ANNEXURE- II

SCHEDULE – II
[(Vide Rule 4(3)]

The Scheme of Examination

I. The Competitive Examination shall comprise as follows, namely :-

(i) Preliminary Examination,
(ii) Main Examination,
(iii) Personality Test or Interview.

II. Candidates who will qualify in the Preliminary Examination, shall be called by the Commission, to appear in the Main Examination. The qualifying marks in the Preliminary Examination shall be such as may be fixed by the Commission. The marks obtained in the Preliminary Examination shall not be counted for ranking. The Main Examination shall comprise Odia Language, English, English Essay, General Studies-I & II papers, two optional subjects having two papers each as prescribed in Scheduled-III.

III. Candidates who obtain such minimum qualifying marks in the Main Examination as may be fixed by the Commission at their discretion shall be called for personality test. The personality test or interview shall carry 250 Marks and no minimum qualifying marks for personality test or interview shall be fixed.

Total marks thus obtained by the candidates in the written examination and personality test or interview would determine their ranking. Candidates shall be allotted to the various services keeping in view their ranks in the examination and the preferences indicated by them for various services.

SCHEDULE – III
[(Vide Rule 4(5)]

Scheme and subjects for the Examination

1 (A). The Preliminary Examination shall consist of two papers of objective type(Multiple choice questions) and each paper shall be of two hours duration. –

Paper – I	General Studies	200 Marks
Paper - II	General Studies	200 Marks

DETAILED SYLLABUS

PAPER - I

(i) Current events of National and International importance;
(ii) History of India and Indian National Movement;
(iii) Indian and World Geography-Physical, Social, Economic Geography of India and the World;
(iv) Indian Polity and Governance-Constitution, Political System, Panchayati Raj, Public Policy, Rights Issues, etc.
(v) Economic and Social Development-sustainable Development, Poverty, Inclusion, Demographics, Social Sector Initiatives, etc.
(vi) General Issues on Environmental Ecology, Bio-diversity and Climate Change that do not require subject specialization, and
(vii) General Science.

PAPER - II

(i) Comprehension;
(ii) Interpersonal Skills including communication skills;
(iii) Logical Reasoning and Analytic ability;
(iv) Decision Making and Problem Solving;
(v) General Mental Ability;
(vi) Basic numeracy (numbers and their relations, orders of magnitude) (Class-X level). Data Interpretation (Charts, Graphs, Tables, Data Sufficiency,etc. – Class-X level); and
(vii) English Language Comprehension Skills (Class-X level).

N O T E (i) - The scope of the syllabi for optional subject papers for the Main Examination is broadly of the Honours Degree level, i.e., a level higher than the Bachelors Degree and lower than the Masters Degree. In the case of Engineering and Law, the level corresponds to the Bachelors' Degree.

(ii) The Preliminary Examination is meant to serve as screening test only. The marks obtained in Preliminary Examination by the candidates who are declared qualified for admission to main examination will not be counted for determining their final order of merit. The number of candidates to be admitted to the Main Examination belonging to each category would be as nearly as may be but not more than 12 times of the total number of vacancies advertised.

Provided that the candidates securing same marks at the cut-off point of each category would be admitted even if it exceeds 12 times to that extent only.

Only those candidates who are declared by the Commission to have qualified in Preliminary Examination against a particular advertisement will be eligible for admission to the Main Examination against the said advertisement.

(iii) In the Preliminary Examination, candidates shall be awarded marks for correct response of each question. One-fourth marks assigned to that question shall be deducted for indicating incorrect response of each question, but no deduction from the total score shall be made if no response is indicated for a question in the answer sheet. There shall be four responses in each question to be answered and only one correct response shall be made to that. More than one response in any question shall be treated as wrong response and marks for such wrong response shall be deducted if one of the responses happened to be an incorrect response.

1 (B). Main Examination –

The Main Examination shall consist of the following papers and each paper shall be of three hours duration.

Compulsory papers - 1400 marks

Paper – I Odia Language	... 300 Marks
Paper – II English	... 300 Marks
Paper – III English Essay	... 200 Marks
Paper – IV General Studies-I	... 300 Marks
Paper – V General Studies-II	... 300 Marks

Optional Papers - (Paper VI,VII,VIII & IX) - 1200 marks

Two subjects to be selected from the list of Optional subjects set out below. Each subject will have two papers and each paper carrying 300 marks.

