discharge and hydraulic design. Introduction to domestic wastewater treatment. Design of septic tank. Solid waste: quantity, characteristics and disposal for urban and rural areas. Introduction to air pollution. Types of pollutants properties and their effects on living beings. ISI standards for pollutants in air and their abetments.

E) GULLEY AND RAVINE CONTROL STRUCTURES

Remote Sensing and GIS Application

Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography; visual image interpretation, image interpretation, basic principles of image interpretation, factors governing the quality of an image; factors governing interpretability, visibility of objects, elements of image interpretation, techniques of image interpretation, digital image processing, digital image; remote sensing in agriculture progress and prospects, microwave radiometry for monitoring agriculture crops and hydrologic forecasting; aerial photo interpretation for water resources development and soil conservation survey. GIS: History of development of GIS definition, basic components, and standard GIS packages; data-entry, storage and maintenance; data types-spatial-non-spatial (attribute data), data structure, data format- point line vector-raster – polygon-object structural model, files, files organization-data base management systems (DBMS), entering data in computer digitizer- scanner-data compression.

Reservoir and Farm Pond Design

Earthen embankments - functions, advantages and disadvantages, classification – hydraulic fill and rolled fill dams - homogeneous, zoned and diaphragm type; foundation requirements, grouting, seepage through dams - estimation of seepage discharge, location of seepage/phreatic line by graphical and analytical methods, flow-net and its properties, seepage pressure, seepage line in composite earth embankments, drainage filters, piping and its causes; design and construction of earthen dam, stability of earthen embankments against failure by tension, overturning, sliding etc; stability of slopes - analysis of failure by slice method; types of reservoirs and farm ponds, design and estimation of earth work; cost analysis.

Tractor Design and Testing

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors. Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection. Design of seat and controls of an agricultural tractor. Tractor Testing.

Hydraulic Drives and Controls

Hydraulic Basics: Pascal's Law, Flow, Energy, Work, and Power. Hydraulic Systems, Color Coding, Reservoirs, Strainers and Filters, Filtering Material and Elements. Accumulators, Pressure Gauges and Volume Meters, Hydraulic Circuit, Fittings and Connectors. Pumps, Pump Classifications, Performance, Displacement, Designs,

Gear Pumps, Vane Pumps, Piston Pumps, Pump Operation. Hydraulic Actuators, Cylinders, Construction and Applications, Maintenance, Hydraulic Motors. Valves, Pressure-Control Valves, Directional- Control Valves, Flow-Control Valves, Valve. Installation, Valve Failures and Remedies, Valve Assembly, Troubleshooting Valves Hydraulic Circuit Diagrams and Troubleshooting, United States of American Standards Institute USASI Graphical Symbols Tractor hydraulics, nudging system, ADDC. Pneumatics: Air services, logic units, Fail safe and safety systems Robotics: Use of Hydraulics and Pneumatics drives in agricultural systems, PLCs (Programmable Logic Controls).

Tractor Design and Testing

Procedure for design and development of agricultural tractor, Study of parameters for balanced design of tractor for stability & weight distribution, hydraulic lift and hitch system design. Design of mechanical power transmission in agricultural tractors. Design of Ackerman Steering and tractor hydraulic systems. Study of special design features of tractor engines and their selection. Design of seat and controls of an agricultural tractor. Tractor Testing.

Renewable Energy Technologies

Design and operational parameters, performance evaluation and maintenance aspects of different renewable technologies like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays, briquetting machines and balers; bio-diesel utilization in CI engines.

Human Engineering and Safety

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications. Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices. Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor & trailer operation etc.

Biomass Management for Fodder and Energy

Introduction to biomass management, biomass resource assessment management techniques/supply chains, Processing of paddy straw, densification- Extrusion process, pellets, mills and cubers, Bailing-classification, uses; residue management for surface mulch and soil incorporation, Paddy Straw choppers and spreaders as an attachment to combine Harvester, Mulch seeder, Paddy Straw Chopper-cum-Loader, Balar for collection of straw; Processing of straw/ fodder for animal use; Agricultural and horticultural use, Cushioning material for fruits and vegetables, Mulching and Composting, Paper and cardboard manufacturing, Straw as a fuel.

Production Technology of Agricultural Machinery

Critical appraisal in production of Agricultural Machinery; Modelling and stress analysis of Machinery parts by using standard software; Advances in material used for tractor & Agril. Machinery. Cutting tools including CNC tools and finishing tools. Advanced manufacturing techniques like powder metallurgy, EDM (Electro-Discharge Machining), Heat Treatment of steels including pack carburizing, shot pining process, chemical vapor deposition (CVD) etc. Limits, Fits & Tolerances, Jigs & Fixtures, Microstructure Analysis. Industrial lay-out planning, Quality management,. Economics of process selection. Techno-economic feasibility of Project Report. Selection of Standard/ critical components. Case studies of manufacturing of agril. machinery. Servo motors, drives & controllers, CNC controllers for machine tools. CNC programming. Assembly and plant automation. Storage and transportation.

Mechanics of Tillage and Traction

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics performance of tillage tools. Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, traction prediction, tyre size, tyre lug geometry and their effects, tyre testing, soil compaction and plant growth, variability and geo statistic, application of GIS in soil dynamics.

Systems Engineering

System concepts. Requirements for a Linear programming problems. Mathematical formulation of Linear Programming problems and its Graphical solution. Response of systems. Computer as a tool in system analysis. Simplex method. Degeneracy and Duality in linear programming. Artificial variable techniques, Big M method and two phase methods. Mathematical models of physical systems. Modelling of Agricultural Systems and operations. Cost analysis. Transportation problems. Assignment problems. Waiting line problems. Project management by PERT/CPM. Resource scheduling.

SYLLABUS FOR THE POST OF JR. ENGINEER (AGRICULTURE)

1. ENGINEERING ECONOMICS AND ACCOUNTANCY

Engineering Economics

Introduction to Economics: Definition of Economics, its utility and scope of study ii) Definition of Engineering Economics. Meaning and concepts of Utility, Consumption, Value, Price, Goods and National Income, inflation. Wants – Definition and characteristics. Wealth & Welfare– Definition, meaning and types. **Demand and Supply:** Meaning and types of Demand, the Law of Demand, its limitations, Preparation of Demand Schedule, Meaning of Supply, the Law of Supply, its limitations, Preparation of Supply Schedule. **Production:** Meaning and factors of production, Factors determining efficiency of labour, Savings, investment and capital formation, Meaning of production function. **Money:** Meaning of money, Types of money, Functions of money. **Banking Organisation:** Central Bank – its functions, Commercial banks – its functions. **Pricing:** Objectives of pricing policy, price determinants, price discrimination.

Accountancy

Introduction to Book-Keeping and Accounting: Definition & objectives of Book-keeping, Need and advantages of Book-keeping, Definition of Accounting, Difference between Book-keeping and Accounting, Double Entry System – main features, Advantages and disadvantages of Double Entry System. **Introduction to Computerised Accounting System:** Components of Computerised Accounting Software, Need for Computerised Accounting, Difference between Manual Accounting and Computerised Accounting. **Transaction:** Definition, Meaning of Account, Classification of Accounts - Traditional Approach, Modern Approach; Meaning of Debit and Credit, Rules of Debit and Credit content. **Journal and Ledger:** Meaning Journal, Recording of Transactions in Journal, Meaning of Ledger, Objectives and utility of Ledger, Posting and balancing of Ledger, Distinction between Journal and Ledger, Names of different Books of Accounts. **Cash Book:** Meaning and importance of Cash Book, Characteristics and advantages of Cash Book, Discount – Trade Discount and Cash Discount, Different types of Cash Book: Single Column Cash Book, Double Column Cash Book, Triple Column Cash Book; Bank Reconciliation Statement – Basic idea. **Trial Balance & Errors in Accounting:** Meaning and objects of Trial Balance, Main features and advantages of Trial Balance, Preparation of Trial Balance, Types of errors in Accounting. **Components of Final Accounts:** Meaning and objectives of Trading Account, Contents of Trading Account, Meaning and objectives of Profit and Loss Account, Contents of Profit and Loss Account, Meaning of depreciation, revenue expenditure and capital expenditure; Contents of Balance Sheet

2. FUNDAMENTAL OF ELECTRICAL & ELECTRONIC ENGINEERING

Introduction: Basics of Electricity: Revision of insulators and conductors and their examples, Definition and units of voltage, current, resistance, inductance, capacitance, different voltage sources, Ohm's law, series & parallel combination of resistance. **DC network:** DC network: Kirchhoff's Law, solving network problem to find current and voltage, Wheatstone bridge and Its problem. **Generator & motor:** Faradays laws of electromagnetic induction, Flemings right hand and left hand rule; D.C. generator and motor: Construction, operating principle, types, uses. **AC fundamental:** Basic terms-cycle, amplitude, time period, frequency, equation of alternating voltage and current, RMS, average value, instantaneous value, peak factor, form factor, simple problem. **AC circuit:** R-L-C series circuit: AC through resistance, capacitance, inductance and their combinations, expression for impedance, reactance, current, power factor, simple problem. **Transformer:** Transformer Construction, operating principle, types and uses. **Semiconductor:** Definition of semiconductor, energy band diagram, intrinsic and extrinsic semiconductor, doping, P- type, N-type semiconductor, PN junction diode, forward and reverse biased diode, diode characteristics, application of PN junction diode like Half-wave, Full-Wave rectifier. **Transistor:** Physical construction of bipolar PNP and NPN transistor, biasing circuit configuration (CE, CB, CC). Application of transistor as an amplifier. Elementary ideas of display - LED, LCD, Seven segment display. **House wiring:** Introduction to house wiring, Methods of house wiring, Safety and precautions measures against electrical hazard. **Microprocessor:** Symbolic representation of logic gates, combinational logic, basic operation of flip-flops, counters and registers. Fundamental concept of microprocessor and its application in instrumentation, 8085 microprocessor and its operation.

3. ELEMENT OF MECHANICAL ENGINEERING

Introduction: Sources of power, prime movers, types of prime movers, Heat and temperature, conversion of heat into mechanical power. **Properties and laws of gases:** Internal energy, enthalpy, specific volume, specific heats, energy equation, isothermal, adiabatic and polytropic processes of gases. **Properties of steam:** Differences between gas and vapour, sensible heat, latent heat, enthalpy of steam, wet, dry saturated and superheated steam, steam table and its uses, some basic problems. **Generation of steam:** Boilers, different classification of boiler, Mainly study of Cochran, Lancashire, and water tube boilers, Boiler mountings and accessories pressure gauge, water level indicator, safety valve, stop valve, feed check valve, blow off cock, fusible plug, manhole, feed pump, injector, feed water heater, air pre heater, steam separator, steam separator, steam trap, all with brief study, Draught natural and artificial draught. **Steam engine:** Working principle of steam engine, and its classification, names of various parts of steam engine and their function, Estimation of power and its efficiency and related problem. **Internal combustion engine:** What is I.C. engine, Classification of IC engine, four stroke cycle, two stroke cycle, principle of working of diesel and petrol engine, names and function of the main parts, carburation, ignition, injection, governing, cooling and lubrication, estimation of power and efficiency and its problem, common defects in IC engines and their remedies. **Steam Turbines:** Classification -impulse and reaction turbine, Cycle and principle of working of a simple steam turbine, Condenser functions and types. **Gas Turbines:** Cycle and principle of working, main components, types of fuel used in gas turbine, application of gas turbine. **Transmission of motion and power:** Belt and pulley, types of belts, pulleys and drives, velocity ratio, length of belt tension in belts, power transmitted by belt, effect of creep, slip, and centrifugal force, gears, types of gears, elements of spur gear, velocity ratio, determination of sizes of gears, gear trains, power transmitted by gear drive, worm and worm wheel, rack and pinion.

4. SURVEYING AND LEVELLING

Introduction to Surveying: Definition, principles and basic concepts of surveying, classification, basic measurements, units of measurements, plans and maps, types of scales. **Chain Surveying:** Principles of chain surveying – definition, selection of survey station and lines, types of ranging and chaining, types of chains, recording the measurements, offset measurements, cross staff, optical square, prism square, obstacles in chaining and ranging chain and tape corrections. **Compass survey:** Methods of traversing, prismatic and surveyors compass, angle and bearings, quadrant systems, local attraction, magnetic declination, dip-traversing, plotting, Bowditch rule, transit rule, errors in compass survey, limits of accuracy. **Plane table:** Instruments and accessories, methods and principles, two point, three point problems, errors in plane tabling, minor instruments – hand level, alidade level, clinometers, sextant, planimeter, pentameter, computation of areas – methods. **Levelling:** Definition, benchmarks types of levels, optical principles, lenses, telescopes, sensitivity of bubble tubes, levelling staves, basic principles of levelling, temporary adjustments, field book entries, reduction of levels, missing entries, types of levelling, simple, differential and profile levelling, cross Sectioning.

5. FARM POWER-I

Introduction to Farm Engines and Tractors: Sources of Farm Power, conventional and Non-conventional sources in terms H.P, Their application in Agril. Farm. Farm mechanization, Role of mechanization and its relationships to productivity, employment, social and technical changes. Construction material- Types, properties,& use. **Thermodynamics:** Laws of thermodynamics Thermodynamic processes, Thermodynamic principle of I.C engine, Brief idea of thermo dynamic cycle, Concepts of reversibility cycle, thermal efficiency and air standard efficiency, carnot cycle efficiency and its implications, Otto, Diesel and dual combustion cycles - Simple problems of their cycles. **Principles of IC Engines:** Introduction and classification of IC engines. Working principle of four stroke and two stroke cycle. ii)Petrol and Diesel engines, their comparison, location and function of various parts of IC engines and material used for them. Concept of IC engine terms, bore, stroke, dead centre, crank throw, compression ratio, clearance volume, piston displacement and piston speed. Working principle of rotary (wankle) engine vii)Explanation and use of term I.H.P,B.H.P and F.H.P, IHP from basic engine data, measurement of BHP Calculation thermal efficiency, Mean effective pressure, engine efficiency. **Tractor and power Tiller Engine systems:** Classification of tractor and power tiller and its importance in Agril. Field. Tractor and power tiller engine components, their function ,piston, connecting rod, crankshaft, camshaft, timing gear, crankcase, cylinder block bearing, different types and their function and use. Valves, different types, valve operation. **Tractor systems:** Introduction to tractor cooling system, its objectives. Lubricants ,Types and their properties, iii)Fuel system,

carburettors, function and types. Injection system. Repair and maintenance of tractor and power tiller selection of tractor and power tiller.

6. FARM POWER – II

Engine system (Link course, Remaining part): Cooling system - Necessity of engine cooling, cooling system, their main features, thermostat, defects in cooling system and their rectification. Lubricating system - functions of lubrication, types and properties of engine lubricants, additives for improving the properties, lubrication system of IC engine, oil pumps, oil filters, pressure relief valve, positive crank case ventilation. Fuel supply System - Components of fuel system, description and working of fuel feed pump, types working of fuel injection pump, injector, fuel filters, complete detail and working of micro fuel injection system for a multi cylinder engine, Ignition system-Battery and Magneto Ignition system. Governing system. Air Intake System- Components of air intake system viz. pre-air cleaner, inlet manifold, exhaust manifold, types of air cleaners: wet, dry. Introduction to tractor and power tiller transmission system, Steering System, Clutches, Gearboxes, Differential and final drive. **Power Transmission:** Engine power, indicated and brake power, efficiency - mechanical, thermal, relative and volumetric efficiencies, methods of finding indicated and brake horse power, Morse test and heat balance sheet performance and endurance tests of IC. **IC Engine Testing:** Engine specification (according to ISI). Exhaust smoke analysis and pollution control. **Maintenance, repair:** Maintenance, repair and overhaul of engines. Common engine troubles and their remedies. **Cost estimation:** Safety Rules, Cost estimation of tractor operation

7. STRENGTH OF MATERIALS

Simple Stresses and strains: Define the strength, Mechanical properties of engineering materials, commonly used. Identify the nature and effect of tensile, compressive and shear forces. Define the terms stress, strain, modulus of elasticity, Poisson's ratio. Draw typical stress Vs strain curve for a mild steel specimen under tension indicating salient points on it. Mention the significance of factor of safety. Compute stress and strain values in bodies of uniform section and of composite section under the influence of normal stresses. Calculate thermal stresses, in bodies of uniform section and composite sections. Find the relations between E, G, and K & Poisson's ratio. Compute the changes in axial, lateral and volumetric dimensions of uniform sections under the action of normal forces. Define resilience and Derive an expression for strain energy. Riveted joint. Failure, Strength, efficiency and design of Rivet. **Shear force and bending moments:** List the type of beams and type loads. Definition of shear force and bending moments. SF and BM diagrams for various loads for simply supported, cantilever and over hanging beam and related problems. Point of contraflexure. **Theory of simple bending and Deflection of beam:** State the theory and terms of simple bending. List the assumptions in theory of simple Bending. Derive the bending equation $M/I = f/y = E/R$, Calculate Bending stress, modulus of section and Moment of resistance. Calculate the safe load and safe span and dimensions of cross section. Define and explain the term deflection. Derive the deflection formula for cantilever and simply supported beams. Calculate the values of deflection in the given beams. Solve problems. **Stresses in beams:** Neutral surface and neutral axis, Bending Equation, Problems of stress on different beams. **Torsion in circular shafts and springs:** Function of shaft. Explain Polar moment of inertia of solid and hollow shaft. Derive the torque equation $T/J = fs/R = C$. Design of solid and hollow shafts and power transmitted by solid and hollow shaft. Definition of spring and types of spring. Derivation of deflection equation for helical spring. Definition of stiffness of a spring. Design of helical spring. **Columns and Struts:** Definition of columns and struts. Failure of a column and a strut. Euler's and Rankine formula for finding critical load. Problems on various (4) end conditions of column. **Rivets and riveted joints:** Riveted joint. Failure, Strength, Efficiency, design of Rivet

8. THEORY OF MACHINES

Introduction: Definition of Theory Of Machine(TOM), Sub – divisions of TOM. **Basic kinematics of Machines:** Kinematic link or element, Types of links, Kinematic pair –types, Types of constrained Motions. Kinematic chain. Machine, Structure and Mechanism, Difference between Machine and Structure, Difference between Machine and Mechanism. Inversions. Types of Kinematic Chains. Four Bar Chain - Beam Engine, Coupling Rod of Locomotive, Watt's Indicator Mechanism. Single Slider Crank Chain - Pendulum Pump, Oscillating cylinder engine, Rotary I.C Engine, Crank and Slotted Lever Quick Return Motion Mechanism, Whitworth Quick Return Motion Mechanism. Double Slider Crank Chain - Elliptical trammel, Scotch yoke mechanism, Oldham's coupling. **Friction:** Friction in Journal Bearing, Friction of Pivot and Collar Bearing, types of Pivot and Collar Bearing (No derivation requires, formulae only). Simple Problems on the above topic. Dynamometer- Difference between brake & clutch, difference between brake and Dynamometer. Types of Dynamometer, classification of absorption type dynamometers. **Transmission of Power:** Types of Belt Drives, Length of belt –open and cross belt drives, Velocity

Ratio, Ratio of driving Tensions, Centrifugal Tension and Initial Tension, Power Transmitted by belts (flat and V) and ropes, Maximum power transmitted by belt (without proof), Problems on belt drives, Introduction to Gears, Classification of Gears, Spur Gear Terminology, Problems on gears, Introduction to Gear Trains, Types of Gear trains –Simple, Compound, Reverted and Epicycle gear trains, Problems on Gear Trains. **Cams:** Introduction, Classification of cams, Classification of followers, Terminology of Radial disc cam. **Mechanical Vibrations:** Introduction, Terms used in Vibrations, Types of Vibrations - Free Vibrations, Forced Vibrations, Damped Vibrations; Types of Free Vibrations - Longitudinal, Transverse and Torsional; Critical or Whirling speed of a shaft. **Governors:** Introduction, Types of Governors, Centrifugal Governor, Terms used in governors, Watt Governor, Porter Governor

9. HYDRAULICS

Introduction: Hydraulics – Definition - Properties of fluids - Mass, force, weight, volume, specific gravity, specific weight, density, relative density, compressibility, viscosity, cohesion, adhesion, capillarity and surface tension, SI Units for area, volume, velocity, acceleration, density, discharge, force, pressure and power. **Measurement of Pressure:** Pressure of liquid – Intensity of pressure - Pressure head of liquid, Conversion from intensity of pressure to pressure head and vice-versa, Formula and Simple problems. Types of pressures – Atmospheric pressure, Gauge pressure, Vacuum pressure and Absolute pressure. Measurement of pressure - Simple mercury. Barometer, Pressure measuring devices, Piezometer tube, Simple U-tube manometer, Differential manometer – Micrometer. Simple numerical problems. Pressure on plane surfaces - Horizontal, vertical and inclined surfaces-Total pressure-Centre of pressure - Depth of centre of pressure – Resultant pressure. Numerical Problems. **Flow of fluids:** Types of flow – Laminar and turbulent flow - Steady and unsteady flow –Uniform and Non-uniform flow - Equation for continuity of flow (law of conservation of mass) – Energy possessed by a fluid body – Potential energy and Potential Head – Pressure energy and Pressure Head - Kinetic Energy and Kinetic Head - Total Energy and Total Head – Bernoulli's theorem – (Proof not necessary). Practical applications of Bernoulli's theorem – Venturi meter – Orifice meter (Derivation not necessary) - Simple numerical problems. **FLOW THROUGH ORIFICES AND MOUTHPIECES:** Definitions- Types of orifices - Vena contracta and its significance –Hydraulic coefficients Cd, Cv and Cc and their relationship. Simple problems. Large orifice – Definition and Discharge formula – Simple problems – Practical applications of orifices – Types of mouthpieces - External and internal mouthpieces - Discharge formula - Simple problems. **FLOW THROUGH PIPES:** Losses of head in pipes – Major losses - Minor losses - Sudden enlargement, sudden contraction, obstruction in pipes (no proof is necessary) -Simple problems – Energy / Head losses of flowing fluid due to friction Darcy's equation - Chezy's equation (No derivation) – Numerical Problems - Transmission of power through pipes – Efficiency - Pipes in parallel connected to reservoir - Discharge formula - Simple problems. **FLOW THROUGH NOTCHES:** Definitions- Types of notches – Rectangular, Triangular and Trapezoidal notches – Derivation of equations for discharges - Simple problems - Comparison of V-Notch and Rectangular Notch. **FLOW THROUGH WEIRS:** Definitions - Classification of weirs - Discharge over a rectangular weir and trapezoidal weir – Derivation – Simple problems – End contractions of a weir – Francis's and Bazin's formula – Simple problems - Cippoletti weir –Problems - Narrow crested weir – Sharp crested weir with free over fall -Broad crested weir - Drowned or Submerged weirs - Suppressed weir -Stepped weir – Problems - Definition of terms - Crest of sill, Nappe or Vein. **Flow through Open channel:** Definition - Classification - Rectangular and Trapezoidal channels –Discharge – Chezy's formula, Bazin's formula and Manning's formula. Hydraulic mean depth – Problems Conditions of rectangular/trapezoidal sections - Specific energy, critical depth –Conditions of maximum discharge and maximum velocity - Numerical Problems. Methods of measurements of velocities – Channel losses - Lining of canals – Advantages of lining of canals - Types of lining- Cement concrete lining with sketches. **Pumps:** Pumps – Definition and types. Centrifugal pump – component parts and their functions, principle of working, priming. Reciprocating pump – component parts and working. Submersible and Jet pump. Selection and choice of pump. Computation of power required for pumps. Turbines – Definition and types.

