SYLLABUS FOR RECRUITMENT OF ASSISTANT CONSERVATORS OF FORESTS THROUGH COMPETITIVE EXAMINATION BY J&K PUBLIC SERVICE COMMISSION.

Annexure-I SYLLABUS FOR WRITTEN EXAMINATION A Compulsory Subject Syllabus 1 General Knowledge – one paper only of 100 marks Broadly covering the same areas as prescribed for KAS mains examination with stress on environmental issues. 2 English – one paper of 100 marks The pattern of questions for this exam will be: i. Essay on a specific topic with choice of subjects. ii. Precise writing. iii. Usage and vocabulary. iv. Comprehension of given passage. B Optional Subject Any two subjects to be selected from the list of the optional subjects below. Each subject will have two papers of 100 marks each. Subject Syllabus 1 Agriculture Same as KAS 2 Animal Husbandry & Veterinary Science Same as KAS 3 Botany Same as KAS 4 Chemistry Same as KAS 5 Forestry Appended as Annexure-2 6 Geology Same as KAS 7 Mathematics Same as KAS 8 Physics Same as KAS 9 Statistics Same as KAS 10 Zoology Same as KAS 11 Engineering - Agricultural Appended as Annexure-2 - Chemical Appended as Annexure-2 - Electrical Same as KAS - Civil Same as KAS - Mechanical Same as KAS Provided that the candidates will not be allowed to offer the following combination of subjects: (a) Agriculture and Agricultural Engineering (b) Agriculture and Animal Husbandry & Veterinary Science. (c) Chemistry and Chemical Engineering. (d) Mathematics and Statistics. (e) Of the Engineering subjects viz. Agricultural Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering and Mechanical Engineering – not more than one subject. The total number of questions in the question papers of optional subjects will be eight. All questions will carry equal marks. Each paper will be divided into two parts. Viz. Part-A and Part-B, each part containing four questions. Out of eight questions, five questions are to be attempted. One question in each part will be compulsory. Candidates will be required to answer three more questions out of the remaining six questions, taking at least one question from each Part. In this way, at least two questions will be attempted from each part i.e. one compulsory question plus one more.   COMPULSORY SUBJECTS GENERAL STUDIES General Studies: - Shall be the following with stress on Environmental issues. 1. Modern History of India and Indian Culture. 2. Current events of national and international importance. 3. Statistical analysis, graphs and diagrams. 4. Indian Polity; 5. Indian Economy and Geography of India; 6. The role and impact of Science and technology in the development of India. Modern History of India and Indian Culture will cover the broad history of the country from about the middle of the nineteenth century and would also include questions on Gandhi, Tagore and Nehru. The part relating to statistical analysis, graphs and diagrams will include exercises to test the candidate's ability to draw common sense conclusions from information presented in statistical, graphical or diagrammatical form and to point out deficiencies, limitations or inconsistencies therein. The part relating to Indian Polity, will include questions on the political system in India. In the part pertaining to the Indian Economy and Geography of India, questions will be put on planning in India and the physical, economic and social geography of India. In the third part relating to the role and impact of science and technology in the development of India, questions will be asked to test the candidate's awareness of the role and impact of science and technology in India; emphasis will be on applied aspects. ENGLISH The pattern of questions for this exam will be: (i) Essay on specific topic with choice of subjects. (ii) Precise wiring. (iii) Usage and vocabulary. (iv) Comprehension of given passage.   OPTIONAL SUBJECTS AGRICULTURE Paper-I Ecology and its relevance to man, natural resources, their management and conservation. Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth, impact of changing environments on cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans. Cropping patterns in different agro climatic zones of the country-impact of high yielding and short duration varieties on shifts in cropping patterns. Concepts of multiple cropping, multi-storey, relay and inter-cropping and their importance in relation to food production, package of practices for production of important cereals, pulses, oilseed fibre, sugar and commercial crops grown during Kharif and Rabi seasons in different regions of the country. Important features, scope and propagation of various types of forestry plantations, such as, extension/social forestry, agro forestry and natural forests. Weeds, their characteristics, dissemination and association with various crops; their multiplication, cultural,

biological and chemical control of weeds. Processes and factors of soil formation, classification of Indian soils including modern concepts, Mineral and organic constituents of soils and their role in maintaining soil productivity. Problem soils, extent and distribution in India and their reclamation. Essential plant nutrients and other beneficial elements in soils and plants; their occurrence, factors affecting their distribution, functions and cycling in soils. Symbiotic and non-symbiotic nitrogen fixation, Principles of soil fertility and its evaluation for judicious fertilizer use. Soil conservation planning on water shed basis, Erosion and run off management in hilly, foot hills and valley lands; processes and factors affecting them. Dryland agriculture and its problems. Technology for stabilizing agriculture production in rainfed agriculture area. Water use efficiency in relation to crop production criteria for scheduling irrigations, ways and means of reducing run off losses of irrigation water, Drainage of water logged soils. Farm management, scope, importance and characteristics, farm planning and budgeting, Economics of different types of farming systems. Marketing and pricing of agricultural inputs and outputs, price fluctuations and their cost; role of co-operatives in agricultural economy, types and systems of farming and factors affecting them. Agricultural extension, its importance and role, methods of evaluation of extension programmes, socio-economic survey and status of big, small and marginal farmers and landless agricultural labourers, the farm mechanization and its role in agricultural production and rural employment. Training programmes for extension workers, lab to land programmes. Paper-II Heredity and variation, Mendels law of inheritance, Chromosomal theory of inheritance, Cytoplasmic inheritance, Sex linked, sex influenced and sex limited characters. Spontaneous and induced mutations. Quantitative characters. Origin and domestication of field crop. Morphology patterns of variations in varieties and related species of important field crops. Causes and utilization of variations in crop improvement. Application of the principles of plant breeding to the improvement of major field crops; methods of breeding of self and cross pollinated crops. Introduction, selection, hybridization. Heterosis and its exploitation, Male sterility and self incompatibility utilization of Mutation and polyploidy in breeding. Seed technology and importance; production, processing and testing of seeds of crop plants; Role of national and state seed organizations in production, processing and marketing of improved seeds. Physiology and its significance in agriculture nature, physical properties and chemical constitution of protoplasm; imbibition, surface tension, diffusion and Osmosis. Absorption and translocation of water, transpiration of water economy. Enzymes and plant pigments: photosynthesis-modern concepts and factors affecting the process, aerobic and anaerobic respiration. Growth and development; photo periodings and vernalization. Auxin, hormones and other plant regulators and their mechanism of action and importance in agriculture. Climatic requirements and cultivation of major fruits, plants and vegetable crops, the package of practices and the scientific basis for the same. Handling and marketing problems of fruits & vegetables, Principal methods of preservation, important fruits and vegetable products, processing techniques and equipment. Role of fruit and vegetable in human nutrition; landscape and floriculture including raising of ornamental plants and design and layout of lawns and gardens. Diseases and pests of field vegetable, orchard and plantation crops of India and measures to control these. Causes and classification of plant diseases; Principles of plant disease control including exclusion, eradication, immunization and protection, Biological control of pests and disease; integrated management of pests and diseases. Pesticides and their formulations, plant protection equipment, their care and maintenance. Storage pests of cereals and pulses, hygiene of storage godowns, preservation and remedial measures. Food production and consumption trends in India. National and International food policies. Procurement, distribution, processing and production constraints, Relation of food production to national dietary pattern, major deficiencies of calorie and protein.   ANIMAL HUSBANDRY AND VETERINARY SCIENCE Paper-I 1. Animal Nutrition: Energy sources, energy, metabolism and requirements for maintenance and production of milk, meat, eggs and wool. Evaluation of feeds as sources of energy. 1.1. Advanced studies in Nutrition-protein-sources of protein, metabolism and synthesis, protein quantity and quality in relation to requirements. Energy protein ratios in ration. 1.2. Advanced studies in Nutrition Minerals: Sources, Functions, requirements and their relationship of the basic minerals nutrients including trace elements. 1.3 Vitamins, Hormones and Growth stimulating, substances-Sources-functions, requirements and inter-relationship with minerals. 1.4. Advanced Ruminant Nutrition: Dairy Cattle Nutrients and their metabolism with reference to milk production and its composition Nutrient requirements for calves, heifers dry and milking cows

and buffaloes. Limitations of various feeding systems. 1.5. Advanced Non-Ruminant Nutrition Poultry-Nutrients and their metabolism with reference to poultry, meat and egg production. Nutrients requirements and feed formulation and broilers at different ages. 1.6. Advanced Non-Ruminant Nutrition Swine- Nutrients and their metabolism with special reference to growth and quality of meat production, Nutrient requirement and feed formulation for baby growing and finishing pigs. 1.7. Advanced Applied Animal Nutrition- A critical review and evaluation of feeding experiments, digestibility and balance studies. Feeding standards and measures of feed energy. Nutrition requirements for growth, maintenance and production Balanced rations. 2. Animal Physiology: 2.1. Growth and Animal Production: Prenatal and postnatal growth, maturation, growth curves, measures of growth factors affecting growth, conformation, body composition meat quality. 2.2. Milk production and reproduction and digestion-Current status of hormonal control of mammary, development milk secretion and milk ejection, composition of milk of cows and buffaloes. Male and female reproduction organs their components and function. Digestive organs and their functions. 2.3. Environmental Physiology - Physiological relations and their regulation; mechanisms of adaption, environmental factors and regulatory mechanism involved in animal behaviour, methods of controlling climatic stress. 2.4. Semen quality: Preservation and Artificial insemination Components of semen, composition of spermatozoa chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro. Factors affecting semen preservation, composition of diluents, sperm concentration transport of diluted semen. Deep Freezing techniques in cows, sheep and goats, swine and poultry.   3. Livestock Production and management. 3.1. Commercial Dairy Farming—comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as a specialised farming, economic dairy farming, starting of a dairy farm. Capital and land requirement, organisation of the dairy farm. Procurement of goods; opportunities in dairy farming, factors determining the efficiency of dairy animal, Herd recording, budgeting, cost of milk production, pricing policy; Personnel Management. 3.2. Feeding practices of dairy-cattle-Developing Practical and Economic ration for dairy cattle, supply of greens throughout the year, field and fodder requirements of Dairy Farm, Feeding regimes for day and young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records. 3.3. General problems of sheep, goat, pigs and poultry management. 3.4. Feeding of animals under drought conditions. 4. Milk Technology: 4.1. Organization of rural milk procurement, collection and transport of raw milk. 4.2. Quality, testing and grading raw milk, Quality storage grades of whole milk. Skimmed milk and cream. 4.3. Processing, packaging, storing distributing marketing defects and their control and nutritive properties of the following milks. Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined, field and flavoured milks. 4.4. Preparation of cultured milks, cultures and their management. Vitamin D soft curd acidified and other special milks. 4.5. Legal standards, Sanitation requirement for clean and safe milk and for the milk plant equipment. Paper-II 1. Genetics and Animal breeding: Probability applied to Mendelian inheritance Hardy Weinberg Law. Concept and measurement of inbreeding and heterozygosity Wright's approach in contrast to Malecot's Estimation of Parameters and measurements. Fishers theorem of natural selection, polymorphism. Polygenic systems and inheritance of quantitative traits. Casual components of variation Biometrical models and covariance between relatives. The theory of Patho coefficient applied to quantitative genetic analysis. Heritability Repeatability and selection models. 1.1. Population, Genetics applied to Animal Breeding-Population Vs. individual, population size and factors changing it. Gene numbers, and their estimation in farm animals, gene frequency and zygotic frequency and forces changing them, mean and variance approach to equilibrium under different situations, sub-division of phenotypic variance; estimation of additive non-additive genetic and environmental variances in Animal population. Mendelism and blending inheritance. Genetic nature of differences between species, races, breeds and other sub-specific grouping and the grouping and the origin of group differences. Resemblances between relatives. 1.2. Breeding systems - Heritability repeatability, genetics and environmental correlations, methods of estimation and the precision of estimates of animal data. Review of biometrical relations between relatives, mating systems, inbreeding outbreeding and uses phenotypic assortive mailing aids to selections. Family structure of animal population under non random mating systems. Breeding for threshold trans, selection index, its precision. General and specific combining ability, choice of effective breeding plans. Different types and methods of selection, their