1(C). Personality Test or Interview shall carry ... 250 Marks

2. LIST OF OPTIONAL SUBJECTS FOR MAIN EXAMINATION

1. Agriculture
2. Animal Husbandry & Veterinary Science
3. Anthropology
4. Agricultural Engineering
5. Botany
6. Chemistry
7. Civil Engineering
8. Commerce & Accountancy
9. Economics
10. Electrical Engineering
11. Education
12. Fisheries Science
13. Forestry
14. Geography
15. Geology
16. Home Science
17. History
18. Indian Language & Literature (any one)
(a) Odia, (b) Hindi, (c) Sanskrit, (d) English, (e) Persian, (f) Urdu.
19. Law
20. Management
21. Mathematics
22. Mechanical Engineering
23. Philosophy
24. Physics
25. Political Science & International Relations
26. Public Administration
27. Psychology
28. Sociology
29. Statistics
30. Zoology

Note (I) –The candidates must opt for two optional subjects for Main Examination in the respective Box of the online application. Request for change of Optional Subjects will not be entertained.

(II) Candidates shall not be allowed to opt for the following combinations of optional subjects.

a) Odia, Hindi, Persian, Sanskrit, Urdu, English

b) Civil Engineering, Mechanical Engineering, Electrical Engineering and Agricultural Engineering.

c) Mathematics & Statistics

d) Anthropology & Sociology

e) Political Science & International Relations and Public Administration.

f) Commerce & Accountancy and Management.

g) Agriculture and Animal Husbandry & Veterinary Science.

h) Management and Public Administration

i) Education and Psychology

j) Agriculture and Agricultural Engineering.

(III) Each of the Papers i.e. Paper-I (Odia language) and Paper-II (English) will be of Matriculation standard and shall be qualifying in nature. The marks obtained in these two papers shall not be counted for ranking.

(IV) The papers on Essay, General Studies and Optional Subjects of only those candidates shall be evaluated who attain such minimum standard as may be fixed by the Commission at their discretion for the qualifying papers in Odia Language and English.

(V) The question papers for the Main Examination shall be of conventional (essay) type.

(VI) The question papers other than Indian Language and Literature shall be set in English as per G.A. Department Letter No 18430/Gen., dt. 04.07.2013, the question papers in all subjects will be in English only except in Language papers and reply are permitted in English or Odia according to the choice of the candidates. The candidates will specify the option of language in the appropriate box of online application form. No candidate will be permitted to use more than one language in the same answer script.

(VII) **Detailed Syllabus of Main Examination are available in the Website of the Commission.**

3. <u>General instructions</u> –

(i) Candidates must answer the papers in their own handwriting and in no circumstances they will be allowed the help of a scribe to write the answer for them.

(ii) The Commission shall be competent to fix the qualifying marks in any or all the subjects of the examination.

(iii) If a candidate's handwriting is not easily legible, a deduction will be made on this account from the total marks otherwise accruing to him.

(iv) Marks will not be allotted for mere superficial knowledge.

(v) Credit will be given for orderly, effective and exact expression combined with due economy of words in all subjects of the examination.

(vi) In the Question Papers, wherever necessary, questions involving the metric system of weights and measures only will be set.

(vii) Candidates shall use only international form of Indian numericals (i.e. 1, 2, 3, 4, 5, 6 etc.) while answering Question papers.

(viii) Candidates will be allowed the use of scientific (Non-programmable type) calculators at the conventional (Essay) type examination of O.P.S.C.. Programmable type calculators will, however, not be allowed and the use of such calculators shall tantamount to resorting to unfair means by the candidates. Loaning or interchanging of calculators in the Examination Hall is not permitted. Candidates are not permitted to use calculators for answering objective type papers (Preliminary Examination). They should not, therefore, bring the same inside the Examination Hall.

(ix) Candidates are not allowed to bring Mobile phones, pagers or any other communication devices into the premises of the Examination Centre and premises of the Commission.

4. Personality Test/Interview –

The candidate shall be interviewed by a Board to be constituted by the O,P.S.C. for the purpose. The said Board will have before them a record of his career. He will be asked questions on matters of general interest. The object of the interview will be to assess the personal suitability of the candidate for a career in public service. The object of test shall be to judge the mental caliber of a candidate, his intellectual qualities as well as social traits and his interest in current affairs. Further some of the qualities (to be judged will be) like mental alertness, critical powers of assimilation, clear and logical exposition, balance of judgment, variety and depth of interest, ability for social cohesion and leadership, intellectual and moral integrity, are to be judged by the said Board.