10. SOIL SCIENCE & SOIL MECHANICS

Introduction to Soil Science and soil classification: Definition and components of soil, genesis. Physical properties of soil -Soil texture, soil structure, density of soil, porosity of soil, soil colour, soil temperature and their role in soil fertility. Classification of Indian soil related to agriculture. Soils types in Assam. Role of soil organic matter in crop. Soil PH – Acid and alkali soil, Their effect on availability of nutrients and plant growth. Salt affected soils:- Nature and classification, characteristics, detrimental effects of soil salinity and alkalinity and their reclamation. **Soil fertility:** Nutrient elements essential for plant growth, Role of nutrient element, micro and macro organism, types and their rate. Different approaches for soil fertility evaluation. Methods, Soil testing - Chemical methods, critical

levels of different nutrients in soil. Biological method of soil fertility evaluation. **Fertilizer and Manure:** Concept of soil productivity and fertility ii) Fertilizer -their types, importance, iii) manures-their types, different group Soil test based fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers, method and scheduling of nutrients for different soils and crops grown. **Soil mechanics:** Soil as three phase system-void ratio, porosity, degree of saturation, water content, unit weight, specific gravity. ii) Functional relationship and related problem. Classification of solid and soil structure: Particle size classification, textural classification. HRB classification, ISI classification. Index Properties determination: Determination of specific gravity, density index, void ratio. Determination of water content. Definition of liquid limit. plastic limit, shrinkage, consistency. Permeability: Darcy's Law, Discharge and seepage velocity, Validity of darcys Law. Factor affecting permeability, field and laboratory, Determination of co-efficient of permeability. Seepage flow net: Definition, piezometric head, velocity head, critical hydrologic gradient, seepage pressure. Concept of flow net and its application. Compaction of soil: Introduction-Rule of moisture in compaction, Determination of optimum moisture content by proctor compaction field test, field compaction method and control. Factors affecting compaction. Consolidation: Definition, comparison with compaction, consolidation process. Strength of soil: Importance of shear strength of soil, Mohr-culomb strength theory.

11. POST HARVEST TECHNOLOGY

Introduction to Agro Industries and Processing: Aims and objectives, Agro Industries in India. Scope & prospect of agro industries with particular reference to Assam & N.E. region. Role of agro industries in mechanizing agriculture. **Post-harvest operations:** Harvest operations. Grain structure, physical and chemical properties of grain. **Grain drying theory:** Grain drying theory and practices. Parameters of drying, Measurement of moisture content, temp., RH, Air flow rate etc. and grain quality as affected by drying. Natural and artificial method of drying. **Grain drying:** Drier, Its importance and function. Types of drier, Brief, idea of each type. Grain drying theory, Equivalent moisture content, thin layer and deep bed drying. **Equipment and Machinery for processing unit:** Processing of major crop in Assam Viz. cereals, pulses, oil seed, Jute, tea, coffee, fruits and vegetables etc. Processing of stock feed. Processing of dairy milk and milk product. Processing of meat and fish. Storage and preservation Control of microbial hazards, causes and remedies of food deterioration during Storage. Fruits and Vegetable preservation, Its importance, Principles and methods of fruits Preservation, Method of packaging and quality evaluation. Study of refrigeration and cold storage process, Basic Principle and application in domestic and industrial purpose. **Material Handling equipment:** Handling and conveying equipment & their importance, rope, chain and belt Drive conveyors. **Seed processing:** Seed processing technology. Utilization of Agricultural by product (Fiber, Paddy, husk etc.)

12. FARM MACHINERY AND IMPLEMENTS

Introduction to Farm Machinery & Farm Power: Importance of Farm Mechanization. Classification of farm machineries & implements – indigenous & Modern Machineries, Animal drawn, Manual & Mechanized farm machineries & implements. **Power transmission:** Power Transmission devices –belt, Pulley & gear drive. **Materials of construction of farm implements** - properties, selection & Uses of implements. **Primary Tillage:** Introduction to Tillage: Primary, Secondary & Zero tillage, definition, objective and requirements. Primary tillage implements- Hand tools. Animal drawn indigenous plough, Modern implements. Construction details of Primary tillage implement, uses & power requirements. **Secondary tillage:** Secondary Tillage & Secondary Tillage Implements. Animal drawn & Power operated M B plough, Animal drawn & Power operated Disc plough, Power operated Disc harrow-Construction, Types, Power requirement & uses. Power operated cultivator--Construction, Types, Power requirement & uses. Animal drawn & Power operated Disc plough Construction, Types, Power requirement & uses; Power operated Disc Harrow- Construction, Types, Power requirement & uses; Power operated Cultivator-Construction, Types, Power requirement & uses; Power operated Ridger plough - Construction, Types, Power requirement & uses; Power operated rotary plough - Construction, Types, Power requirement & uses; Sub soiler and Chisel plough - Construction, Types, Power requirement & uses. Method of ploughing. **Hitching & attachments of power operated implements with tractor:** Introduction to Seeding planter and fertilizer applicator, Method of Seeding and Planting, Broad casting method & implements, Dibbling & Dibblers. Seed Drill & Planters, Seed cum fertilizer drill, Calibration of seed cum fertilizer drill. Introduction to Intercultural Operations, Weed and identification of weeds, Animal & Power operated implements for intercultural operation. Flame cultivation. Introduction to plant Physiology of common crops of Assam. Common diseases of crops of Assam. Plant protective chemicals – herbal & commercial chemicals. Implements & uses of plant protective chemicals.

13. CROP PRODUCTION TECHNOLOGY

Plant science: Definition, scope and importance of crop production technology. Different branches of plant science and their application to agriculture. Classification & grouping of plant kingdom. Morphology and anatomy of plant parts, Cell structure & inclusions, Physiological process in plants. **Crop production:** Nursery technique – Types of nursery beds, shading, use of chemicals, vegetations propagation. Study of major crops of NE India. Modern cropping pattern. Crop Ecology. **Diagnosis of crop health problems:** Crop health problem, different types of pest, disease and weed. Diagnosis of health problem in important crops and control methods. Types of agrochemicals – pesticides, fungicides, herbicides etc. Manures and fertilizers - principles of manuring doses and methods of application. **Biotechnology:** Importance of bio technology in agriculture. Industrial microbiology and biotechnology. Plant breeding and tissue culture. **Seed technology:** Morphology of Seeds- development & different types of seeds. Quality analysis of improved seeds – methods of seed production and certified seeds. Seed germination and problem of dormant seeds. Seed viability and storage of seeds.

14. FARM BUILDING STRUCTURE

Introduction to Farm planning: Importance of planning, Improved Farming Practice, Equipment and their Importance. Farm layout selection and acquisition of site measurement of farm, Farm layout -Bum house, Goat Piggery, poultry, sheep & Swine house. Planning of various machineries, supplies, enterprises related to farm structure, their economic aspect and utility. **Farm Building Material:** Different types of material use in construction, Description of engineering material. Bricks- Classification, uses, properties of good brick and testing of brick as per IS3495. Sand-characteristics of good quality sand for mortar and concrete work. **Storage house structure:** Raw material storage, storage house of agricultural food and feed product. Types, construction details farm grains bins and godowns, silos, Bunker. **Livestock Farm:** Livestock Farm- Types, construction details, capacity & functional requirements. Fencing-types, Estimate of fencing. **Rural Sanitation:** Septic Tank, soak pit, PRAI Channels, Bore hole, latrines, trench latrine, PRAI Latrine. **Rural Road & Drainage:** Brief idea of machine foundation. Installation of machine on platform. Pump house, Bio Gas Plant – Plant and its specification. Threshing floor, Implement sheds. Construction details of Kacha Road, W.B.M. Road and Pukka Road, Specification as per B.I.S.

15. RENEWABLE ENERGY RESOURCES

Introduction to renewable energy: Conventional and nonconventional source of energy, Need, importance and scope of non-conventional energy. **Bio-gas and Bio-mass:** Bio-gas, benefit of bio-gas, Technology of bio-gas, Principles, feedstock, types and design of bio-gas plant. Digester, gas holder, pressure gauge, gas controlling cocks and meter. Selection of bio-gas model and their sizes. site selection for bio-gas plant. Application of bio-gas plant, operation, troubleshooting and maintenance of bio gas plant, safety measures in bio-gas plant. Bio mass and farm residues. **Wind Energy:** Introduction, scope and significance. Classification of wind mill, construction details of windmill. Vertical and horizontal axis wind mill and their working. Data required for installation of wind mill. Maintenance and performance of wind mill. **Solar Energy technology:** Introduction, significance of solar energy. Solar Radiation at the Earth's Surface, Instruments for measuring solar radiation and sun shine. Solar spectral and greenhouse effect. Collectors and their types, Flat and concentrating collector. Principle of thermal collection and storage Construction, installation of solar panel. **Solar thermal Energy:** Operation, construction details and maintenance of solar cooker, solar water heater, solar pump, solar drier, solar pump etc. Solar Photo Voltaic Applications of Solar Photo-Voltaic System in Rural Areas- solar lighting, solar lantern, street lighting etc. **Tidal power:** Introduction of tidal power plant. Factor effecting suitability of site for tidal power plant Classification and working of different tidal power plant. **Fuel cells:** Introduction to fuel cell, Principle and working of fuel cell, Types of fuel cell. **Modern Chullah:** Design and construction of modern smokeless *chullah*, comparative study on different types of *chullah*.

16. ADVANCE FARM MACHINERY

Plant protection equipments: Sprayer, different types. Function, uses. Duster - different types, function, uses. Safety Rules. **Power Transmission Devices:** Transmission of power in farm machinery. Flat and V -belt drives, length of belt, ratio of tensions. Horse power transmitted, effect of centrifugal tension, condition for maximum power transmission, belt dynamometer. **Harvesting and Threshing:** Harvesting and Threshing Machinery Familiarization with the harvesting machines for various crops e. g. hay harvesters, forage harvesters, vertical conveyer reapers, cotton pickers, com harvester, potato diggers, ground nut diggers. Constructional details & principles of working. Study of power thresher including axial flow thresher - main components, function and

constructional details. Safety requirements in threshing operations. Introduction to combine harvesters and straw combines and study of their operation. Losses during harvesting and threshing operations and their management. **Land Development Equipments:** Land Development Machinery Familiarization with various land development implements e.g. leveler, planer, scraper, ridger. Study of their functions and adaptability. Dozer, its adjustment of blade operation and output. Concept of land levelling, cutting and filling. Scraper, construction and output. Excavating equipments, construction and working. Power Shovel, drag outs and draft line and its working. **Economic and Management of Farm Equipments:** Matching equipments to farm needs. Calculation of cost of operation of machines. Field Capacity and Field efficiency. Repairing and maintenance of farm machinery. Customer use of farm equipments, advantages and disadvantages.

17. WATER RESOURCE ENGINEERING

Introduction to water Resource engineering: Hydrology - Definition, Hydrologic cycle, Precipitation forms and types of PPT. Evaporation, Transpiration & Consumptive use of water. Estimation of evaporation. Measurement of rainfall and analysis of rainfall chart, Graphical measurement of rainfall. Estimate of missing date & adjustment of record. Mean aerial depth of PPT. **Run off:** Factor effecting run off & its measurement. Rainfall & runoff relationship. Hydrograph, unit hydrograph. **Stream flow:** Stream flow measurement, Estimation of peak flow. **Irrigation Technology Conveyance of irrigation water:** Irrigation - Definition, Necessary, Advantages, Disadvantages, function of irrigation water sources of water. Types of irrigation, brief description of each types. Methods of irrigation & Irrigation efficiencies. **Canal irrigation:** Canals and their classification (brief description only), ii) seepage from canals and field channels. Canal lining-various types. Their merit & demerit. Introduction to various water conveyance structure and their functions e.g. flumes, tunnels. **Drainage:** Drainage – types, planning & design of field drainage. Sub-surface drainage system, Miscellanies works. **Water logging:** Water logging definition effect & cause, anti water logging measure. **Water requirement of Crop:** Definition of duty, delta & base period, their relationship Factor effecting duty, Improvement of duty, definition of G.C.A, CCA, crop ratio, etc. Crop quality of irrigation water, plant response .rotation, its merit & demerit, Irrigation requirement of major crops. **Soil & water conservation:** Types, causes of erosion, damage causes by erosion. Gully erosion – Bio-logical & engineering method of control. **Reclamation of saline alkaine soil:** Salt affected soils and their reclamation. Saline, alkaline and acid soils, Reasons and factors of their formation. Effect of salinity, alkalinity and acidity on plant growth. Reclamation of these soils and their management. **Agricultural Dam:** Earthen Dams - Hydraulic consideration, failure & structural stability of earthen dams culverts in earthen dams.

18. HYDRAULIC MACHINE

Examination of ground water: Occurrence of ground water, Prospect and testing of ground water. **Water lifting devices for Agril. Use:** Classification of water lifting devices. Construction, working principle. Installation, limitation, scope for development. **Tube well Engineering:** Selection of site for tube well. Rigs, types of rotary and percussion for drilling. Tube well construction, Installation and working. Drilling of tube wells and construction of open wells. Preparation of well logs, types of strainer and its advantages. Cavity tube well and bamboo tube well. **Pumps Maintenance:** Reciprocating pump, Principle and operation. Centrifugal pumps, principle and operation. Types of impeller, Installation of centrifugal pump. Pumps characteristics, performance curve, Effect of speed and impeller diameter on pump performance, trouble shooting and remedies. Turbine pump, deep well submersible jet pump. Operation, Maintenance, trouble shooting and remedies. **Pump testing:** Testing and selection of pump

19. REFRIGERATION AND COLD STORAGE

Introduction to Refrigeration & Cold storage: Introduction to Refrigeration & Cold storage- details of syllabus, Reference books etc. Definition of Heat, Heat transfer process, Units & Dimension- calorie, specific heat. **Definitions of some common terms:** Isotropic & adiabatic processes ,heat transfer related to ref. and cold storage. **Heat transfer theory:** Definitions & terminology of refrigeration, refrigerants & desired properties. **Refrigeration terminology and the refrigeration cycle:** Refrigerating system- air cycle, vapour compression, vapour absorption, Thermo electric cooling, Joule Thomson effect. **Refrigeration system cycles:** Vapour compression system-operational cycle, compressor, expansion valve, fans, evaporator pipe fitting, and accessories. **Vapor compression system:** Types of compressor, evaporator, condenser, Thermostat, application, types of thermostat. **Vapour absorption system:** PV diagram – theoretical & actual, super heating & sub cooling. **Analysis of psychrometric chart:** Vapour absorption system-operational cycle & components. **Refrigerant:** Introduction to Psychrometric chart and analysis. **Cooling load:** Cooling load estimation, determination of U factor and COP. **Application of refrigeration:** Analysis of cold storage condition for fruits & vegetables Analysis of cold storage condition for

Cereals & pulses Analysis of cold storage condition for Meat & Fish Analysis of cold storage condition for Dairy products Analysis of cold storage condition for refrigerated products for transit.