effectiveness and limitations, selection indices construction of selection in retrospect; evaluation of genetic gains through selection, correlated response in animal experimentations. Approach to estimation of general and specific combining ability, Diallele, fractional dialele crosses, reciprocal recurrent selection: inbreeding and hybridization. 2. Health and Hygiene-Anatomy of Ox and Fowl. Histological technique freezing, paraffin embeding etc. Preparation and staining of blood films. 2.1. Common histological stains, Embryology of a cow. 2.2. Physiology of blood and its circulation, respiration, excretion, Endocrine glands in health and disease. 2.3. General knowledge of pharmacology and therapeutics of drugs. 2.4. Vety Hygiene with respect of water, air and habitation. 2.5. Most common cattle and poultry diseases, their mode of infection, prevention and treatment etc. Immunity, General Principles and Problems of meat inspection jurisprudence of Vet practice. 2.6. Milk Hygiene. 3. Milk Product Technology-Selection of raw materials assembling, production, processing, storing, distributing and marketing milk products such as Butter, Ghee, Khoa, Channa, Cheese; Condensed evaporated, dried milk and baby foods; Ice cream and Kulfi; by-products; whey products, butter milk lactose and casein. Testing, Grading, judging milk products ISI and Agmark specifications, legal standards, quality control nutritive properties. Packaging, processing and operational control costs. 4. Meat Hygiene 4.1. Zoonosis Diseases transmitted from animals to man. 4.2. Duties and role of Veterinarians in a slaughter house to provide meat that is produced under ideal hygienic conditions. 4.3. By-products from slaughter houses and their economic utilisation. 4.4. Methods of collection, preservation and processing of hormonal glands for medicinal use. 5. Extension: 5.1. Extension different methods adopted to educate farmers under rural conditions. 5.2. Utilisation of fallen animals for profit extension education etc. 5.3. Define Trysem Different possibilities and methods to provide self employment to educated youth under rural conditions. 5.4. Cross breeding as a method of upgrading the local cattle. BOTANY Paper-I 1. Microbiology: viruses, bacteria, plasmids- structure and reproduction. General account of infection and immunology, Microbes in agriculture industry & medicine, and air, soil and water. Control of pollution using micro-organisms. 2. Pathology: Important plant diseases in India caused by viruses, bacteria, mycoplasma, fungi and nematodes. Modes of infection, dissemination, physiology and parasitism and methods of control, Mechanism of action of biocides. Fungal toxins. 3. Cryptogams Structure and reproduction from evolutionary aspect and ecology and economic importance of algae-fungi, bryophytes and pteridophytes. Principal distribution in India. 4. Phanerogams: Anatomy of wood, secondary growth Anatomy of C and C plants. Stomatal types Embryology, barriers to sexual incompatibility. Seed structure, Apomixis and polyembryony. Palynology and its applications. Comparison of systems of classification of angiosperms. Modern trends in biosystematics. Taxonomic and economic importance of Cycadaceae, Pinaceae, Gnetabes, Magnoliaceae, Ranunculaceae, Cruciferae, Rosaceae, Leguminosae, Euphorbiaceae. Malvaceae Dipterocarpaceae. Umbelliferae, Asclepiadaceae, Verbaneceae, Solanceae, Rubiaceae, cucurbitaceae. Compositae, Gramineae, Plame, Liliaceae. Musacease and Orchidaceae. 5. Morphogenesis, Polarity symmetry and totipotency. Differentiation and dedifferentiation of cells and organs. Factors of morphogenesis, Methodology and applications of cell, tissues, organ and protoplast cultures from vegetative and reproductive parts, Somatic hybrids. Paper-II Cell Biology : Scope and perspective General knowledge of modern tools and techniques in the study of cytology-Prokarytic and eukaryotic cells-structural and ultrastructural details. Functions of organelles including membrances. Detailed study of mitosis and meiosis. Numerical and structural variations in chromosome and their significance. Study of poltyene and lampbrush chromosomes-structure, behaviour and cytological significance. 2. Genetics and Evolutions: Development of genetics and gene concept. Structure and role of nucleic acids in protein synthesis and reproduction. Genetic code and regulation of gene expression. Gene amplification. Mutation and evolution, Multiple factors, linkage and crossing over. Methods of gene mapping. Sex chromosomes and sex linked inheritance. Male sterility, its significance in plant breeding. Cytoplasmic inheritance. Elements of human genetics. standard deviation and Chi-square analysis. Gene transfer in micro-organisms. Genetic engineering. Organic-evolution evidence, mechanism and theories. Physiology and Biochemistry: Detailed study of water relations. Mineral nutrition and ion/transport. Mineral deficiencies. Photosynthesis-mechanism and importance, photosystems I and II, photorespiration. Respiration and fermentation. Nitrogen fixation and nitrogen metabolism. Protein synthesis. Enzymes. Importance of secondary metabolites. Pigments as

photoreceptors, photoperiodism, flowering. Growth indices, growth movements. Senescence. Growth substances their chemical nature, role and applications in agri- horticulture. Agrochemicals, Stress physiology. Vernalization Fruit and seed physiology -dormancy, storage and germination of seed. Parthenocarphy, fruit ripening. Ecology: Ecological factors. Concept and dynamics of community, succession. Concept of biospheres. Conservation of ecosystems. Pollution and its control. Forest types of India. Afforestation, deforestation and social forestry Endangered plants. Economic Botany: Origin of cultivated plants. Study of plants as sources of food, fodder and forage, fatty oils, wood and timber, fiber, paper rubber, beverages, alcohol, drugs, .narcotics, resins and gums, essential oils, dyes, mucilage, insecticides and pesticides, Plant indicators Ornamental plants. Energy plantation. CHEMISTRY Paper-1 1. Atomic structure and chemical bonding: Quantum theory, Heisenberg's uncertainty principle, Schrödinger wave equation (time independent) Interpretation of the wave function, particle in a one dimensional box, quantum numbers, hydrogen atom wave functions. Shapes of s.p. and d orbitals, ionic bond, Lattice energy, Born Haber cycle, Fajans rule, dipole moment, characteristics of ionic compounds, electro-negativity differences. Covalent bond and its general characteristics; valence bond approach Concept of resonance and resonance energy. Electronic configuration of H_2, H_2NO_3, F, NO, CO and HF molecules in terms of molecular orbital approach. Sigma and pi bonds, bond order, bond strength and bond length. 2. Thermodynamics: Work, heat and energy: First law of thermodynamics Enthalpy, heat capacity Relationship between C_p and C_v. Laws of thermo-chemistry Kirchoffs equation Spontaneous and non-spontaneous changes, second law of thermodynamics, Entropy changes in gases for reversible and irreversible processes. Third law of thermodynamics Free energy, variations of free energy of a gas with temperature, pressure and volume. Gibbs-Helmholtz equation. Chemical potential, Thermodynamic criteria for equilibrium. Free energy change in chemical reaction and equilibrium constant. Effect of temperature and pressure on chemical equilibrium. Calculation of equilibrium constants from thermodynamic measurements. 3. Solid State: Forms of solids, law of constancy of interfacial angles crystal systems and crystal classes (crystallographic groups). Designation of crystal laces, lattice structure and unit cell. laws of rational indices. Bragg's law X-ray diffraction by crystals. Defects in crystals Elementary study of liquid crystals. 4. Chemical kinetics : Order and molecularity of a reaction. Rate equations (differential and integrated forms) of zero, first and second order reactions half life of a reaction. Effect of temperature, pressure and catalysts on reaction rates. Collision theory of reaction rates of bimolecular reactions. Absolute reaction rate theory. Kinetics of polymerisation and photo chemical reactions. 5. Electrochemistry : Limitations of Arrhenius theory of dissociation, Debye-huckel theory of strong electrolytes and its quantitative treatment. Electrolytic conductance theory and theory of activity coefficients. Derivation of limiting laws for various equilibria and transport properties of electrolyte solutions. 6. Concentration cells, liquid junction potential, application of e.m.f measurements of fuel cells. 7. Photochemistry : Absorption of light, Lambert-Beer's Laws. Laws of photochemistry. Quantum efficiency. Reasons for high and low quantum yields. Photoelectric cells. 8. General Chemistry of 'd' block elements. (a) Electronic configuration; Introduction to theories of bonding in transition metal complexes, Crystal field Theory and its modifications; applications of the theories in the explanation of magnetism and electronic spectra of metal complexes. (b) Metal Carbonyls: Cyclopentadienyl, Olefin and acetylene complexes. (c) Compounds with metal -metal bonds and metal atom clusters. 9. General Chemistry of 'f' block elements Lanthanides and actinides: Separations, Oxidation states, magnetic and spectral properties. 10. Reactions in non aqueous solvents (liquid ammonia and sulphur dioxide). Paper-II Reaction mechanisms: General methods (both kinetic and non-kinetic) of study of mechanisms of organic reactions illustrated by examples: Formation and stability of reactive intermediates (carbocations, carbanions, free redicals, carbenes, nitrenes and benzynes) SN 1 and SN2 mechanisms - Hi, E2 and EtcB eliminations-cis and trans addition to carbon, to carbon double bonds-mechanism of addition to carbon oxygen double bonds - Michael addition-addition to conjugated carbon-carbon double bonds - aromatic electrophilic and nucleophilic substitutions allylic &. benzylic substitutions. 2. Pericyclic reactions-Classification and examples an elementary study of Woodward Hoffmann rules of pericyclic reactions. 3. Chemistry of the following name reactions Aldol condensation, Claisen condensation, Dieck-mann reaction, Perkin reaction, Reimer- Tieman reaction, Cannizzaro reaction. 4. Polymeric Systems (a) Physical chemistry of polymers, End group analysis,

Sedimentation, Light Scattering and viscosity of polymers. (b) Polyethylene, Polystyrene, Polyvinyl Chloride, Ziegler Natta Catalysis, Nylon Terylene. (c) Inorganic Polymeric Systems; Phosphonitric halide compounds; silicones, Borazines. Friedel - Craft reaction, Reformatsky reaction, Pinacol pinacolone, Wagner- Meerwein' and Beckmann rearrangements and their mechanism - uses of the following reagents in organic synthesis: O5O4HIO4, NBS, diborane, Na-liquid ammonia, NaBH4, LiA IH4 5. Photochemical reactions of organic and inorganic compounds, types of reactions and examples and synthetic uses-Methods used in structure determination; Principles and applications of UV-visible, IR, IH, NMH, and mass spectra for structure determination of simple organic and inorganic molecules. 6. Molecular Structural determinations: Principles and Applications to simple organic and inorganic Molecules. i) Rotational spectra of diatomic molecules (Infra red and Raman), isotopic substitutions and rotational constants. ii) Vibrational spectra of diatomic linear symmetric, linear asymmetric and bent triatomic molecules (infrared and Raman) iii) Specificity of the functional groups (Infrared and Raman) iv) Electronic Spectra - Singlet and triplet states, conjugated, double bonds, alpha beta. unsaturated carbonyl compounds. v) Nuclear magnetic resonance: Chemical shifts, spin-spin Coupling. vi) Electron Spin Resonance: Study of inorganic complexes and free radicals.   FORESTRY PAPER-I Section – A 1. Silviculture – Principles and Practices: Growth and development of trees; classification of forests; growth of forests; factors of locality; natural and artificial regeneration of forests; methods of propagation, grafting techniques; site factors; forest nurseries – classification, layout, nursery beds, containers, nursery operations, nursery techniques, types of planting stock, grading and hardening of seedlings, special approaches; organization of plantation work; planting techniques and afforestation of different types of areas; establishment and tending. 2. Silvicultural Systems: Classification of Silvicultural systems; Clear felling; Uniform; Shelterwood; Selection; Coppice; Conversions. Silvicultural systems for management of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of standards, enrichment methods, technical constraints, intensive mechanized methods, aerial seeding, thinning. 3. Silviculture of trees and shrubs: Silviculture of some of the economically important species in India such as Abies pindrow, Picea smithiana, Pinus wallichiana, Cedrus deodara, Pinus roxburghii, Quercus species, Populus species, Salix species, Ulmus wallichiana, Alnus nitida, Acer species, Morus alba, Toona ciliate, Bauhinia variegate, Juglans regia, Olea cuspidate, Acacia nilotica, Dalbergia sissoo, Acacia catechu, Albizia lebbeck, Tectona grandis, Casuarina equisetifolia, Eucalyptus species, Terminalia species, Emblica officinalis Bombax ceiba, Shorea robusta, Santalum album, Vitex negandu, Dodonia viscose, Bamboos and canes. Recent advances in temperate and subtropical silvicultural research and practices. Section B 1. Agroforestry, Social Forestry, Joint Forest Management and Rangeland Management: Agro-forestry – scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological balances through pest-predator relationships and (v) providing opportunities for enhancing bio-diversity, medicinal and other flora and fauna. Agro-forestry systems under different agro-ecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, food, fodder and fuel security. Research and Extension needs. Social/Urban Forestry: objectives, scope and necessity; peoples participation. Participatory Forest Management: principles, objectives, methodology, details of steps involved such as formation of Village Forest Committees; scope, benefits and role of NGOs. Rangeland Management: Introduction, definition and scope; Environmental factors determining rangelands; manmade and natural rangelands; Rangelands in India-origin, distribution, characteristics, status and management; Grazing Capacity, Planned grazing systems and impact of grazing on forests, soils and water. 2. Forest Soils, Soil Conservation and Watershed management: Forests Soils: Classification, factors affecting soil formation; physical, chemical and biological properties. Soil Conservation: definition, causes for erosion; types – wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. Role of forests in conserving soils. Maintenance and build up of soil organic matter, provision of lopping for green leaf manuring; forest leaf litter and composting; Role of micro-organisms in ameliorating soils; N and C cycles, VAM. Watershed Management: concept of watershed; role of forests and trees in overall resource

management, forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of environmental functions of forests; water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders. 3. Environmental Conservation: Environment: components and importance; principles of conservation; impact of deforestation, forest fires and various human activities like mining, construction and developmental projects, population growth on environment. Pollution: types, global warming, green house effects, ozone layer depletion, acid rain, impact and control measures, environmental monitoring; concept of sustainable development. Role of trees and forests in environmental conservation; control and prevention of air, water and noise pollution. Environmental policy and legislation in India. Environmental Impact Assessment. Economics assessment of watershed development vis-a-vis ecological and environmental protection. 4. Tree improvement and Seed Technology: General concept of tree improvement, methods and techniques, variation and its use, provenance, seed source, exotics; quantitative aspects of forest tree improvement, seed production and seed orchards, progeny tests, use of tree improvement in natural forest and stand improvement, genetic testing programming, selection and breeding for resistance to diseases, insects, and adverse environment; the genetic base, forest genetic resources and gene conservation in situ and ex-situ. Cost benefit ratio, economic evaluation. PART-II Section-A 1. Forest Management and Working Plans: Forest Management: objective and principles; techniques, stand structure and dynamics, sustained yields; rotation; normal forest; growing stock and its increment; regulation of yield; forest organization; management of forest plantations, commercial forests, forest cover monitoring. Working Plans: working plans in forestry; objectives and scope; unit of working plan; period of working plan; annual plan of operations; preparation of working plans, format of working plan; control forms, stock maps, compartment histories and plantation journals; evaluation and monitoring tools and approaches for integrated planning; multipurpose development of forest resources and forest industries development. 2. Forest Mensuration and Remote Sensing: Methods of measuring diameter, girth, height and volume of trees; form-factor; volume estimation of stand, current annual increment; mean and annual increment. Sampling methods and sample plots. Yield calculation; yield and stand tables, forest cover monitoring through remote sensing; Geographic Information Systems for management and modelling. 3. Surveying and Forest Engineering: Forest surveying: Fundamental definitions and concepts of surveying; linear measurements; different methods of surveying; levelling and contouring; maps and map reading. Forest Engineering: Basic principles; building materials and construction; roads and bridges; general principles, objects, types, simple design and construction of timber bridges; estimates. Section – B 1. Forest Ecology, Biodiversity Conservation and Dendrology: Forest Ecology: Biotic and abiotic components, forest eco-systems; forest community concepts; vegetation concepts, ecological succession and climax, primary productivity, nutrient cycling and water relations; physiology in stress environments (drought, water logging salinity and alkalinity). Forest types in India, identification of species, composition and associations; Biodiversity Conservation: definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity. Measurement of diversity; diversity indices. Management of biodiversity; principles of conservation biology; Ex situ and In situ methods of conservation. Genetic and evolutionary principles in conservation; concept of rarity in plants. IUCN classification of rare/endangered plants. Biosphere concept; conservation of forest ecosystems; clonal parks; conservation efforts in India and worldwide. Dendrology: Scope of dendrology, taxonomic classification, importance of tree taxonomy in forestry. Description of the plants in scientific terms, study of spot characteristics of plants. Systematic identification of seeds, seedling, trees, and wood in field; vegetative morphology in identification of woody flora of forests. Floristics and procedures. Herbariums, collection processing and preservation of plant material, arboretums and xylariums. 2. Forest Resources and Utilization: Environmentally sound forest harvesting practices; logging and extraction techniques and principles, transportation system, storage and sale; Non-Timber Forest Products, (NTFPs) definition and scope; gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, Katha and Bidi leaves collection; processing and disposal. Needs and importance of wood seasoning and preservation; general principles of seasoning, air and kiln seasoning, solar dehumidification, steam heated and electrical kilns. Composite wood; adhesives; manufacture, properties and uses of

plywood, laminated wood, fibreboards, particle boards; importance of composite wood and present status. Pulp-paper and rayon; present position of supply of raw material to industry, wood substitution, utilization of plantation wood; problems and possibilities. Anatomical structure of wood, defects and abnormalities of wood, timber identification – general principles. 3. Forest Protection & wildlife Biology: Injuries to forest: abiotic and biotic, destructive agencies, insect-pests and disease, effects of air pollution on forests and forest die back. Susceptibility of forests to damage, nature of damage, cause, prevention, protective measures and benefits due to chemical and biological control. General forest protect against fire, equipment and methods, controlled use of fire, economic and environmental costs; timber salvage operations after natural disasters. Role of afforestation and forest regeneration in absorption of CO2. Rotational and controlled grazing, different methods of control against grazing and browsing animals; effect of wild animals on forest regeneration, human impacts; encroachment, poaching, grazing, live fencing, theft, shifting cultivation and control. 4. Forest Economics and Legislation: Forest Economics: fundamental principles, cost-benefit analyses; estimation of demand and supply; analysis of trends in the national and international market and changes in production and consumption patterns; assessment and projection of market structures; role of private sector and co-operatives; role of corporate financing. Socio-economic analyses of forest productivity and attitudes; valuation of forest goods and service. Legislation: History of forest development; Indian Forest Policy of 1894, 1952, National Forest Policy 1988; people's involvement, Joint Forest Management, gender issues in forestry. Forest laws; necessity; general principles. Jammu & Kashmir Forest Act 1930; Forest Conservation Act 1997; Wildlife Protection Act 1978 and their amendments; application of Ranbir Penal Code in forest offence cases. GEOLOGY Paper-I (General Geology, Geomorphology, Structural Geology, Palaeontology and Stratigraphy) (i) General Geology: Energy in relation to Geo-dynamic activities. Origin and interior of the Earth. Dating of rocks by various methods and age of the Earth. Volcanoes - causes and products; volcanic belts. Earthquakes-causes, geological effect and distribution, relation to volcanic belts. Geosynclines and their classification. Island arcs, deep sea trenches and mid-ocean ridges, sea-floor spreading and plate tectonics, Isostracy Mountains - types and origin. Brief ideas about continental drift, Origin of continents and oceans. Radioactivity and its application to geological problems. (ii) Geomorphology: Basic concepts and significance. Geomorphic processes and parameters. Geomorphic cycles and their interpretation. Relief features; topography and its relation to structures and lithology. Major landforms Drainage systems. Geomorphic features of Indian subcontinent. (iii) Structural Geology: Stress and strain ellipsoid, and rock deformation. Mechanics of folding and faulting. Linear and planer structures and their genetic significance. Petrofabric analysis, its graphic representation and application to geological problems. Tectonic framework of India. (iv) Palaeontology : Micro and Macro-fossils, Modes of preservation and utility of fossil General idea about classification and nomenclature. Organic evolution and the bearing of paleontological studies on it. Morphology, classification and geological history including evolutionary trends of brachiopods, bivalves, gastropods, ammonids, trilobites, echinoids and corals. Principal groups of vertebrates and their main morphological characters, Vertebrates life through ages; dinosaurs; Siwalik vertebrates. Detailed study of horses, elephants and man, Gondwana flora and its importance. Types of microfossils and their significance with special reference to petroleum exploration. (v) Stratigraphy: Principles of Stratigraphy. Stratigraphic classification and nomenclature. Standard stratigraphical scale. Detailed study of various geological systems of Indian subcontinent. Boundary problems in stratigraphy. Correlation of the major Indian formations with their world equivalents. An outline of the stratigraphy of various geological systems in their type-areas. Brief study of climates and igneous activities in Indian subcontinent during geological past. Palaeogeographic reconstructions. Paper-II (Crystallography, Mineralogy, Petrology and Economic Geology) (i) Crystallography: Crystalline and non-crystalline substances. Special groups. Lattice symmetry. Classification of crystals into 32 classes of symmetry. International system of crystallographic notation. Use of stereographic projections to represent crystal symmetry. Twinning and twin laws. Crystal irregularities. Application of X-rays for crystal studies. (ii) Optical Mineralogy: General principles of optics. Isotropism and anisotropism; concepts of optical indicatrix, Pleochroism; interference colours and extinction. Optic orientation in crystals. Dispersion, optical accessories. (iii) Mineralogy: Elements of crystal chemistry - types of bondings. Ionic radii-coordination number, Isomorphism polymorphism & psudoneorphism. Structural classification

of silicates. Detailed study of rock - forming minerals - their physical, chemical and optical properties, and uses, if any. Study of the alteration products of these minerals. (iv) Petrology: Magma, its generation, nature and composition. Simple phase diagrams of binary and ternary systems, and their significance. Bowen's Reaction Principle.. Magmatic differentiation; assimilation. Textures and structures, and their petrogenetic significance. Classification of igneous rocks. Petrography and Petrogenesis of important rock types of India; granites and granites charnockites and charnockites. Decan basalts. Processes of formation of sedimentary rocks. Diagenesis and lithification. Textures and structures and their significance. Classification of sedimentary rocks, clastic and non-clastic. Heavy minerals and their significance. Elementary concept of depositional environments, sedimentary facies and provenance. Petrography of common rock types. Variable of metamorphism. Types of metamorphism. Metamorphic grades, zones and facies. ACF, AKF and AEM diagram Textures, structures and nomenclature of metamorphic rocks. Petrography and petrogenesis of important rock types. (v) Economic Geology: Concept of ore, ore mineral and gangue; tenor or ores. Processes of formation of mineral deposits. Common forms and structures of ore deposits. Classification of ore deposits. Control of ore deposition Metalloginitic epochs. Study of important metallic and non metallic deposits, oil and natural gas fields, and coal fields of India Mineral wealth of India, Mineral economics, National Mineral Policy. Conservation and utilisation of minerals. (vi) Applied Geology: Essentials of prospecting and exploration techniques. Principal methods of mining, sampling, ore-dressing and beneficiation. Application of Geology in Engineering works. Elements of soil and ground water geology and geochemistry. Use of aerial photographs in geological investigations. MATHEMATICS Paper-I Any five questions may be attempted out of 12 questions to be set in the paper. Linear Algebra Vector space, bases, dimension of a finitely generated space, Linear Transformations, Rank and nullity of a linear transformation, Cayley Hamilton theorem, Eigen values and Eigen-vectors. Matrix of a linear transformation. Row and Coloumn reduction. Echelon form. Equivalence, Congruence and similarity. Reduction to canonical forms. Orthogonal, symmetrical, skew-symmetrical, unitary, Hermitian and skew- Hermitian matrices-their eigen values, orthogonal and unitary reduction of quadratic and Hermitian forms. Positive definite quadratic forms. Simultaneous reduction. Calculus. Real numbers, limits, continuity, differentiability, Mean-value theorem, Taylor's theorem, indeterminate forms, Maxima and minima. Curve Tracing. Asymptotes. Functions of several variables, partial derivatives, maxima and minima, Jacobian, Definite and indefinite integrals, Double and triple integrals (techniques only). Application to Beta and Gamma Functions. Areas volumes; centre of gravity. Analytic Geometry of two and three dimensions. First and second degree equations in two dimensions in cartesian and polar coordinates. Plane, sphere, paraboloid, Ellipsoid, hyperboloid of one and two sheets and their elementary properties. Curves in space, curvature and torsion, Frenet's formulae. Differential Equations. Order and Degree of a differential equation; differential equation of first order and first degree, variables seperable. Homogeneous, linear, and exact differential equations. Differential equations with constant coefficients. The complementary function and the particular integral of e^{ax}, $Cos ax$, $sin ax$, x^m, $e^{ax} Cos bx$, $e^{ax} Sin bx$ Vector, Tensor, Statics, Dynamics and Hydrostatics. (i) Vector Analysis- Vector Algebra, Differentiation of Vector function of a scalar variable, Gradient, divergence and curl in cartesian, cylindrical and spherical coordinates and their physical interpretation. Higher order derivatives. Vector identities and Vector equations, Gauss and Stokes Theorems. (ii) Tensor Analysis- Definition of a Tensor, Transformation of coordinates, contravariant and covariant tensors. Addition and multiplication of tensors, contraction of tensors. Inner product, fundamental tensor, christoffel symbols, covariant differentiation, Gradient, Curl and divergence in tensor notation. (iii) Statics-Equilibrium of a system of particles, work and potential energy, Friction, Common Catenary. Principle of Virtual work. Stability of equilibrium. Equilibrium of forces in three dimensions. (iv) Dynamics- Degree of freedom and constraints. Rectilinear motion, Simple harmonic motion. Motion in a plane. Projectiles. Constrained motion, work and Energy, Motion under impulsive forces, Kepler's laws Orbits under central forces. Motion of varying mass. Motion under resistance. (v) Hydrostatics-Pressure of heavy fluids, Equilibrium of fluids under given system of forces. Centre of pressure. Thrust on curved surfaces. Equilibrium of floating bodies. Stability of equilibrium and Pressure of gases, problems relating to atmosphere. Paper-II This paper will be in two sections. Each section will contain eight questions. Candidates will have to answer any five questions. Section-A Algebra, Real Analysis, Complex Analysis, Partial Differential

equations. Section-B Mechanics, Hydrodynamics, Numerical Analysis, Statistics including probability, operational Research. Algebra Groups, Subgroups, normal subgroups, homomorphism of groups, quotient groups. Basic isomorphism theorems. Sylow theorems Permutation Groups. Cayley's theorem. Rings and Ideals, Principal Ideal domains unique factorization domains and Euclidean domains. Field Extensions finit fields. Real Analysis Metric spaces, their topology with special reference to R sequence in a metric space, Cauchy sequence, Completeness, completion, Continuous functions, Uniform Continuity, Properties of continuous functions on compact sets. Riemann Steilties Integral, Improper integrals and their conditions of existence. Differentiation of functions of several variables. Implicit function theorem, maxima and minima. Absolute and Conditional Convergence of series of real and Complex terms, Rearrangement of series, Uniform convergence, infinite products. Continuity, differentiability and integrability for series, Multiple integrals. Complex Analysis Analytic functions, Cauchy's theorem, Cauchy's integral formula power series, Taylor's series, Singularities, Cauchy's Residue theorem and Contour integration. Partial Differential Equations Formation of partial differential equations, Types of integrals of partial differential equations of first order, Charpits methods, partial differential equation with constant coefficients. Mechanics Generalised Coordinates, Constraints, holonomic and non holonomic systems, D'Alembert's principle and Langranges equations, Moment of Inertia, Motion of rigid bodies in two dimension, Hydrodynamics.

Equation of continuity, momentum and energy. Inviscid Flow Theory :—

Two dimensional motion, Streaming motion, Sources and Sinks

Numerical Analysis

Transcedental and Polynomial Equations:- Methods of tabulation, bisection, regulatalsi, secants and Newton- Raphson and order of its convergence.

Interpolation and Numerical Differentiation:- Polynomial interpolation with equal or unequal step size. Spline interpolation-Cubic splines, Numerical differentiation furmulae with error terms.

Numerical Integration:- Problems of approximate quadrative, quadrature formulae with equispaced arguments, Caussian quadrature Convergence.

Ordinary Differential Equations:- Euler's method, multisteppredictore Corrector methods-Adam's and Milne's method, Convergence and stability, Runge-Kutta methods. Probability and Statistics.

1. Statistical Methods :- Concept of Statistical population and random sample, collection and presentation of data, Measure of location and dispersion. Moment and Shepard's corrections. Comulants. Measures of Skew ness and Kurtosis.

Curve fitting by least squares Regression, correlation and correlation ratio. Rank correlation, partial correlation co-efficient and Multiple Correlation co-efficient.

2. Probability:- Discrete sample space, Events, their union and intersection etc. Probability Classical relative frequency and exiomatic approaches, Probability in continuum, Probability space Conditional probability and independence, Basic laws of Probability, Probability of combination of events, Bayes theorem, Random Variable probability function, Probability density function. Distributions function, mathematical expectation, Marginal and conditional distributions, Conditional expectation.

3. Probability distributions:- Binomial, Poisson, Normal, Gamma, Beta Cauchy, Multinomial, Hypergeometric, Negative Binomial, Chebychev's lemma (weak) Law of large numbers, Central limit theorem for independent and identical varieties. Standard errors, Sampling distribution of t F and Chi-square and their uses in tests of significance large sample tests for mean and proportion.

Operational Research

Mathematical Programming:- Definition and some elementary properties of convex sets, simplex methods, degeneracy, duality, and sensitivity analysis, rectangular games and their solutions, Transportation and assignment problems, Kuha Tukcer condition for non-linear programming. Bellman's optimality principle and some elementary applications of dynamic programming.

Theory of Queues:- Analysis of steady- State and transient solutions for quequeing system with Poisson arrivals and exponential service time.

Deterministic replacement models, Sequencing problems with two machines, n jobs 3 machines, n jobs (Special case) and n machines 2 jobs.

PHYSICS
Paper-I
MECHANICS, THERMAL PHYSICS AND WAVES AND OSCILLATIONS
1. Mechanics
Conservation laws; Collision impact parameter, scattering cross-section, centre of mass and lab systems with transformation of physical quantities, Rutherford Scattering. Motion of a rocket under constant force field. Rotating frames of reference, Coriolis force, Motion of rigid bodies, Angular momentum, torque and Procession of a Top, gyroscope, Central forces Motion under inverse square law, Kepler's law, Motion of Satellites (including geostationary). Galilean Relativity, Special theory of Relativity, Michelson- Morley Experiment, lorentz Transformations addition theorem of velocities. Variation of mass with Velocity, Mass-energy equivalence. Fluid dynamics, streamlines, turbulance, Bernoulli's Equation with simple applications. .
2. Thermal Physics:
Laws of Thermodynamics, Entropy, Carnot's cycle, Isothermal and Adiabatic changes. Thermodynamic Potentials, Maxwell's relations, the Clausius- Clapeyron equation, reversible cell, Joule- Kelvin effect, Stefan Boltzmann Law. Kinetic Theory of Gases, Maxwell's Distribution law of Velocities, Equipartition of Energy, Specific heats of gases, mean Free path, Brownian Motion, Black Body radiation, specific heat of solids-Einstein and Debye theories, Wein's Law, Planck's Law, Solar constant. Thermalionization and stellar spectra. Production of low temperatures using adiabatic demagnetization and dilution refrigeration, Concept of negative temperature.
3. Waves and Oscillations:
Oscillations, Simple harmonic motion, stationary and travelling waves, Damped harmonic motion, Forced Oscillation and Resonance. Wave equation, Harmonic solutions, Plane and Spherical waves, superposition of waves, Phase and Group velocities, Beats, Huygen's principle, interference. Diffraction Fresnel and Fraunhofer. Diffraction by straight edge, single and multiple slits. Resolving power of grating and Optical Instruments. Rayleigh criterion. Polarization; Production and Detection of polarized light (linear, circular and elliptical), Laser sources (Helium-Neon, Ruby, and semi conductor diode). Concepts of spatial and temporal coherence. Diffraction as a Fourier Transformation. Fresnel and Fraunhofer diffraction by rectangular and circular apertures, Holography; theory and applications.
Paper-II
ELECTRICITY AND MAGNETISM, MODERN PHYSICS AND ELECTRONICS
1. Electricity and Magnetism
Coulomb's Law. Electric field. Gauss's Law, Electric -potential, Poisson and Laplace equations for a homogeneous dielectric, uncharged conducting sphere in a uniform field, Point charge and infinite conducting plane. Magnetic shell. Magnetic induction and field strength. Biot-Savart law and applications. Electromagnetic induction, Faradays's and Lenz's laws, Self and Mutual inductances. Alternating currents. L.C.R. circuits, series and parallel resonance circuits, quality factor. Kirchoffs laws with applications. Maxwell's equations and electromagnetic waves. Transverse nature of electromagnetic waves, Poynting vector. Magnetic fields in matter-dia para, ferro antiferro and ferri magnetism (qualitative approach only).
2. Modern physics
Bohr's theory of hydrogen atom. Electron spin. Optical and X-ray Spectra. Stern-Gerlach experiment and spatial quantization. Vector model of the atom, spectral terms, fine structure of spectral lines J-J and L-S coupling, Zeeman effect, Paulis exclusion principle ,Spectral terms of two equivalent and non-equivalent electrons. Gross and fine structure of electronic band spectra Raman effect. Photoelectric effect. Compton effect. Debroglie waves. Wave Particle duality and uncertainty principle. Schrodinger wave equation with application to (i) particle in a box, (ii) motion across a step potential, One dimensional harmonic oscillator eigen values and eigen functions. Uncertainty, Principle Radioactivity. alpha, beta and gamma radiations. Elementary theory of the alpha decay. Nuclear binding energy. Mass spectroscopy, Semi empirical mass formula. Nuclear fission and fusion-Elementary reactor Physics.
Elementary particles and their classification, Strong, and weak Electromagnetic interactions. Particle accelerator; cyclotron, Leniar accelerators, Elementary particles and their classification Strong, and Weak electromagnetic interactions.

Particle accelerator ; cyclotron, Linear accelerators, Elementary ideas of superconductivity.

3. Electronics

Band theory of solids- conductors, insulators and semiconductors, intrinsic and extrinsic semiconductors P-N junction, thermistor, Zenner diodes reverse and forward biased P-N junction, solar cell. Use of diodes and transistors for rectification, amplification, oscillation, modulation and detection of r.t. waves. Transistor receiver, Television, Logic Gates.

STATISTICS

Paper-I

Attempt any 5 questions choosing at most 2 from each section. Four questions of equal weightage will be set in each section.

i) Probability

Sample space and events, probability measure and probability space, Statistical independence, Random variable as a measureable function, discrete and continuous random variables, Probability density and distribution functions, marginal and conditional distributions functions of random variables and their distributions, expectations and movements, conditional expectation, correlation coefficient; convergence in probability in LP almost everywhere; Markov, Chebychev and Kolmogrov inequalities, Borel- Cantelli lemma, weak and strong law of large numbers probability generating and characteristic functions. Uniqueness and continuous probability distributions, their interrelations including limiting cases.

ii) Statistical Inference

Properties of estimates, consistency, unbiasedness, efficiency, sufficiency and completeness. Cramer-Rao bond, Minimum variance unbiased estimation, Rao Blockwell and Lehmann Sheffe's theorem methods of estimation by movements maximum likelihood, minimum Chi-square. Properties of maximum likelihood estimators confidence intervals for parameters of standards distributions.

Simple and composite hypotheses, statistical tests and critical region, two kinds of error, power function unbiased tests, most powerful and uniformly most powerful tests Neyman Person Lemma, Optimal tests for simple hypotheses concerning one parameter, monotone likelihood ratio property and its use in constructing UMP test, Likelihood ratio criterion and its asympiotic distribution, Chi-square and Kolmogoro tests for goodness of fit. Run test for randomness Sign test for Location, Wilcoxon-Mann-Whitney test and Kolmogor- Smirnov test for the two sample problem. Distribution free confidence intervals for quantities and confidence bands for distribution function.

Notions of a sequential test, walds SPRT, its CC and ASN function.

iii) Linear Inference and Multivariate Analysis

Theory of least squares and Analysis of variance, Gauss-Mark off theory, normal equations, least square estimates and their precision. Tests of significance and intervals estimates based on least square theory in one way, two way and three way classified data. Regression Analysis, linear regression, estimates and tests about correlation and regression coefficient curve linear regression and orthogonal polynomials, test for linearity of regression Multivariate normal distribution, multiple regression, multiple and partial correlation. Mahalanoblis D2 and Hotening T2— Statistics and their applications (derivatiorns of distribution of D2 and T2 excluded) Fisher's discriminant analysis.

Paper-II

(i) Select any three sections

(ii) Attempt any 5 questions from the selected sections, choosing at most, two questions from each selected section. Four questions of equal weight will be set in each section.

I. Sampling Theory and Design of Experiments.

Nature and scope of sampling, simple random sampling, sampling from finite populations with and without replacements estimation of the standard errors sampling with equal probabilities and PPS sampling. Stratified random and systematic sampling two stage and multistage sampling multi phase and cluster sampling schemes.

Estimation of Population total and mean, use of biased and unbiased estimates auxiliary variables, double sampling standard errors of estimates cost and variance functions ratio and regression estimates and their relative efficiency. Planning and organization of sample surveys with special reference to recent large scale surveys conducted in India.

Principles of experimental designs, CRD, RBD, LSD, missing plot technique factor experiments 2n and 3n design general theory of total and partial confounding and fractional

replication. Analysis of split plot, BIB and simple lattice designs.

II. Engineering Statistics

Concepts of quality and meaning of control. Different type of control charts like X-R charts, P charts np charts and cumulative sum control charts.

Sampling inspection Vs 100 percent inspection. Single, double, multiple and sequential sampling plans for attributes inspection, OC, ASN and ATI curves, Concepts of producer risk and consumer's risk AQL, AQQL, LTPD etc. Variable Sampling plants.

Definition of Reliability, maintainability and availability. Life distribution failure rate and both tub, failure curve expotential and Weibull model. Reliability of series and Parallel systems and other simple configuration different types of redundancy like hot and cold and use of redundancy in reliability improvement problem in life testing censored and truncated experiments for exponential model.

III. Operational Research

Scope and definition of OR different types of models, their construction and obtaining solution.

Homogenous discrete time Markov chains, transition probability matrix, classification of states and ergodic theorems. Homogenous continuous time Markov chains. Elements of queuing theory, M/M/I and M/M/K queues, the problem of machine interference and GI/M/I and M/GI queues.

Concepts of scientific inventory management and analytical structure of inventory problems Simple models with deterministic and stochastic demand with and without lead time. Storage models with particular reference to dam type.

The Structure and formation of a linear programming problem. The simplex procedure two phase methods and charnes- M Method with artificial variables. The quality theory of linear programming and its economic interpretation Sensitivity analysis.

Transportation and assignment problems.

Replacement of items that fail and those that deteriorate, group and individual replacement policies.

Introduction to computers and elements of Fortran IV Programming formats for input and output, statements specification and logic statements and sub-routines. Applications to some simple statistical problems.

IV. Quantitative Economics

Concept of time series, additive and multiplicative models, resolution into four components, determination of trend by free- hand drawing, moving averages, and fitting of mathematical curves, seasonal indices and estimate of the variance of the random components.

Definition, construction, interpretation, and limitations of index numbers, Lespeyre Parsche Edgewoth- Marshall and Fisher index numbers their comparisons tests for index numbers and construction of cost of living index.

Theory and analysis of consumer demand- specification and estimation of demand function. Demand elasticities. Theory of production, supply functions and elasticities, input demand functions. Estimation of parameters in single equation model- classical least squares, generalised least squares heterscedasticity, serial correlation, multicollinearity, errors in variables model simultaneous equation models - identification, rank and order conditions, Indirect least squares and two stage least squares. Short term economic forecasting.

V. Demography and Psychometry

Sources of demographic data; census registration; NSS and other demographic surveys. Limitation and uses of demographic data.

Vital rates and rations; Definition construction and uses

Life tables- complete and abridged: construction of life tables from vital statistics and census returns Uses of life tables.

Logistic and other population growth curves.

Measure of fertility, Gross and net reproduction rates

Stable population theory, Uses of stable--- and quasi stable population techniques in estimation of demographic parameters.

Morbidity and its measurement Standard classification by cause of death. Health surveys and use of hospital statistics.

Educational and psychological statistics methods of standardisation of scales and tests, IQ tests, reliability of tests and T and Z scores.

Section A

ZOOLOGY

Paper-I

Non Chordata and Chordata, Ecology, Ethology,Biostatistics and Economic Zoology

Non Chordata and Chordata

1. A general survey, classification and relationship of the various phyla.

2. Protozoa: Study of the structure, bionomica and life history of Paramaecium, Monocyotis, malarial parasite, Trypanosoma and Leishmania

Locomotion, nutrition and reproduction in Protozoa

3. Porifiera ; Canal system, skeleton and reproduction.

4. Coelenterata: Structure and life history of Obelia and Aurelia, polymorphism in Hydrozoa, coral formation, metagenesia, phylogenetic relationship of Cinidaria and Acnidaria

5. Helminths: Structure and life History of Planaria, Fasciola, Taenia and ascaris. Parasitic adaptation, Helminths in relation to man.

6. Annelida: Neries, earth work and leech; coelom and metamerism; modes of life in polychaetes.

7. Arthropoda: Palemon, scorpion, Cockroach, larvel forms and parasitism in Crustace, mouth part vision and respiration in arthropods, social life and metamorphosis in insects. Importance of Peripatus.

8. Mollusca: Unio Pila, oyster culture and pearl formation, cephalopodes.

9. Echinodermata-General organisation, larval forms and affinities of Echinodermata.

10. General organisation and characters, outline classification and interrelationship of protochordata, Pisces,Amphibia, Reptilila, Aves and Mammalia.

11. Neoteny and retrogressive metamorphosis.

12. A general study of comparative account of the various systems of vertebrates.

13. Locomotion; migration and respiration in fishes; structure and affinities of Dipnoi.

14. Origin of Amphibia: distribution, anatomical peculiarities and affinities of Urodela and Apoda.

15. Origin of Reptiles; adaptive radiation in reptiles; 'fossil reptiles; poisonous and non poisonous snakes of India; poison apparatus of snake.

16. Origin of birds: flightless birds, aerial adaptation and migration of birds.

17. Origin of mammals; homologies of ear ossicles in mammals; dentition and skin derivatives of mammals; distribution, structural peculiarities and phylogenetic relations of Prototheria and Methatheria.

Section B

ECOLOGY, ETHOLOGY, BIOSTATICS AND ECONOMIC ZOOLOGY

Ecology

1. Environment; Abiotic factors and their role; Biotic factors- Inter and inter-specific relations.

2. Animal: Organisation at population and community levels, ecological successions.

3. Ecosystem: Concept, components, fundamental operation, energy flow, biogeo chemical cycles, food chain and trophic levels.

4. Adaptation in fresh water, marine and terrestial habitats.

5. Pollution in air, water and land.

6. Wild life in India and its conservation.

Ethology

7. General survey of Various types of animal behaviour.

8. Role of hormones and pheromones in behaviour

9. Chronobiology; Biological clock, seasonal rhythms, tidal rhythms.

10. Neuro-endocrine control of behaviour.

Economic Zoology

11. Parasitism, commensalism and host parasite relationship.

12. Parasitic protozoan's helminthis and insects of man and domestic animals.

13. Insect pests of crops and stored products.

14. Beneficial insects.

15. Pisiculture and induced breeding.

Paper-II

Cell Biology, Genetics, Evolution and Systematics, Biochemistry, Physiology and Embryology.

Section A

Cell Biology, Genetics, Evolution and Systematics

1. Cell Biology- Structure and function of cell and cytoplasmic constituents; structure of nucleus, plasma membrane, mitochondria, golgibodies, endo-plasmic reticulum and ribosomes, cell division; mitotic spindle and chromosome movements and meiosis.

Gene structure and Function; Watson -Crick model of DNA, replication of DNA Genetic code; protein synthesis cell differentation sex chromosomes and sex determination.

2. Genetics- Mendelian laws of inheritance re-combination linkage and linkage maps, multiple alleles; mutation (natural and induced) mutation and evolution, meiosis, chromosome number and form, structural rearrangements; polyploidy; cytoplasmic inheritance, regulation of gene expression in prokaryotes and eukaryotes; biochemical genetics, elements of human genetics; normal and abnormal karyotypes; genes and diseases. Eugenics.

3. Evolution and systematics- Origin of life, history of evolutionary thought Lamarck and his works. Darwin and his works sources and nature of organic variation. Natural Selection, Hardy-Weinberg law, cryptic and warning colouration mimicry; isolating mechanism, and their role Insular fauna, concept of species and sub-species, principles of classification, Zoological nomenclature and international code. Fossils, outline of geological eras phylogeny of horse, elephant, camel, origin and evolution of man, principles and theories of continental distribution of animals Zoogeographical realms of the world.

Section B

BIOCHEMISTRY, PHYSIOLOGY AND EMBRYOLOGY

1. Biochemistry: Structure of carbohydrates, lipids, aminoacids, proteins and nucleic acids, glycolysis and krebs cycle, oxidation and reduction, oxidative phosphorylation, energy conservation and release, ATP Cyclic AMP, saturated and unsaturated fatty acids, cholesterol, steroid hormones Types of enzymes, mechanism of enzyme action immunoglobulins and immunity, vitamins and co-enzymes; Hormones, their classification, biosynthesis and functions.

2. Physiology with special reference to mammals: composition of blood, blood groups in man, coagulation, oxygen and carbon dioxide transport haemoglobin, breathing and its regulation nephron and urine formation, acid base balance and homeostasis; temperature regulation in man, mechanism of conduction along axon and across synapes, neurotransmitters, vision, hearing and other receptors; types of muscles, ultra structures and mechanism of contraction of skeletal muscles, role of salivary gland, liver, pancreas and intestinal glands in digestion, absorption of digested food, nutrition and balanced diet of man, mechanism of action of steroid and peptide hormones, role of hypo-thalamus, pituitary thyroid, parathyroid, pancreas, adrenal testis ovary and pineal organs and their inter-relationships, physiology of reproduction in humans, hormonal control of development in man and insects, pheromones in insects and mammals.

Embryology: Gametogenesis, fertilization, types of eggs, cleavage, development upto gastrulation in branchiostoma, frog and chick, Fate maps of frog and chick, Metamorphosis in frog; Formation and fate of extra embryonic membrane in chick; formation of anmion allantois and types of placenta in mammals, function of placenta in mammals; organisers, Regeneration, genetic, control of development. Organogenesis of central nervous system, sense organs heart and kidney of vertebrate embryos. Aging and its implication in relation to man.

AGRICULTURAL ENGINEERING

Paper-I

Section-A

1. Soil and Water Conservation: Scope of soil and water conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement. Soil erosion control measures – biological and engineering including stream bank protection-vegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterways. Gully control structures – temporary and permanent – design of permanent soil conservation structures such as chute, drop and drop inlet spillways. Watershed Management – investigation, planning and implementation – selection of priority areas and water shed work plan, water harvesting and moisture conservation. Land development – leveling, estimation of earth volumes and costing. Wind Erosion process – design to shelter belts and wind brakes and their management. Forest (Conservation) Act.

2. Aerial Photography and Remote Sensing: Basic characteristics of photographic images, interpretation keys, equipment for interpretation, imagery interpretation for land use, geology, soil and forestry.

Remote Sensing- merits and demerits of conventional and remote sensing approaches. Types of satellite images, fundamentals of satellite image interpretation, techniques of visual and digital interpretations for soil, water and land use management. Use of GIS in planning and development of watersheds, forests including forest cover, water resources etc.

Section-B

3. Irrigation and Drainage: Sources of water for irrigation. Planning and design of minor irrigation projects. Techniques of measuring soil moisture – laboratory and in situ, soil - water plant relationships. Water requirement of crops. Planning conjunctive devices – orifices, weirs and flumes. Methods of irrigation – surface, sprinkler and drip, irrigation. Irrigation efficiencies and their estimation. Design and construction of canals, field channels, underground pipelines, head-gates, diversion boxes and structures for road crossing.

Occurrence of ground water, hydraulics of wells, types of wells (tube wells and open wells) and their construction. Well development and testing. Pumps-types, selection and installation. Rehabilitation of sick and failed wells.

Drainage causes of water logging and salt problem. Methods of drainage – drainage of irrigated and un-irrigated lands, design of surface, sub-surface and vertical drainage systems. Improvement and utilization of poor quality water. Reclamation of saline and alkali soils. Economics of irrigation and drainage systems. Use of waste water for irrigation – standards of waste water for sustained irrigation, feasibility and economics.

4. Agricultural Structures: Site selection, design and construction of farmstead – farm house, cattle shed, dairy bam, poultry shed, hog housing, machinery and implement shed, storage structures for food grains, feed and forage. Design and construction of fences and farm roads. Structures for plant environment – green houses, poly houses and shade houses. Common building materials used in construction – timber, brick, stone, tiles, concrete etc and their properties. Water supply, drainage and sanitation system.

Paper-II

Section-A

1. Farm Power and Machinery: Agricultural mechanization and its scope. Sources of farm power – animate and electro-mechanical. Thermodynamics, construction and working of internal combustion engines. Fuel, ignition, lubrication, cooling and governing system of IC engines. Different types of tractors and power tillers. Power transmission, ground drive, power take off (p.t.o) and control systems. Operation and maintenance of farm machinery for primary and secondary tillage. Traction theory. Sowing transplanting and inter-culture implements and tools. Plant protection equipment – spraying and dusting. Harvesting, threshing and combing equipment. Machinery for earth moving and land development – methods and cost estimation. Ergonomics of man-machine system. Machinery for horticulture and agro-forestry, feeds and forages. Haulage of agricultural and forest produce.

2. Agro-energy: Energy requirements of agricultural operations and agro-processing. Selection, installation, safety and maintenance of electric motors for agricultural applications. Solar (thermal and photo-voltoic), wind and bio-gas energy and their utilization in agriculture. Gasification of biomass for running IC engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels. Distribution of electricity for agricultural and agro-industrial applications.

Section-B

3. Agricultural Process Engineering: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations – cleaning grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment – belt and screw conveyors, bucket elevators, their capacity and power requirement.

Processing of mild and dairy products – homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization – rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

4. Instrumentation and computer applications in Agricultural Engineering: Electronic devices and their characteristics – rectifiers, amplifiers, oscillators, multivibrators. Digital circuits –

sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes – measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers – introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

CHEMICAL ENGINEERING
PAPER-I
Section-A
(a) Fluid and Particle Dynamics
Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equation-Bernoulli's theorem. Flow meters. Fluid drag and pressure drop due to friction, Reynolds Number and friction factor – effect of pipe roughness. Economic pipe diameter. Pumps, water, air/steam jet ejectors, compressors, blowers and fans. Agitation and mixing of liquids. Mixing of solids and pastes. Crushing and Grinding – principles and equipment. Rittinger's and Bond's laws. Filtration and filtration equipment. Fluid-particle mechanics – free and hindered setting. Fluidisation and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of solids.
(b) Mass Transfer
Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates. Liquid-liquid equilibria. Extraction – theory and practice; Design of gas-absorption columns. Drying. Humidification, Dehumidification. Crystallisation. Design of equipment.
(c) Heat Transfer
Conduction, thermal conductivity, extended surface heat transfer.
Convection – free and forced. Heat transfer coefficients – Nusselt Number. LMTD and effectiveness. NTU methods for the design of Double Pipe and Shell & Tube Heat Exchangers. Analogy between head and momentum transfer. Boiling and condensation heat transfer. Single and multiple-effect evaporators. Radiation – Stefan-Boltzman Law, emissivity and abnsorptivity. Calculation of head load of a furnace. Solar heaters.
Section-B
(d) Noval Separation Processes
Equilibrium separation processes – ion-exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. Super critical fluid extraction.
(e) Process Equipment Design
Factors affecting vessel design criteria – Cost considerations. Design of storage vessels-vertical, horizontal spherical, underground tanks for atmospheric and higher pressure. Design of closures flat and elliptical head. Design of supports. Materials of construction-characteristics and selection.
(f) Process Dynamics and Control
Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/pneumatic/analogue/digital signal forms. Control variable, manipulative variable and load variables. Linear control theory-Laplace, transforms, PID controllers. Block diagram representing transient and frequency response, stability of closed loop system. Advanced control strategies. Computer based process control.

Paper-II
Section-A
(a) Material and Energy Balances

Material and energy balance calculations in processes with recycle/bypass/purge. Combustion of solid/liquid/gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.
(b) Chemical Engineering Thermodynamics

Laws of thermodynamics. PVT relationships for pure components and mixtures. Energy functions and inter-relationships – Maxewell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria, for ideal/non-ideal, single and multi-component systems. Criteria for chemical reaction equilibrium, equilibrium constant and equilibrium conversions. Thermodynamic cycles – refrigeration and power.

(c) Chemical Reaction Engineering

Batch reactors – kinetics of homogeneous reactions and interpretation of kinetic data. Ideal flow reactors – CSTR, plug flow reactors and their performance equations. Temperature effects and run-away reactions. Heterogeneous reactions – catalytic and non-catalytic and gas-solid and gas-liquid reactions. Intrinsic kinetics and global rate concept. Importance of interphase and intraparticle mass transfer on performance. Effectiveness factor. Isothermal and non-isothermal reactors and reactor stability.

Section-A

(d) Chemical Technology

Natural organic products – Wood and wood-based chemicals, pulp and paper, Agro industries – sugar, Edible oils extraction (including tree based seeds). Soaps and detergents. Essential oils – Biomass gasification (including biogas). Coal and coal chemical. Petroleum and Natural gas-petroleum refining (Atmospheric distillation/cracking/reforming) – Petrochemical industries – Polyethylene's (LDPE/HDPE/LLDPE), Polyvinyl Chloride, Polystyrene. Ammonia manufacture. Cement and lime industries. Paints and varnishes. Glass and ceramics. Fermentation – alcohol and antibiotics.

(e) Environmental Engineering and Safety

Ecology and Environment. Sources of pollutants in air and water. Green house effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazards rating – HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislations – water, air environment protection Acts. Forest (Conservation) Act.

(f) Process Engineering Economics

Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR, Depreciation, taxes and insurance. Break-even point analysis. Project scheduling - PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

ELECTRICAL ENGINEERING

Paper-I

Network: Steady state analysis of d.c and a.c networks, network theorems, Matrix Algebra, network functions transient response frequency response, Laplace transform, Fourier series and Fourier transform, frequency spectral polezero concept, elementary network synthesis.

Statics and Magnetics:

Analysis of electrostatic and magnetostatic fields: Laplace and Poisson Equations, solution of boundary value problems. Maxwell's equations, electromagnetic wave propagation, ground. and space waves, propagation between earth station and satellites.

Measurements:

Basic methods of measurements, standards, error analysis, indicating instruments cathode ray oscilloscope; measurement of voltage current, power, resistance, inductance, capacitance, time, frequency and flux; electronic meters.

Electronics:

Vacuum and semiconductor devices: equivalent circuits transistor parameters, determination of current and voltage gain input and output impedances biasing technique, single and multistage, audio and radio small signal and large signal amplifiers and their analysis, feedback amplifiers and oscillators: wave shaping circuits and time base generators, analysis of different types of multivibrator and their uses; digital circuits.

Electrical Machines:

Generation of e.m.f. —m.m. f and torque in rotating machines, motor and generator characteristics of d.c. synchronous and induction machines equivalent circuits, commutation parallel operation; phasor diagram and equivalent circuits of power transformer,

determination of performance and efficiency, autotransformers, 3-phase transformers.

Paper-II
SECTION A
Control Systems
Mathematical modelling of dynamic linear control systems, block diagrams and signal flow graphs, transient response steady state error, stability, frequency response techniques, root-locus techniques series compensation.
Industrial Electronics
Principles and design of single phase and polyphase rectifiers controlled rectification, smoothing filters; regulated power supplies, speed control circuits for drivers, inverters, a.c. to d.c. Conversion, Choppers; timers and welding circuits.
SECTION B (Heavy currents)
ELECTRICAL MACHINES
Induction Machines - Rotating magnetic field; poly phase, motor, principle of operation; Phasor diagram; Torque slip characteristic; Equivalent circuit and determination of its parameters; circle diagram; starters; speed control double cage motor; induction generator; Theory; Phasor diagram, characteristics and application of single phase motors. Application of two phase induction motor.
Synchronous Machines - e.m.f. equation phasor and circle diagrams operation on infinite bus: synchronizing power, operating characteristic and performance by different methods; sudden short circuit and analysis of oscillogram to determine machine reactances and time constants, motor characteristics and performance methods of starting application. Special machines-Amplidyne and metadyne operating characteristics and their applications.
Power Systems and Protection - General layout and economics of different types of power stations ; Baseload, peakload and pumped storage plants; Economics of different systems of d.c and a.c power distribution. Transmission line parameter calculation; concept of G.M.D. short, medium and long transmission line; insulators, voltage distribution in a string of insulators and grading; Environmental effects on insulators. Fault calculation by symmetrical components; load flow analysis and economic operation; steady state and transient stability; Switch-gear Methods of arc extinction; Restriking and recovery voltage; testing of circuit breaker, Protective relays; protective schemes for power system equipment; C.T. and P.T. Surges in transmission lines; Traveling waves and protection.
Utilisation - Industrial drives electric motors for various drives and estimates of their rating; Behaviour of motor during starting acceleration, braking and reversing operation; Schemes of speed control for d.c and induction motors.
Economic and other aspects of different systems of rail traction; mechanics of train movement and estimation of power and energy requirements and motor rating characteristics of traction motors, Dielectric and induction heating.
OR
SECTION C (Light Currents)
Communication Systems - Generation and detection of amplitude - frequency phase and pulse modulate signals using oscillators, modulators and demodulators, Comparison of. modulated systems, noise, problems, channel efficiency sampling theorem, sound and vision broadcast transmitting and receiving system, antennas, feeders and receiving circuits, transmission line at audio radio and ultra high frequencies.
Microwaves - Electromagnetic wave in guided media, wave guide components cavity resonators, microwaves tubes and solid state devices; Microwave generators and amplifiers, filters microwave measuring techniques microwave radiation pattern, communication and antenna systems, Radio aids to navigation.
D.C. Amplifiers - Direct coupled amplifiers, difference amplifiers, choppers and analog computation.
CIVIL ENGINEERING
Paper I
A) Theory and Design of Structure
a) Theory Structures: Energy theorems Castrigliano I theorems I and II: Unit load method and method of consistent deformation to beams and pinjointed plane frames. Slope deflection, Moment distribution and Kani methods of analysis applied to indeterminate beams and rigid frames.

Moving loads: Criteria for maximum sheer force and bending moment in beams traversed by a system of moving loads influence lines for simply supported plane pinjointed, girders.

Arches: Three hinged, two hinged and fixed arches rib. Shortening and temperature effects. Influence lines.

Matrix: Methods of analysis. Force method and displacement method.

b) Structural Steel: Factors of safety and load factors.

Designs of tension and compression members. Beams of built up section, riveted and welded plate girders. Gantry girders. Stanchions with battens and facing, Slab and gusseted bases.

Design of Highway and Railway Bridges: Through and deck type plate girder. Warren girder and Pratruss.

c) Reinforced concrete, Limit state, method, design. Recommendations of IS codes. Design of one way and two way slabs, staircase slabs, simple and continuous beams of rectangular T and L sections.

Compression members under direct load with or without accentricity fottings isolated and combined.

Retaining walls, Cantilever and counterfort types. Methods and systems of prestressing. Anchorages Analysis and design of sections for flexure, loss of prestress

(B) FLUID MECHANICS

Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curved surfaces.

Kinematics and Dynamics and fluid flow velocity and accelerations, stream lines equation of continuity ir-rotational and rotational flows velocity potential and stream function, flow nets and methods of drawing flow net sources and sinks flow separation and stagnation.

Euler's equation of motion, energy and momentum equation and their application to pipe flow free and forced vortices, plane and curved stationary and moving vanes sluice gates weirs otieive meters and venturimeters.

Dimensional Analysis and similitude, Buckingham's Pi theorem similarities models laws undistorted and distorted models movable bed models model calibration.

Laminar Flow: Laminar flow between parallel stationary and moving plates, flow through tube Reynolds experiments lubrication principles.

Boundary Layers: Laminar and turbulent boundary Layer on a flat plate laminar sub layer smooth and rough boundaries drag and lift.

Turbulent Flow Through Pipes: Characteristics of turbulent flow, velocity distribution and variation of friction factor, hydraulic grade line and total energy line siphons expansions and contractions in pipes, pipe networks water hammer.

Open Channel flow Uniform and non-uniform flows specific energy and specific force critical depth, resistance equations and variation of roughness coefficient. Rapidly varied flow, flow in contractions, flow at sudden drop, hydraulic jump and its applications, surges and waves, Gradually varied flow differential equation for gradually varied flow classification of surface profiles control section step method of integration of varied flow equation.

(C) SOIL MECHANICS AND FOUNDATION ENGINEERING

Soil composition influence of clay minerals on engineering behaviour. Effective stress principles, change in effective stress due to water flow condition Static water table and steady flow conditions. Permeability and compressibility of soils.

Strength behaviour, strength determination through direct and triaxial tests Total and effective stress strength parameters Total and effective stress paths.

Methods of site exploration, planning a sub-surface exploration programme sampling procedures and sampling disturbance. Penetration tests and plate load tests and data interpretation.

Foundation types and selection. Footings, rafts, piles, floating foundations, effect of footing shapes, dimensions, depth of embedment load inclination and ground water on bearing capacity. Settlement components. Computation for immediate and consolidation settlements limits on total and differential settlement correction for rigidity.

Deep foundations, philosophy of deep foundations, piles, estimation of individual and group capacity. Static and dynamic approaches. Pile load tests, separation into skin friction and point bearing under-reamed piles. Well foundations for bridges and aspects of design.

Earth pressure, states of plastic equilibrium. Cullman's procedure for determination of lateral, thrust determination of anchor force and depth of penetration. Reinforced earth retaining walls concept, Materials and applications.

Machine foundations, Modes of vibrations. Determination of natural frequency, Criteria for design. Effect of vibration on soils. Vibration isolation.

(D) COMPUTER PROGRAMMING

Types of computers - components of computers, history and development different languages.

Fortran/Basic programming constant variables expressions arithmetic statements library functions control statements unconditional GO-TO statements computed GO-TO Statements IF and DO statements CONTINUE CALL RETURN STOP END Statements 1/0 Statements FORMATS field specifications.

Subscripted variables arrays DIMENSION statement function and sub routine sub-programmes application to simple Problems with flow charts in Civil Engineering.

Paper- II

Note:— Candidate shall answer questions from any two parts.

PART A

BUILDING CONSTRUCTION

Physical and mechanical properties of construction materials factors influencing selection brick and clay products limes and cements polymeric materials and special uses, damp proofing materials.

Bickward for walls type cavity walls design of brick masonry walls as per LS code factors of safely serviceability and strength requirements detailing of walls floors roofs ceiling finishing of building plastering pointing painting.

Functional planning of buildings orientation of buildings elements of fire proof construction repair to damaged and cracked buildings use of teno cement, more reinforced and polymer concrete in construction techniques and materials for low cost housing.

Building estimates and specifications construction scheduling PERT and CPM methods.

PART B

TRANSPORTATION ENGINEERING

Railway: Permanent way ballast sleeper, fastenings points and, crossing different types or turn outs cross-over. Setting out of points.

Maintenance of track super-elevation creep of rail ruling gradients trick resistance, tractive effort, curve resistance.

Station yards and machinery, Station building platform siding cum tables signals and interlocking level crossings.

Roads and Railways, Traffic engineering and traffic surveys, Inter sections, road signs signals and marking.

Classification of roads, planning and geometric design.

Design of flexible and rigid pavements. Indian Roads congress Guidelines on pavement, layers and design methodologies.

PART C

WATER RESOURCE AND IRRIGATION ENGINEERING

Hydrology: Hydrologic cycle, precipitation, evaporation, transpiration depression, storage, infiltration, hydrograph unit, hydrograph frequency analysis, flood estimation.

Ground water flow, Specific yield, storage coefficient, coefficient of permeability. Confined and unconfined aquifers. Radial flow into a well under confined and unconfined conditions. Tubewells pumping and recuperation tests. Ground water potential.

Water resources planning. Ground and surface water resources single and multipurpose projects. Storage capacity of reservoirs, reservoir losses, reservoir sedimentation, flood routing through reservoirs. Economics of water resources projects.

Water requirements for crops, consumptive use of water. Quality of irrigation water, duty and delta, Irrigation methods and their efficiencies.

Canals: Distribution system for canal irrigation, Canal capacity, canal losses, Alignment of main and distributory canals. Most efficient section, lined channels their design, regime theory, Critical shear stress bed load. Local and suspended load. Transport cost. Analysis of lined and unlined canals. Drainage behind lining.

Water Logging: Causes and control, Drainage system. Design salinity.

Canal structures: Design of regulation, cross drainage and communication works, cross regulators, head regulators, canal falls, aqueducts, metering, flumes and outlets. Diversion

head works, Principles of design of weirs on permeable and impermeable foundations. Khosla's theory Energy dissipation. Stilling basins, sediments exclusion. Storage Works, Types of dams design. Principles of rigid gravity and earth dams stability analysis foundation treatment joints and galleries. Control of seepage construction methods and machinery.

Spillways: Types, crest, gates, energy Dissipation River training, objectives of river training. Methods of river training.

PART-D

ENVIRONMENTAL ENGINEERING

Water supply : Estimation of water resources, ground and surface water. Ground water hydraulic, predicting demand of water. Impurities of water and their significance. Physical chemical and bacteriological analysis, water borne diseases. Standards for portable water.

Intake of water, Pumping and gravity schemes. Water treatment Principles of coagulation flocculation and sedimentation. Slow rapid pressure, biflow and multi-media filters, chlorination, softening, removal of taste odour and salinity.

Water storage and distribution. Storage and balancing reservoirs- types location and capacity.

Distribution systems: Layout hydraulics of pipelines. Pipe fittings valves including check and pressure. Reducing valves meters analysis of distribution systems using Hardy Cross Method General principles of optimal, design based on cost headloss ratio criterion. Leak detection maintenance of distribution systems pumping stations and their operations.

Sewerage systems: Domestic and industrial wastes, storm sewage, separate and combined systems flow through sewers. Design of sewers, sewer appurtenances. Manholes inlets. Junctions syphon.

Sewage characterisation. BOD COD solids. Dissolved oxygen, nitrogen and TOS, Standards of disposal in normal water course and on land.

Sewage treatment: Working principles, Units chambers sedimentation tank, trickling, filters, oxidation ponds, activated sludge process septic tank disposal of sludge. Recycling of waste water.

Solid Waste: Collection and disposal. Environmental pollution. Ecological balance. Water pollution control acts. Radio active wastes and disposal. Environmental impact. Assessment for thermal power plants, mines.

Sanitation: Site and orientation of buildings. Ventilation and damp proof courses. House drainage. Conservancy and water born system of waste disposal. Sanitary appliances, latrines and urinals. Rural sanitation.

MECHANICAL ENGINEERING

Paper-I

Statics:- Equilibrium in three dimensions suspension cables. Principle of virtual work.

Dynamics:- Relative motion coriolis force Motion of a rigid body. Gyroscopic motion impulse.

Theory of Machines:- Higher and lower parts inversions, steering mechanisms, Hooks joint, velocity and acceleration of links, inertia forces. Cams Conjugate action of gearing and interference, gear trains epicyclic gears, Clutches, belt drives, brakes, dynamometers, Flywheels Governors. Balancing of rotating and reciprocating masses and multicylinder engines. Free, forced and damped vibrations for a single degree of freedom. Degree of freedom. Critical speed and whirling of shafts.

Mechanics of solids:- Stress and strain in two dimensions. Mohr's circle. Theories of failure, Deflection of beams. Buckling of columns. Combined bending and torsion. Castiglapo's theorem. Thick cylinders Rotating disks, Shrink fit. Thermal Stresses.

Manufacturing Science:- Merchants theory Taylors equation Machineability. Unconventional machining methods including EDM, ECM and ultrasonic machining. Use of lasers and plasms. Analysis of forming process. High velocity forming. Explosive forming. Surface roughness, gauging comparators jigs and Fixtures.

Production management:- Work simplification, work sampling, value engineering, Line balancing, work station design, storage space requirement, ABC analysis, Economic order, quantity including finite production rate. Graphical and simplex methods for linear programming; transportation model, elementary queing theory. Quality control and its uses in product design. Use of X,R,P (Sigma) and C charts. Single sampling plans, operating characteristics curves, Average sample size. Regression analysis.

Paper-II

Thermodynamics:- Applications of the first and second laws of thermodynamics. Detailed

analysis of thermodynamics cycles.

Fluid Mechanics:- Continuity momentum and energy equations. Velocity distribution in laminar and turbulent flow. Dimensional analysis. Boundary layer on a flat plate. Adiabatic and isentrophic flow. Mach number.

Heat transfer:- Critical thickness of insulation conduction in the presence of heat sources and sinks. Heat transfer from fins. One dimensional unsteady conduction Time constant for thermocouples. Momentum and energy equations for boundary layers on a flat plate. Dimensionless numbers Free and Forced convection Boiling and condensation nature of radiant heat. Steafan- Boltzmann Law, Configuration factor logarithmic mean temperature difference. Heat exchanger effectiveness and number of transfer units.

Energy Conversion:- Combustion phenomenon in C.I. and S.I. engines Carburetion and fuel injection. Selection of pumps, classification of compressor Analysis of steam and gas turbines. High pressure boilers. Unconventional power systems. including Nuclear power and MHD systems. Utilisation of solar energy.

Environmental control:- Vapour compression, absorption, steam jet and air refrigeration systems. Properties and characteristics of important refrigerants. Use of psychrometric chart and comfort chart, estimation of cooling and heating loads. Calculation of supply air state and rate. Air conditioning plants layout.