Syllabi for the
Odisha Civil Services
(Main) Examination

(Subject-wise)

SYLLABUS FOR ODISHA CIVIL SERVICES (MAIN) EXAMINATION

ODIA LANGUAGE

The aim of the paper is to test the candidate's ability to understand serious discursive prose and express his ideas clearly and correctly in Odia language. The pattern of questions would broadly be as follows:-

Comprehension of a given passage	..	30 Marks
Precis writing with a passage of around 1000 words	..	40 Marks
Translation from English to Odia	..	30 Marks
Grammar, usage and vocabulary	..	80 Marks
Short Essay of around 1000 words	..	100 Marks
Expansion of an idea	..	20 Marks
Total	..	300 Marks

ENGLISH

The aim of the paper is to test the candidate's ability to understand serious discursive prose and express his ideas clearly and correctly in English language. The pattern of questions would broadly be as follows :-

Comprehension of a given passage	..	30 Marks
Precis writing with a passage of around 1000 words	..	40 Marks
Translation from Odia to English	..	30 Marks
Grammar, usage and vocabulary	..	80 Marks
Short Essay of around 1000 words	..	100 Marks
Expansion of an idea	..	20 Marks
Total	..	300 Marks

ENGLISH ESSAY

GENERAL INSTRUCTION

Candidates will be required to write an Essay on a specific topic. The choice of subjects will be given. They will be expected to keep closely to the subject of the essay to arrange their ideas in orderly fashion and to write concisely. Credit will be given for effective and exact expression.

GENERAL STUDIES

The nature and standard of questions in this paper will be such that a well educated person will be able to answer them without any specialized study. The questions will be such as to test a candidate's general awareness of a variety of subjects, which will have relevance for a career in Civil Services.

Paper-I

(a) **History of Modern India and Indian Culture-**

1) The History of Modern India will cover the following :

* History of India since 1857
* Important personalities who shaped the Freedom Movements in Odisha and India
* Social Reform Movements

2) Indian culture will cover the following;

* Indian culture from ancient times to modern times
* Temple architecture of Odisha.
* Socio-cultural developments in Odisha

(b) **Geography of India will cover the following-**

* Physical, economic and social geography of India.
* Odisha's Physiography and Drainage system
* Odisha's Natural Resources – Water, forest and minerals.

(c) **Indian Polity will include the following-**

* Constitution of India
* Political system of India
* Government and politics in Odisha
* Panchayati Raj Institutions (PRIs) in Odisha.

(d) **Current National issues and topics of social relevance-**

This part is intended to test the candidate's awareness of current national issues and topics of social relevance in the present day India such as;

1. Demography & Human Resource Development
2. Behavioural & Social issues and Social Welfare problems : Child labour, gender inequality, adult literacy, rehabilitation of the handicapped and other deprived segments of society, drug abuse, public health, education and unemployment.

(e) Legal and environmental issues -

1. Human Rights
2. Corruption in public life
3. Communal harmony
4. Protection of minorities
5. Internal security and related issues
6. Environment and ecological issues;

   ecological preservation, conservation of natural resources and national heritage.
7. Role of national institutions, their relevance and need for change

Paper-II

(a) India and the World :

This part is intended to test candidate's awareness of India's relationship with the world in various spheres, such as the following;

1. Foreign Affairs
2. External security and related matters
3. Nuclear policy
4. Indians abroad

(b) Indian Economy :

1. This part will include the following;

I Planning, economic development, economic reforms and development of the Corporate Sector in India

II Economic and Trade issues

III Foreign trade

IV Role and functions of IMF, World Bank and WTO V Reserve Bank of India – its role and functions

2. I. Odishan Economy : Development during the post Reform Period.

II. Regional disparity

(c) International Affairs & Institutions :

This part will include the following;

1 . Important events in world affairs

2. International institutions like UN, ILO, EU, SAARC, WHO, ICJ

(d) Developments in the field of science & technology, communications and space :

In this part questions will test the candidate's awareness of the developments in the field of science and techonology, communications and space and also on basic ideas of computer;

(e) Statistical Analysis, Graphs & Diagrams :

This part will include exercises to test the candidates ability to draw common sense conclusions from information presented in graphical, statistical or diagrammatical form and to point out deficiencies, limitations or inconsistencies therein. The candidates should also be aware of techniques of counting and elementary probability.

OPTIONAL SUBJECTS FOR MAIN EXAMINATION

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.

AGRICULTURE

PAPER – I

Section – A

Cropping pattern in different a g r o -climatic zones of the country. Crop diversification. Impact of high-yielding and short-duration varieties on shifts in cropping pattern. Concepts of multiple cropping, multistorey, relay and inter-cropping, and their importance in relation to food production. Package of practices of cereals, pulses, oil seeds, fibres, sugar, tuber and fodder crops grown during Kharif and Rabi seasons in different regions of the country. Organic farming – principles and practices.

Water-use efficiency in relation to crop production, criteria for scheduling irrigation, ways and means of reducing run-off losses of irrigation water. Drip and sprinkler irrigation. Drainage of water-logged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.

Weeds, their characteristics, dissemination and association with various crops; their multiplication; cultural, biological and chemical control of weeds.

Important features, scope and propagation of various types of forestry plantations such as extension, social forestry, agro-forestry, and natural forests.

Soil-physical, chemical and biological properties. Processes and factors of soil formation. Modern classification of Indian soils. Mineral and organic constituents of soils and their role in maintaining soil productivity. Essential plant nutrients and other beneficial elements in soils and plants. Principles of soil fertility and its evaluation for judicious fertiliser use. Integrated nutrient management. Losses of nitrogen in soil, nitrogen-use efficiency in submerged rice soils, nitrogen fixation in soils. Fixation of phosphorus and potassium in soils and the scope for their efficient use. Problem soils and their management.

Soil conservation planning on watershed 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 stabilising agricultural production in rainfed areas.

Section – B

Ecology and its relevance to man. Biodiversity - natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth. Impact of changing environment on cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals, and humans.

Farm management, scope, importance and characteristics, farm planning and budgetting. Economics of different types of farming systems and factors affecting it. Marketing and pricing of agricultural inputs and outputs, price fluctuation and their cost; role of co-operatives in agricultural economy. Agriculture export zone. World Trade Organisation, General Agreement on Trade and Tariff, Intellectual Property Rights in relation to agriculture.

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; farm mechanization and i t s role in agricultural production and rural employment. Training programmes for extension workers. Institution village linkage programme.

PAPER – II

Section – A

Cell theory, structure, organells and their function. Cell division, nucleic acidsstructure and function, gene structure and function. Laws of heredity, their significance in plant breeding. Chromosome structure, chromosomal aberrations, linkage and cross-over, and their significance in recombination breeding. Polyploidy-euploid and aneuploids. Induction of mutation – micro- and macro-mutation and their role in crop improvement. Variation, components of variation, heritability, sterility and incompatibility and their application in crop improvement. Cytoplasmic inheritance, sex-linked, sex-influenced and sex-limited characters.

History of plant breeding. Modes of reproduction, selfing and crossing techniques. Origin and evolution of crop plants, centre of origin, law of homologous series. Plant biodiversity - crop genetic resources conservation and utilization. Application of principles of plant breeding to the improvement of major field crops. Pureline, pedigree, mass and recurrent selections. Combining ability, its significance in plant breeding. Hybrid vigour and its exploitation, backcross method of breeding, breeding for disease and pest resistance, role of interspecific and intergeneric hybridization. Role of biotechnology in plant breeding-tissue culture and molecular approach. Improved varieties, hybrids, composites of various crop plants.

Seed technology, its importance. Different kinds of seeds. Seed production and processing techniques. Role of public and private sectors in seed production, processing and marketing in India.

Plant physiology and its significance in agriculture. Imbibition, surface tension, diffusion and osmosis. Absorption and translocation of water, transpiration and water economy. Enzymes and plant pigments; photosynthesis-modern concepts and factors affecting the process, aerobic and anaerobic respiration; C_3, C_4 and CAM mechanisms. Carbohydrate, protein and fat metabolism. Growth and development; photoperiodism and vernalization. Auxins, hormones, and other plant regulators and their mode of action and importance in agriculture. Physiology of seed development and germination; dormancy.

Section – B

Climatic requirement and cultivation of major fruits, vegetable crops and flower and ornamental plants. Dryland and Hightech horticulture. Handling and marketing problems of fruit and vegetables. Methods of preservation of important fruits and vegetable products, processing techniques and equipment. Role of fruits and vegetables in human nutriton. Land scaping – design and layout of lawns and gardens.

Diseases and pests of field crops, vegetables, orchard and plantation crops of India. Causes and classification of plant pests and diseases. Principles of control of plant pests and diseases. Biological control of pests and diseases. Integrated pest and disease management. Epidemiology and forecasting of diseases and pest. Pesticides, their formulations and mode of action. Compatibility with rhizobial inoculants. Microbial toxins. Storage pests and diseases of cereals, oilseeds and pulses and their control. Commercial cultivation of mushroom and bee keeping.

Food production and consumption trends in India. National and international food policies. Production, procurement, distribution and processing constraints. Relation of food production to national dietary pattern. Protein – calorie malnutrition.

AGRICULTURAL ENGINEERING

Paper-I

Section – A

1. Surveying :

Chain survey, compass survey, plain table survey, computation of area, levelling, contour survey, land levelling, design, methods, earth work computation, land grading, land shaping, layout of fields, irrigation and drainage systems planning.

2. Fluid mechanics and irrigation :

Hydraulics of flow, open channel flow, steady and unsteady, uniform and non uniform, laminar and turbulent, Reynold's number, Froude number, critical depth, hydraulic jump, Chezy's and Manning's formula. Soil-water-plant relationship, soil moisture types and its measurement, movement of water in soil, evaporation, transpiration, evapotranspiration, water requirement of crops, filed capacity, wilting point, available soil moisture, consumptive use-methods of estimation, irrigation efficiencies, irrigation scheduling, irrigation methodsgravity and pressure irrigation systems and their adoptability, micro irrigation system, measurements of irrigation water, irrigation planning and farm water management, earthen channel, lined channel, lining materials, culverts, inverted siphons, under ground pipe irrigation management, participatory irrigation management, irrigation pumps types and suitability, selection of pumps installation of pumps, care and maintenance of pumps.

3. Drainage :

Water logging problems in crops, drainage co-efficient, role of drainage in cropped area, drainage investigation and selection, open drains on farm, field surface drainage, sub-surface drainage systems, pipe drainage interceptor drain, mole drain, tube-well drainage, bio drainage, saturated hydraulic conductivity, salinity control and drainage water-utilization. .

Section – B

4. Groundwater & surface hydrology; wells and pumps :

Hydrologic cycle measurement of rainfall, evaporation, infiltration, estimation of runoff, factors affecting runoff, computation of volume of runoff and peak flow, unit hydrograph. Occurrence of ground water and its; movement, aquifer types, well screens, gravel packing, radius of influence, transmissibility, basin-wide ground water development, ground water recharge, artificial recharge, ground water investigation, well hydraulics, types of shallow and deep tube wells, their method of construction, design of tube wells and open wells, multiple well systems, boring and deepening of open wells, sealing of brackish and saline aquifer horizons, well development, draw down-yield relationship.

5. Soil conservations and Watershed Management:

Soil erosion, types, factors affecting different kinds of crosion, methods to control soil crosion-biological control measures, contour farming, strip cropping, mixed cropping, inter cropping, mulching, mechanical control measures-their suitability for different conditions-design of contour ditches, contour bunds, graded bunds, bench terraces, contour stone wall-gully control structures vegetative control method-brush dams, loose rock dam, drop spillway, chute spillway and drop inlet spillway, universal soil loss equation, vegetated waterways-its design.

Watershed concept, land capacity classification, objectives of watershed management-selection of priority areas, management of natural resources, water harvesting, farm pond, percolation pond, runoff, farming systems, catchment area treatments, watershed-based soil and water conservation, integrated watershed development, role of remote sensing and GIS in watershed planning, development and evaluation.

6. Farm structures :

Building Materials, bearing capacity of soil, factor of safety, types of masonary foundations, basement and superstructure, types of roofs, building plan and estimation, planning of farmstead and farm residence, farm fencing, farm gates, farm roads, dairy farm, poultry house and equipments, silo, feed storage structure, grain storage structure, storage structure for semi-perishables, threshing floor, drying floors, storage structure for fertilizer and seeds.

PAPER – II

Section – A

1. Farm Power and Machinery.

Agricultural mechanization and its scope. Sources of farm power. History of tractor development. **T**hermodynamic-cycles, Thermal efficiency, Classification, construction and working principles of internal combustion (IC) engines, fuels, ignition, lubrication, cooling, governing system of I.C. engines, Different types of tractors and Power tillers, their manufacturers in India & their specifications, power transmission, ground drive, power take off (PTO), differential and control systems. Operation and maintenance of farm machinery, farm tractor and engines. Traction theory, mechanics of farm tractor chassis, weight transfer, human factors in tractor design. Different methods of locating C.G. of tractor. Primary and secondary tillage equipments. Sowing planting, inter culture, spraying, dusting, harvesting and threshing equipments. Mowers and combines. Earthmoving and land development machinery like scrapers, draglines, bulldozers and power buckets. Dynamometers their types and principles of prony brake dynamometer used for power measurement, cost estimation for hiring of tractors. Ergonomics of man-machine-system. Haulage of agricultural and forest produce, land clearing.

2. Energy.

Energy requirements in agricultural, different renewable energy sources, energy from the sun and wind, biomass gasification, producer gas and bio-gas for running I.C. engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels, use of electricity for agriculture and agro industrial application.

Section – B

3. Agricultural Process Engineering:

Post Harvest Technology of crops and its scope, unit operations in processing of cereals, oil seeds and pulses. Working principles of equipments for milling, mixing, cleaning, grading, drying and storage of cereals, pulses and oil seeds, moisture content determination, physical properties, psychometry , energy and material balance, solvent extraction, process flowchart, properties of fruits and vegetables, food texture and theology, process parameters and equipment for sorting, washing, handling, peeling, slicing, blanching, mixing and handling, chilling, packaging, transportation, storage and preservation technology, properties of diary and food products. Process flow chart for product manufacturing. Working principles of equipments for receiving, pasteurization, sterilization, homogenization, filling and packaging, butter manufacturing, evaporation, drying, freezing, juice extraction, filtration, thermal processing. Material handling equipments – belt and screw conveyors, bucket elevators, their capacity and power requirement. Application for computer techniques in design optimization. Waste and by-product utilization of rice husk, rice bran, plant residues and coir pith.

4. Electronics and Instrumentation :

Electronic devices and their characteristics, study of rectifiers, amplifiers, Oscillators, operational amplifiers, multivibrators, Digital circuit, sequential and combinational systems. Introduction to micro processor. Programming of micro processors and data acquisition and control of Agricultural Engineering processes. Generalized instrumentation system. Absolute and secondary measurements. Accuracy, precision, sensitivity and errors in measurements. Primary sensors and transducers, measuring instruments for current, voltage, electrical power flow, pressure, temperature, humidity, strain, force, torque and energy.

ANIMAL HUSBANDRY AND VETERINARY SCIENCE

Paper-I

SECTION – A

1. **Animal Nutrition**-Energy sources, energy, metabolism and requirements for maintenance and production of milk, meat, egg and wool. Evaluation of feeds as source of energy.

1.1. Trends in protein nutrition: sources, protein metabolism and synthesis, protein quantity and quality in relation to requirements. Energy protein ratios in ration.

1.2. Minerals in animal diet : Sources, functions, requirements and their relationship of the basic mineral nutrients including trace elements.

1.3. Vitamins, Hormones and Growth Stimulating, substances : Sources, functions, requirements and inter-relationship with minerals.

1.4. Advances in 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 Advances in Non-Ruminant Nutrition - Poultry : Nutrients and their metabolism with reference to poultry for meat and egg production. Nutrient requirements and feed formulation for layers and broilers at different ages.

1.6 Advances in Non-Ruminant Nutrition - Swine : Nutrients and their metabolism with special reference to growth and quality of meat production. Nutrient requirement and feed formulation for piglets, growing and finishing pigs.

1.7. Advances in Applied Animal Nutrition - A critical review and evaluation of feeding experiments, digestibility and balance studies. Feeding standards and measures of food energy. Nutritional 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 : Current status of hormonal control of mammary development, milk secretion and milk ejection. Male and Female reproductive organs, their components and functions. Repeat breeding. Pregnancy diagnosis. Prolapse of reproductive organs. Digestive organs and their functions.

2.3 Environmental Physiology : Physiological relations and their regulation; mechanisms of adaptation, 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 and spermatozoa, chemical and physical properties of ejaculated semen, factors affecting semen *in vivo* and *in vitro***.** Factors affecting semen production and quality. Preservation of semen. C omposition of diluents, sperm concentration, transport of diluted semen. Deep Freezing techniques of semen. Detection of oestrus and time of insemination for better conception.

SECTION-B

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 inputs. O pportunities in dairy farming, factors determining the efficiency of dairy animal, Herd recording, budgeting, cost of milk production; pricing policy; personnel Management. Developing Practical and Economic ration for dairy cattle; supply of greens throughout the year, feeds and fodder requirements of Dairy Farm. Feeding regimes for dry and young stock and bulls, heifers and milch animals, new trends in feeding young and adult stock; Feeding records. Age estimation through dentition.

3.2. Commercial meat, egg and wool production: Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry. Supply of dry and green fodders, feeding regimens for young and mature stock. New trends in management for enhancing production. Capital and land requirements. Socio-economic concept.

3.3. