APPENDIX II

SYLLABI FOR THE EXAMINATION

PART A—PRELIMINARY EXAMINATION

COMPULSORY SUBJECT

GENERAL STUDIES

The paper on General Studies will include questions covering the following fields of knowledge :

General Science

Current events of national and international importance, History of India.

World Geography.

Indian Polity and Economy.

Indian National Movement and also questions on General Mental Ability.

Questions on General Science will cover general appreciation and understanding of science, including matters of everyday observation and experience, as may be expected of a well educated person who has not made a special study of any scientific discipline. In History, emphasis will be on broad general understanding of the subject in its social, economic and political aspects. In Geography, emphasis will be on Geography of India. Questions on the Geography of India will relate to physical, social and economic Geography of the country, including the main features of Indian agricultural and natural resources. Questions on Indian Polity and Economy will test knowledge on the country's political system, panchayati raj, community development and planning in India. Questions on the Indian National Movement will relate to the nature and character of the nineteenth century resurgence, growth of nationalism and attainment of Independence.

OPTIONAL SUBJECTS

Agriculture

Agriculture, its importance in national economy; factors determining agro-ecological zone and geographic distribution of crop plants.

Important crops of India, cultural practices for cereal, pulses, oil-seed, fibre, sugar and tuber crops and the scientific basis for these crop rotation; multiple and relay cropping, inter-cropping and mixed cropping.

Soil as a medium of plant growth and its composition, mineral and organic constituents of the soil and their role in crop production; chemical, physical and microbiological properties of the soils. Essential plant nutrients, their functions, occurrence of cycling in soils principles of soil fertility and its evaluation for judicious

fertilizer use. Organic manures and bio-fertilizers, straight, complex and mixed fertilizers manufactured and marketed in India.

Principles of plant physiology with reference to plant nutrition, absorption, translocation and metabolism of nutrients. Diagnosis of nutrient deficiencies and their amelioration photosynthesis and respiration, growth and development, auxins and hormones in plant growth.

Elements of Genetics and Plant breeding as applied to improvement of crops; development of plant hybrids and composites, important varieties, hybrids and composites of major crops.

Important fruit and vegetable crops of India, the package of practices and their scientific basis, crop rotations, intercropping and companion crops, role of fruits and vegetables in human nutrition ; post harvest handling and processing of fruits and vegetables.

Serious pests and diseases affecting major crops. Principles of pest control, integrated control of pests and diseases; proper use and maintenance of plant protection equipments.

Principles of economics as applied to agriculture.

Farm planning and resource management for optimal production. Farming systems and their role in regional economies.

Philosophy, objectives and Principles of extension. Extension organisation at the State, District and Block levels their structure, functions and responsibilities. Methods of Communication, Role of farm organisations in extension service.

ANIMAL HUSBANDRY AND VETERINARY SCIENCE

Animal Husbandry :

1. *General* : Importance of livestock in Agriculture, Relationship between Plant and Animal Husbandry, Mixed farming Livestock and milk production statistics.

2. *Genetics*: Elements of genetics and breeding as applied to improvement of animals. Breeds of indigenous and exotic cattle, buffaloes, goats, sheeps, pigs and poultry and their potential of milk, eggs, meat and wool production.

3. *Nutrition*: Classification of feeds, feeding standards, computation of ration and mixing of rations, conservation of feeds and fodder.

4. *Management*: Management of livestock (Pregnant and milking cows, young stock), livestock records, principles of clean milk production, economies of livestock farming Livestock housing.

Veterinary Science

1. Major contagious diseases affecting cattle and drought animals, poultry and pigs.
2. Artificial insemination, fertility and sterility.
3. Veterinary hygiene with reference to water, air and habitation.
4. Principles of immunization and vaccination.
5. Description, symptoms, diagnosis and treatment of the following diseases of :

(a) Cattle: Anthrax, Foot and mouth disease, Haemorrhagic, Septicaemia, Rinderpest, Black quarter, Tympanitis, Diarrhoea, Pneumonia, Tuberculosis, Johnes disease and diseases of new born calf.

(b) Poultry : Coccidiosis, Ranikhet, Fowl Pox, Avian leukosis, Marks Disease.

(c) Swine: Swine fever.

6. (a) Poisons used for killing animals.

(b) Drugs used for doping of race horses and the techniques of detection.

(c) Drugs used to tranquilize wild animals as well as animals in captivity.

(d) Quarantine measures prevalent in India and abroad and improvements therein.

Dairy Science

1. Study of milk composition, physical properties and food value.
2. Quality control of milk, common tests, legal standards.
3. Utensils and equipment and their cleaning.
4. Organization of Dairy, processing of milk and distribution.
5. Manufacture of Indian indigenous milk products.
6. Simple dairy operations.
7. Micro-organisms found in milk and dairy products.
8. Diseases transmitted through milk to man.

BOTANY

1. *Origin of Life*—Basic ideas on origin of earth and origin of life.

2. Biological Evolution General account of biochemical and biological aspects of evolution, Speciation.

3. *Cell biology*—Cell structure, function of organelles. Mitosis, meiosis, significance of meiosis. Differentiation, senescence and death of cells.

4. *Tissue Systems*—Origin, development, structure and function of primary and secondary tissues.

5. *Genetics*—Laws of inheritance, concept of gene and genetic code. Linkage, crossing over, gene mapping. Mutation and polyploidy. Hybrid vigour. Sex determination, Genetics and plant improvement.

6. *Plant Diversity*—Structure and function of plant form from evolutionary aspect (viruses to angiosperms, including lichens and fossils).

7. *Plant Systematics*—Principles of nomenclature, classification and identification. Modern approaches in plant taxonomy.

8. *Plant Growth and Development*—Dynamics of growth. Growth movements. Growth substances. Factors of morphogenesis. Mineral nutrition. Water relations. Elementary knowledge of photosynthesis. Respiratory metabolism, Nitrogen metabolism, nucleic acids and protein synthesis. Enzymes. Secondary metabolites. Isotopes in biological studies.

9. *Methods of Reproduction and Seed Biology*—Vegetative, asexual and sexual methods of reproduction, Physiology of flowering. Pollination and fertilization. Sexual incompatibility. Development, Structure, dormancy and germination of seed.

10. *Plant Pathology*—Knowledge of diseases of rice, wheat, sugarcane, potato, mustard, groundnut and cotton crops. Principles of biological control. Crown gall.

11. *Plant and Environment*—Biotic components. Ecological adaptation. Types of vegetational zones and forests of India. Deforestation, afforestation, social forestry. Soil erosion, wasteland reclamation. Environmental pollution, bioindicators. Plant introduction.

12. *Botany*—A HUMAN CONCERN - Importance of conservation. Germplasm resources, endangered, threatened & endemic taxa. Cell, tissue, organ and protoplast cultures in propagation and enrichment of genetic diversity. Plants as sources of food, fodder, forage, fibers, fatty oils drugs, wood and timber, paper, rubber, beverages, spices, essential oils and resins, gums, dyes, insecticides, pesticides and ornamentation. Biomass as a source of energy. Bio-fertilizers. Biotechnology in agri-horticulture, medicine and industry.

CHEMISTRY

SECTION A

Atomic number, Electronic Configuration of elements, Aufbau principle, Hund's Multiplicity Rule, Pauli's Exclusion Principle, long form of the Periodic Classification of elements; salient characteristics of 's', 'p', 'd' and 'f block elements.

Atomic and ionic radii, ionisation potential, electron affinity and electronegativity; their variation with the position of the element in the periodic table.

Natural and artificial radioactivity theory of nuclear disintegration; disintegration and displacement laws; radioactive series; nuclear bindings energy, nuclear reaction, fission and fusion, radioactive isotopes and their uses.

Electronic Theory of Valency. Elementary ideas about sigma and pi-bonds, hybridization and directional nature of covalent bonds. Shapes of simple molecules, bond order and bond length.

Oxidation states and oxidation number. Common redox reactions; ionic equation.

Bronsted and Lewis theories of acids and bases.

Chemistry of common elements and their compounds, treated from the point of view of periodic classification.

Principles of extraction of metals, as illustrated by sodium, copper, aluminium, iron and nickel.

Werner's theories of coordination compounds and types of isomerism in 6- and 4- coordinate complexes. Role of coordination compounds in nature, common metallurgical and analytical operations.

Structures of Diborane, aluminium chloride, ferrocene alkyl magnesium halides, dichlorodiamine platinum and xenon chloride.

Common ion effect, solubility product and their applications in qualitative inorganic analysis.

SECTION B

Electron displacements-inductive, mesomeric and hyper-conjugative effects - effects of structure on dissociation constants of acids and bases - bond formation and bond fission of covalent bonds-reaction intermediates-carbonations, carbanions, free radicals and carbenes nucleophiles and electrophiles.

Alkanes, alkenes and alkynes-petroleum as a source of organic compounds-simple derivatives of aliphatic compounds; halides, alcohols, aldehydes, ketones, acids, esters, acid chlorides, amides, anhydrides, ethers, amines and nitro compounds monohydroxy, ketonic and amino acids-Grignard reagents-active methylene group - malonic and acetoacetic esters and their synthetic uses - unsaturated acids.

Stereochemistry: elements of symmetry, chirality, optical isomerism of lactic and tartaric acids, D, L,-notation, R,S,-notation of compounds containing chiral centres, concept of conformation -Tischer sawhors and Newman projections of butane 2,3 - diolgeometrical isomerism of maleic and fumaric acids, E and Z notation of geometrical isomers.

Carbohydrates classification and general reactions, structures of glucose, fructose and sucrose, general idea on the chemistry of starch and cellulose. Benzene and common monofunctional benzenoid compounds, concept of aromaticity as applied to benzene naphthalene and pyrole-orientation influence in aromatic substitution chemistry and uses of diazonium salts.

Elementary idea of the chemistry of oils, fats, proteins and vitamins-their role in nutrition and industry.

Basic principles underlying spectral techniques (UV-visible, IR, Raman and NMR).

SECTION C

Kinetic theory of gases and gas laws. Maxwell's law of distribution of velocities. Van der Vaals equation, Law of corresponding states. Specific heat of gases, ratio Cp/Cv.

Thermodynamics: The first law of thermodynamics, isothermal and adiabatic expansions. Enthalpy, heat capacities and thermochemistry. Heats of reaction. Calculation of bond energies. Kirchoffs equation. Criteria for spontaneous changes. Second law of thermodynamics. Entropy, Free energy, Criteria for chemical equilibrium.

Solutions: Osmotic pressure, Lowering of vapour pressure, depression of freezing point and elevation of boiling point. Determination of molecular weight in solution. Association and dissociation of solutes.

Chemical equilibria: Law of mass action and its application to homogeneous and heterogeneous equilibrium; Le Chaterliere principle and its application to chemical equilibria.

Chemical Kinetics: Molecularity and order of a reaction, First order and second order reactions, Temperature coefficient and energy of activation. Collision theory of reaction rates qualitative treatment of theory of activated complex.

Electrochemistry—Faraday's laws of electrolysis, conductivity of an electrolyte, Equivalent conductivity and its variation with dilution. Solubility of sparingly soluble salts. Electrolytic dissociation. Ostwald's dilution law, anomaly of strong electrolytes, Solubility product. Strength-of acids and bases, Hydrolysis of salts. Hydrogen ion concentration. Buffer action. Theory of indicators.

Reversible cells—Standard hydrogen and calomal electrodes. Redox potentials, concentration cells. Ionic product of water. Potentiometric titrations.

Phase rule—Explanation of terms involved. Application to one and two component systems. Distribution law.

Colloids—General nature of colloidal solutions and their classification. Coagulation. Protective action and Gold number.

Absorption

Catalysis—Homogenous and heterogeneous catalysis. Promoters and Poisons.

CIVIL ENGINEERING

Engineering Mechanics: Statics; units and dimensions SI units, vectors, coplanar and noncoplanar force systems, equations of equilibrium, free body diagrams, static friction, virtual. work, distributed force systems, first and second moments of area, mass moment of Inertia.

Kinematics and Dynamics: Velocity and acceleration in Cartesian and curvilinear coordinate systems, equations of motion and their integration, principles of conservation of energy and momentum, collision of elastic bodies, rotation of rigid bodies about fixed axis, simple harmonic motion.

Strength of Materials: elastic, isotropic and homogeneous materials, stress and strain, elastic constants, relation among elastic constants, axially loaded determinate and indeterminated members, shear force and bending moment diagrams, theory of simple bending, shear stress distribution, stitched beams.

Deflection of Beams: Macaulay method, Mohr theorems, Conjugate beam method, torsion, torsion of circular shafts, combined bending, torsion and axial thrust, close coiled helical springs Strain Energy, strain energy in direct stress, shear stress, bending and torsion.

Thin and thick cylinders, columns and struts, Euler and Rankine loads, principal stresses and strains in two dimensions- Mohr circle-theories of elastic failure. Structural Analysis; indeterminate beams, propped, fixed and continuous beams, shear force and bending moment diagrams, deflections, three hinged and two hinged arches, rib shortening, temperature effects, influence lines.

Trusses: Method of joints and method of sections, deflections of plane pin jointed trusses.

Rigid Frames: analysis of rigid frames and continuous beams by theorem of three moments, moment distribution method, slope deflection method, Kani method and column analogy method, matrix analysis; Rolling loads and influence lines for beams and pin-jointed girders.

Soil Mechanics : Classification and identification of soils, phase relationships; surface tension and apillary phenomena in soils, laboratory and field determination of co-efficient of permeability; seepage forces, flow nets, critical hydraulic gradient, permeability of stratified deposits; Theory of compaction, compaction control, total and effective stresses, pore pressure coefficient, shear strength parameters in terms of total and effective stress, Mohr-Coulomb theory; total and effective stress analysis of soil slopes ; active and passive pressures, Rankine and Coulomb theories of earth pressure, pressure, distribution on trench sheeting, retaining walls, sheet pile walls: soil consolidation, Terzaghione-dimensional theory of consolidation, primary and secondary settlement.

Foundation Engineering: Exploratory program for sub-surface investigations, common types of boring and sampling, field test and their interpretation, water level observations;. Stress distribution beneath loaded areas by Boussinesq and Steinbrenner methods, use of influence charts, contact pressure distribution determination of ultimate bearing capacity by Terzaghi, Skempton and Hansen's methods; allowable bearing pressure beneath footings and rafts; settlement criteria, design aspects of footings and rafts; bearing capactiy of piles and pile groups, pile load tests, underreamed piles for swelling soil; Well foundations, conditions of statical equilibrium, vibration analysis of single degree freedom system, general considerations for design of machine foundations; earthquake effects on soil foundation systems, liquefaction.

Fluid Mechanics—Fluid properties, fluid statics, forces on plane and curved surfaces. Stability of floating and submerged bodies

Kinematics—Velocity streamlines, continuity equation, accelerations, irrotational and rotational flow, velocity potential and stream functions, flow net, separation and stagnation.

Dynamics—Euler's equation along stream line, energy and momentum equations, Bernoulli's theorem, applications to pipe flow and free surface flows, free and forced vortices.

Dimensional Analysis and similitude Buckingham's Pi theorem, dimensionless parameters, similarities, undistorted and distorted models.

Boundary layer on a flat plate, drag and lift on bodies.

Laminar and Turbulent flows: Laminar flow through pipe and between parallel plates, transition to turbulent flow, turbulent flow through pipes, friction factor variation, energy loss in expansions, contraction and other non-uniformities, energy grade line and hydraulic grade line, pipe networks, water hammer.

Compressible flow: Isothermal and isentropic flows, velocity of propogation of pressure wave, Mach number, subsonic and supersonic flows, shock waves.

Open channel flow: Uniform and non-uniform flows, specific energy and specific force, critical depth, flow in contracting transitions, free overall, wires, hydraulic jump, surges, gradually varied flow equation and its integration, surface profiles.

Surveying: General principles; sign conventions, chain surveying, principles of plane table surveying, two point problem, three point problem, compass surveying, traversing ; bearings local, attraction, traverse computations, corrections.

Levelling: Temporary and permanent adjustments; fly- levels, reciprocal levelling, contour levelling; volume computations, refraction and curvature corrections.

Theodolite: Adjustments traversing, heights and distances, tacheometric surveying.

Curve setting by chain and by theodolite; horizontal and vertical curves.Triangulation and base-line measurements; Satellite stations, trigonometric levelling, astronomical surveying , celestial co-ordinates, solution of spherical triangles, determination of azimuth, latitude, longitude and time.

Principles of aerial photogrammetry, hydrographic surveying.

COMMERCE

Part-I Accounting

Accounting equation-concepts and conventions, Generally accepted accounting principles-capital and revenue expenditures and receipts- preparation of the financial

statements including statements of sources and application of funds-Partnership accounts including dissolution and piece meal distribution among the partners. Accounts of non profit organisations-Preparation of accounts from incomplete records- Company Accounts-Issue and redemption of shares and debentures-Capitalisation of profits and issue of bonus shares- Accounting for depreciation-including accelerated methods of providing depreciation-Inventory valuation and control.

Ratio analysis and interpretation-Ratios relating to short term liquidity, long term solvency and profitability-importance of the rate of return on investment (ROI) in evaluating the overall performance of a business entity.

Nature and objects of auditing- Balance Sheet and continuous audit-Statutory management and operational audits-Auditors, working papers-internal control and internal audit-Audit of proprietary and partnership firms-Broad outlines of the Company audit.

Part II: Business organisation and Secretarial Practice

Distinctive features of different forms of business organisation. Formalities and documents in floating a Joint Stock Company-Doctrine of indoor management and principle of constructive notice-Type of securities and methods of their issue-Economic functions of the new issues market and stock exchange- Business combinations-Control of monopoly houses- Problems of modernisation of industrial enterprises. Procedure and financing of export and import trade- Incentives for export promotion Role of the EXIM Bank- Principles of insurance, life, fire-and marine.

Management functions: Planning, Organising, Staffing, Directing, Coordination and Control.

Organisation Structure: Centralisation and decentralisation, delegation of authority, span of control, management by objective (M.B.O) and Management by exception.

Office Management: Scope and principles-Systems and routines-Handling of records- Office equipment and machines-Impact of Organisation and methods (O&M).

Company Secretary: Functions and scope-Appointment, qualifications and disqualifications-Right, duties and liabilities of company secretary-Drafting of agenda and minutes.

ECONOMICS

PART-I

1. National Economic Accounting: National Income Analysis, Generation and Distribution of Income and related aggregates: Gross National Product, Net National Product, Gross Domestic Product and Net Domestic Product (at market prices and factor costs) : at constant and current prices.

2. Price Theory: Law of demand; Utility analysis and Indifference curve techniques, consumer equilibrium; cost curves and their relationships; equilibrium of a firm under different market structures: pricing of factors of Production.

3. Money & Banking: Definitions and functions of money (Ml, M2, M3); Credit creation; Credit sources, costs and availability, theories of the Demand for money.

4. International trade: The theory of comparative costs; Ricardian and Hocksher Ohlin ; the balance of payments and the adjustment mechanism. Trade theory and economic growth and development.

Part II

Economic growth and development: Meaning and measurement; characteristics of underdevelopment; rate and pattern. Modern Economic Growth; Sources of growth distribution and growth; problems of growth of developing economies.

Part III

Indian Economy: India's economy since independence; trends in population growth since 1951; Population and poverty; general trends in National Income and related aggregates; Planning in India; Objectives, strategy and rate and pattern of growth; problems of industrialisation strategy; Agricultural growth since Independence with special reference to foodgrains; unemployment; nature of the problem and possible solutions; Public Finance and Economic Policy.

ELECTRICAL ENGINEERING

Primary and secondary cells, Dry accumulators, Solar Cells, Steady state analysis of d.c. and a.c. network, network theorems; network functions, Laplace techniques, transient response; frequency response; three- phase networks; inductively coupled circuits.

Mathematical modelling of dynamic linear systems, transfer functions, block diagrams; stability of control systems.

Electrostatic and magnetostatic field analysis; Maxwell's equations. Wave equations and electromagnetic waves.

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

Vaccum based and Semi-conductor devices and analysis of electronic Circuits; single and multi-stage audio and radio, small signal and large signal amplifiers; oscillators and feed back amplifiers; wave shaping circuits and time base generators ; multi-vibrators and digital circuits; modulation and demodulation circuits. Transmission line at audio, radio and U.H. Frequencies; Wire and Radio communication.

Generation of e.m.f. and torque in rotation machine; motor and generator characteristics of d.c. synchronous and induction machines, equivalent circuits; commutation starters ; phaser diagram, losses, regulation, power transformers.

Modelling of transmission lines, steady, state and transient stability, surge phenomena and insulation coordination; protective devices and schemes for power system equipment.

Conversion of a.c. to d.c. and d.c. to a.c. controlled and uncontrolled power, speed control techniques for drives.

GEOGRAPHY

Section A: General principles :

(i) Physical geography.
(ii) Human Geography.
(iii) Economic Geography.
(iv) Cartography.
(v) Development of Geographical thought.

Section B: Geography of the World :

(i) World land forms, climates, soils and vegetation.
(ii) Natural regions of the World.
(iii) World population, distribution and growth; races of mankind and international migrations; cultural realms of the World.
(iv) World agriculture, fishing and forestry minerals and energy resources; World industries.
(v) Regional study of Africa, South-East Asia, S.W. Asia, Anglo-America, U.S.S.R and China.

Section C : Geography of India :

(i) Physiography, climate, soils and vegetation.
(ii) Irrigation and agriculture; forestry and fisheries.
(iii) Minerals and energy resources.
(iv) Industries and industrial development.
(v) Population and settlements.

GEOLOGY

Part-I

(a) Physical Geology; Solar system and the Earth Origin, age and internal constitution of Earth, Weathering , Geological work of river, lake, glacier, wind, sea and groundwater. Volcanoes-types distribution, geological effects and products; Earthquakes-distribution causes and effects. Elementary ideas about geosynclines, isostasy and mountain building, continental drift, seafloor spreading and plate tectonics.

(b) Geomorphology: Basic concepts of geomorphology. Normal cycle of erosion, drainage patterns. Landforms formed by ice, wind and water.

(c) Structural and Field geology: Clinometer compass and its use. Primary and secondary structures. Representation of altitude; Slope; strike and dip. Effects of topography on outcrop. Folds, Fault, unconformities and joint-their description,

classification, recognition in the field and their effects on outcrops. Criteria for the determination of the order of super- position in the field. Nappes and Geological windows. Elementary ideas of geological survey and mapping.

Part-II

(a) Crystallography: Crystalline and amorphous substances. Crystal, its definition and morphological characteristics; elements of crystal structure. Laws of Crystallography. Symmetry elements of crystal belonging to normal class of seven Crystal Systems. Crystal habits and twinning.

(b) Mineralogy: Principles of optics. Behaviour of light through isotropic and anisotropic substances. Petrological microscope; construction and working of Nicol Prism. Birefringence; Pleochroism; extinction. Physical, chemical and optical properties of more common rock forming minerals of following groups; quartz, feldspar, mica, amphibole, pyroxene, olivine, garnet, chlorite and carbonate.

(c) Economic Geology: Ore, ore mineral and gangue. Outline of the processes of formation and classification of ore deposits. Brief study of mode of occurrence, origin, distribution (in India) and economic uses of the following; gold, ores of iron, manganese, chromium, copper, aluminium, lead and zinc; mica, gypsum magnesite and kyanite; diamond; coal and petroleum.

PETROLOGY

Part-III

(a) Igneous Petrology: Magma- Its composition and nature, Crystallization of Magma Differentiation and assimilation. Bowen's reaction principle Texture and structure of igneous rocks. Mode of occurrence and mineralogy of igneous rocks. Classification and varieties of igneous rocks.

(b) Sedimentary Petrology: Sedimentary process and products. An outline classification of sedimentary rocks . Important primary sedimentary structures (bedding, cross bedding, graded bedding , ripple marks, sole structures, parting lineation). Residual deposit, their mode of formation, characteristics and important types. Clastic deposits, their classification, mineral, composition and texture. Elementary knowledge of the origin and characteristics of quartz arenites, arkoses and greywackes. Siliceous and calcoreous deposits of chemical and organic origin.

(c) Metamorphic Petrology: Definition, agents and types of metamorphism. Distinguishing characters of metamorphic rocks. Zones, grades of metamorphic rocks. Texture and structure of metamorphic rocks. Basis of classification of metamorphic rocks. Brief petrographic description of quartizite, slate, schist, gneiss, marble and homfels.

Part-IV

(a) Palaeontology : Fossils, conditions for entombent, types of preservation and uses. Broad morphological features and geological distribution of brachiopods, bivalves (lamelli-branches), gastropodes, cephalopods, trilobites, echinoids and corals. A brief study of Gondwana flora and Siwalik mammals.

(b) Stratigraphy: Fundamental laws of stratigraphy: Classification of the stratified rocks into groups, systems and series etc. and classification of geologic time into eras, periods and epochs. An outline Geology of India and a brief study of the following systems with respect to their distribution, lithology, fossil interest and economic importance, if any; Dharwar, Windhyan, Gondwana and Siwalik.

INDIAN HISTORY

Section A

1. Foundations of Indian Culture and civilisation :
   Indus Civilisation
   Vedic Culture
   Sangam Age

2. Religious Movements :
   Buddhism
   Jainism
   Bhagavatism and Brahmanism

3. The Maurya Empire.
4. Trade and Commerce in the pre Gupta and Gupta period.
5. Agrarian structure in the post-Gupta period.
6. Changes in the social structure of ancient India.

Section B

1. Political and Social conditions, 800-1200. The Cholas.
2. The Delhi Sultanate : Administration Agrarian Conditions.
3. The Provincial Dynasties, Vijayanagar Empire Society and Administration.
4. The Indo-Islamic culture, Religious movements, 15th and 16th centuries.
5. The Mughal Empire (1526-1707) Mughal polity; agrarian relations; art, architecture and culture under the Mughals.
6. Beginning of European Commerce.
7. The Maratha Kingdom and Confederacy.

SECTION C

1. The decline of the Mughal Empire; the autonomous state with special reference to Bengal, Mysore and Punjab.
2. The East India Company and the Bengal Nawabs.
3. British Economic Impact in India.
4. The Revolt of 1857 and other popular movements against British rule in the 19th century.
5. Social and cultural awakening; the lower caste, trade union and the peasant movements.
6. The Freedom struggle.

LAW

I. Jurisprudence

1. Schools of Jurisprudence; Analytical, historical, philosophical and sociological.
2. Sources of law: custom, precedent and legislation.
3. Rights and duties.
4. Legal Personality.
5. Ownership and possession.

II. Constitutional Law of India

1. Salient features of the Indian Constitution;
2. Preamble;
3. Fundamental Rights, Directive Principles and Fundamental Duties.
4. Constitutional position of the President and Governors and their powers.
5. Supreme Court and High Courts: their powers and jurisdiction.
6. Union Public Service Commission and State Public Service Commissions :Their Powers and Functions.
7. Distribution of Legislative powers between the Union and the States.
8. Emergency provisions.
9. Amendment of the Constitution.

III. International Law

1. Nature of International Law.
2. Sources: Treaty, Custom, General Principles of law recognized by civilized nations and subsidiary means for the determination of law.
3. State Recognition and State Succession.
4. The United Nations: its objectives and Principal Organs; the constitution, role and jurisdiction of the International Court of Justice.

IV. Torts

1. Nature and definition of tort;
2. Liability based on fault and strict liability;
3. Vicarious liability;
4. Joint tort-feasors;
5. Negligence;
6. Defamation;
7. Conspiracy;
8. Nuisance;
9. False imprisonment and malicious prosecution.

V. Criminal Law

1. General principles of criminal liability;
2. Mens rea;

3. General exceptions;
4. Abetment and conspiracy;
5. Joint and constructive liability;
6. Criminal attempts;
7. Murder and Culpable homicide;
8. Sedition;
9. Theft; extortion, robbery and dacoity;
10. Misappropriation and Criminal breach of trust;

VI. Law of Contract

1. Basic elements of contract: offer, acceptance, consideration, contractual capacity.
2. Factors vitiating consent.
3. Void, viodable, illegal and unenforceable agreements.
4. Performance of contracts.
5. Dissolution of contractual obligations, frustration of contracts.
6. Quassi-contracts.
7. Remedies for breach of contract.

MATHEMATICS

Algebra : Sets, relations equivalence relations, Natural numbers, Integers, Rational numbers, Real and Complex numbers, division algorithm, greatest common divisor polynomials, division algorithm, derivations, Integral, rational real and complex roots of a polynomial, Relation between roots and coefficients, repeated roots, elementary symmetric functions, Groups, rings, fields and their elementary properties.

Matrices: Addition and multiplication, elementary row and column operation, rank determinants, inverse, solutions of systems of linear equations.

Calculus: Real numbers, order completeness property, standard functions, limits, continuity, properties of continuous functions in closed intervals, differentiability, Mean value Theorem, Taylors Theorem, Maxima and Minima, Application to curves-tangent normal properties, Curvature, asymptotes, double points, points of inflexion and tracing.

Definition of a definite integral of continuous function as the limit of a sum, fundamental theorem of integral Calculus, methods of integration, rectification quadrature, volume and surfaces of solids of revolution.

Partial differentiation and its application.

Simple test of convergence of series of positive terms alternating series and absolute convergence.

Differential Equations: First order differential equations, Singular solutions, geometrical interpretations, linear differential equations with constant coefficients.

Geometry: Analytic Geometry of straight lines and conics referred to Cartesian and polar Coordinates; three dimensional geometry for planes, straight lines, sphere, Cone and Cylinder.

Mechanics: Concept of particle, lamina, rigid body, displacement, force, mass, weight, concept of scalar and vector quantities, Vector Algebra, Combination and equilibrium of Coplanar forces, Newton's Laws of motion, motion of a particle in a straight line; Simple Harmonic motion, projectile, circular motion, motion under central forces (inverse square law), escape velocity.

MECHANICAL ENGINEERING

Statics: Simple applications of equilibrium equations.

Dynamics: Simple applications of equations of motion, simple harmonic motion, work energy, power.

Theory of Machines: Simple examples of links and mechanism. Classification of gears, standard gear tooth profiles, Classification of bearing. Function of fly wheel. Types of governors. Statics and dynamic balancing. Simple examples of vibration of bars. Whirling of shafts.

Mechanics of solids : Stress, strain, Hook's Law, elastic modulii, Bending moments and shearing force diagrams for beams. Simple bending and torsion of beams springs, thin walled cylinders Mechanical properties and material testing.

Manufacturing Science: Mechanics of metal cutting, tool life, economics of machining, cutting tool materials. Basic machining processes, types of machine tools, transfer lines, shearing, drawing, spinning, rolling, forging, extrusion. Different types of casting and welding methods.

Production Management: Method and time study, motion economy and work space design, operation and flow process charts. Product design and cost selection of manufacturing process. Break even analysis, Site selection, plant layout, Materials handling, selection of equipment for job, shop and mass production, Scheduling, despatching routing.

Thermodynamics: Heat, work and temperature, First and second laws of thermodynamics, Carnot, Rankine, Otto and Diesel Cycles.

Fluid Mechanics: Hydrostatics Continuity equation. Bernoulli’s theorem. Flow through pipes. Discharge measurement. Laminar and Turbulent flow, concept of boundary layer.

Heat Transfer: Heat transfer by Conduction, Convection and Radiation. One dimensional steady state conduction through walls and cylinders. Fins, Concept of thermal boundary layer. Heat transfer, coefficient, Combined heat transfer, coefficient, Heat exchangers.

Energy Conversion: Compression and spark ignition engines, Compressors, fans and blowers. Hydraulic pumps and turbines Thermal turbo machines.

Boiler Flow of steam through nozzles layout of power plants.

Environmental Control Refrigeration cycles, refrigeration equipment—its operation and maintenance, important refrigerants, Psychometrics comfort, cooling and dehumidification.

PHILOSOPHY

(i) *Logic* : Symbolic Logic Syllogism and fallacies, Mathematical Logic, Truth Functional logic ;

(ii) *History of Indian Ethics*: Source, Types, Meaning of Dharma, Ethics and Metaphysics; and Karma and Freewill ; Karma and Gyana ;

(iii) *History of Western Ethics*: Moral standards Judgement, Order and progress; Ethics and Emotivism; Determinism and Freewill; Crime and Punishment, Individual and Society.

(iv) *History of Philosophy* : Western, Indian Orthodox. Indian Heterodox.

PHYSICS

1. *Mechanics* : Units and dimensions, S.l. units, Motion in one and two dimensions, Newton's laws of motion with applications. Variable mass systems, Frictional forces, work, power and Energy. Conservative and non-conservative systems, Collisions, Conservation of energy. Linear and angular momenta. Rotational Kinematics, Rotational dynamics. Equilibrium of rigid bodies. Gravitation, Planetary motion, Artificial Satellites.. Surface tension and Viscosity. Fluid dynamics, streamline and turbulent motion. Bernoulli's equation with applications. Stoke's law and its application, Special theory of relativity, Lorentz Transformation, Mass Energy equivalence.

2. *Waves and Oscillations* : Simple harmonic motion, Travelling & Stationary waves, Superposition of waves, Beats. Forced oscillations, Damped oscillations, Resonance, Sound waves, Vibrations of air columns, strings and rods. Ultrasonic waves and their application. Doppler effect.

3. *Optics* : Matrix method in paraxial optics. Thin lens formulae, Nodal planes, Systems of two thin lenses, Chromatic and Spherical aberration, Optical instruments, Eyepieces, Nature and propagation of light, Interference, Division of wavefront, Division of amplitude, Simple interferometers. Diffraction-Fraunhefer and Fresnel, Gratings. Resolving power of optical instruments, Rayleigh criterion, Polarization, Production and Detection of Polarized light. Rayleigh Scattering. Raman Scattering, Lasers and their applications.

4. *Thermal Physics* : Thermometry, Laws of thermodynamics, Heat engines, Entropy, Thermodynamic potentials and Maxwell's relations. Vander Waals equation of

State, Critical constants. Joule-Thomson effect, Phase transition, Transport phenomenon, heat conduction and specific heat in solids, Kinetic Theory of Gases, Ideal Gas equation, Maxwell's velocity distribution, Equipartition of Energy, Mean free path, Brownian Motion Black- body radiation, Planck's Law.

5. *Electricity and Magnetism*: Electric charge, Fields and Potentials, Coulomb's Law, Gauss Law, Capacitance, Dielectrics, Ohm's Law, Kirchoffs laws, Magnetic field, Ampere's Law, Faraday's Law of electromagnetic induction, Lenz's Law. Alternating Currents, LCR Circuits, Series & Parallel resonance, Q-factor, Thermoelectric effects and their applications, Electromagnetic Waves. Motion of charged particles in electric and magnetic fields. Particle accelerators, Ven de Graaff generator, Cyclotron, Betatron, Mass spectrometer, Hall effect, Dia, Para and ferro magnetism.

6. *Modern Physics* : Bohr's Theory of Hydrogen atom, Optical and X-ray spectra, Photoelectric effect. Compton effect, Wave nature of matter and Wave-Particle duality, Natural and artificial radio-activity, alpha, beta and gamma radiation, chain decay, Nuclear fission and fusion, Elementary particles and their classification.

7. *Electronics*: Vacuum tubes diode and triode p- and n-type materials p-n diodes and transistors. Circuits for rectification, amplification and oscillations. Logic gates.

POLITICAL SCIENCE

Section A (Theory)

1. (a) The State - Sovereignty; Theories of Sovereignty.

   (b) Theories of the Origin of the States (Social contract Historical—Evolutionary and Marxist).

   (c) Theories of the functions of the State (Liberal Welfare and Socialist).

2. (a) Concepts—Rights, Property, Liberty, Equality, Justice.

   (b)Democracy—Electoral process; Theories of Representations; Public opinion, freedom of speech, the role of the Press; Parties and Pressure Groups.

   (c) Political Theories—Liberalism ; Early Socialism, Marxian Socialism, Fascism.

   (d) Theories of Development and Under-Development Liberal and Marxist.

Section B (Government)

1. *Government:* Constitution and Constitutional Government, Parliamentary and Presidential Government Federal and Unitary Government; State and Local Government; Cabinet Government; Bureaucracy.

2. *India :* (a) Colonialism and Nationalism in India; the national liberation movement and constitutional development.

(b) The Indian Constitution, Fundamental Rights, Directive Principles of State Policy; legislature; Executive, Judiciary, including Judicial Review; the Rule of Law.

(c) Federalism, including Centre State Relations, Parliamentary System in India.

(d) Indian Federalism compared and contrasted with federalism in the USA, Canada, Australia, Nigeria and Federal Republic of Germany and the U.S.S.R.

PSYCHOLOGY

1. Scope and methods, Subject Matter.

2. Methods, Experimental methods, Field studies, Clinical and case methods, Characteristics of psychological studies.

3. Physiological Basis. Structure and functions of the nervous system, Structure and functions of the endocrine system.

4. Development of Behaviour, Genetic mechanism. Environmental factors. Growth and maturation. Relevant experimental studies.

5. *Cognitive processes (I)*. Perception, Perception process, Perceptual organisation, Perception of form, Colour, depth and time. Perceptual constancy. Role of motivation, social and cultural factors in perception.

6. *Cognitive processes (II).* Learning, Learning process, Learning theories : Classical conditioning. Operant conditioning, Cognitive theories. Perceptual learning. Learning and motivation. Verbal learning. Motor learning.

7. *Cognitive Processes (III).* Remembering, Measurement of remembering. Short-term memory. Long-term memory, forgetting, theories of forgetting.

8. *Cognitive Processes (IV).* Thinking Development of thinking, language and thought, images, concept formation, problem solving.

9. Intelligence, nature of intelligence, Theories of intelligence, Measurement of intelligence, Intelligence and creativity.

10. Motivation, Needs, drives and motives, Classification of motives, Measurement of motives, Theories of motivation.

11. Personality, Nature of personality, Trait and type approaches, Biological and socio-cultural determinants of personality. Personality assessment techniques and tests.

12. Coping Behaviour, Coping mechanisms, Coping with frustration and stress Conflicts.

13. Attitudes, Nature of attitudes, Theories of attitudes, Measurement of attitudes, Change of attitudes.

14. Communication, Types of communication, Communication process. Communication network, Distortion of communication.

15. Applications of psychology in industry. Education and Community.

PUBLIC ADMINISTRATION

1. *Introduction :* Meaning, scope and significance of public administration. Private and Public Administration; Evolution of Public Administration as a discipline.

2. *Theories and Principles of Administration:* Scientific Management; Bureaucratic Model; Classical Theory; Human Relations Theory; Behavioural Approach; Systems Approach. The Principles of Hierarchy; Unity of Command; Span of Control; Authority and Responsibility; Coordination; Delegation; Supervision; Line and Staff.

3. *Administrative Behaviour:* Decision Making Leadership theories Communication Motivation.

4. *Personnel Administration:* Role of Civil Service in developing society; Position Classification; Recruitment; Training; Promotion; Pay and Service Condition, Neutrality and Anonymity.

5. *Financial Administration:* Concept of Budget: Formulation and execution of budget; Accounts and Audit.

6. *Control over Administration:* Legislative, Executive and Judicial Control, Citizen and Administration.

7. *Comparative Administration:* Salient features of administrative systems in U.S.A, U.S.S.R., Great Britain and France.

8. *Central Administration in India :* British legacy; constitutional context of Indian administration: The President; the Prime Minister as Real Executive; Central Secretariat; Cabinet Secretariat; Planning Commission, Finance Commission; Comptroller and Auditor General of India; Major patterns of Public Enterprises.

9. *Civil Service in India :* Recruitment of All India and Central Services, Union Public Service Commission, Training of lAS and IPS, Generalists and specialists; Relations with the Political Executive.

10. *State, District and Local Administration :* Governor, Chief Minister; Secretariat; Chief Secretary; Directorates; Role of District Collector in revenue, law and order and development administration; Panchayati Raj; Urban local government; Main features, Structure and problem-areas.

SOCIOLOGY

Concepts: race and culture; human evolution, phases of culture, culture change-culture contact, acculturation, cultural relativism society, group, status, role, primary, secondary and reference groups, community and association, social structure and social

organisation, structure and function, objective facts, norms, values and belief systems, sanctions deviance, socio-cultural processes- assimilation, integration cooperation, competition and conflict, Social Demography Institutions: Kinship system and kinship usages; rules of residence and descent; marriage and family; economic systems of simple and complex societies-barter and ceremonial exchange, market economy, political institutions in simple and complex societies; religion in simple and complex societies, magic, religion and science. Practices and Organizations, Social stratification: Caste, class and estate. Communities: village, town, city, region.

Types of society: tribal agrarian, industrial, post-industrial, Constitutional provisions regarding scheduled castes and scheduled tribes.

STATISTICS

I. Probability (25 per cent weight):

Classical and axiomatic definitions of probability, simple theorems on probability with examples, conditional probability, statistical independence Bayes' theorem, Discrete and continuous random variables probability mass function and probability density function, cumulative distributions function, joint marginal and conditional probability distributions of two variables, functions of one and two random variables moments, moment generating function chebichev's inequality, Binomial; Poisson Hypergeometric, Negative Binomial, Uniform, exponential, gamma, beta, normal and bivariate normal probability distributions Convergence in probability weak law of large numbers, simple form of central limit theorem.

(II) Statistical Methods (25 per cent weight):

Compilation, classification, tabulation and diagrammatic representation of statistical data, measures of central tendency, dispersion, skewness and kurtosis measures of association and contingency correlation and linear regression involving two variables, correlation ratio, curve fitting.

Concept of a random sample and statistics, sampling distributions of X, X^2, T and F statistics, their properties, estimation and tests of significance based on them. Order statistics and their sampling distributions in case of uniform and exponential parent distribution.

(III) Statistical Inference (25 percent weight):

Theory of estimation, unbiasedness, consistency, efficiency, sufficiency, Cramer-Rao Lower bound, best linear unbiased estimates, methods of estimation, methods of moments, maximum likelihood, least squares, minimum X^2 properties of maximum likelihood estimators (without proof) simple problems of constructing confidence intervals.

Testing of hypothesis, simple and composite hypothesis, Statistical tests, two kinds of error, optimal critical regions for simple hypothesis concerning one parameter, likelihood ratio tests, tests for the parameters of binomial, Poisson, uniform, exponential and normal distributions. Chi-square test, sign test, run test, medium test, Wilcoxon test rank correlation methods.

(IV) Sampling Theory and Design of Experiments (25 per cent weight):

Principles of sampling, frame and sampling units, sampling and non sampling errors, simple random sampling, stratified sampling, cluster sampling, systematic sampling, ratio and regression estimates, designing of sample surveys with reference to recent large scale surveys in India.

Analysis of variance with equal number of observations per cell in one, two and three way classifications, transformations to stabilize variance. Principles of experimental design, completely randomized design. Randomized block design, Latin square design, missing plot technique, factorial experiments with confounding in 2n design balanced incomplete block designs.

ZOOLOGY

1. *Cell structure and function:* Structure of an animal cell, nature and function of cell organells, mitosis and meiosis, chromosomes and genes, laws of inheritance mutation.

2. *General survey and Classification of non-chordates, (upto sub-classes) and chordates (upto orders) of following :* Protozoa, Porifera, Coelenterate, Platyhelminthes, Aschminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordata.

3. *Structure, Reproduction and life history of the following types:* Amoeba, Monocytis, Plasmodium, Paramaecium, Sycon, Hydra, Obelia, Fasciola, Taenia, Ascaris, Nereis, Pheretima, Leech, prawn, scorpion, cockroach, a bivalve, a snail, Balanaglosus, an ascidian, Amphioxus.

4. *Comparative anatomy of vertebrates:* Integument endoskeleton, locomotory organs, digestive system, respiratory system, heart and Circulatory system, urinogenitial system and sense organs.

5. *Physiology:* Chemical composition of protoplasm, nature and function of enzymes, colloids and hydrogen-ion concentration biological oxidation. Elementary physiology of digestion, excretion, respiration, blood, mechanism of circulation with special reference to man, nerve impulse, conduction and transmission across synaptic junction.

6. *Embryology:* Gametogenesis, fertilization, cleavage, gastrulation; Early development and meta-morphogenesis of frog. Ascidian and retrogressive metamorphosis. Neoteny, development of foetal membranes in chick and mammals.

7. *Evolution :* Origin of life, Principles and evidences of evolution, speciation, mutation and isolation.

8. *Ecology :* Biotic and abiotic factors; concept of ecosystem, food chain and energy flow; adaptation of aquatic and desert fauna, parasitism, and symbiosis; factors causing environmental pollution and its prevention. Endangered species Chronobiology and circadian rhythm.

9. Economic Zoology-beneficial and harmful insects.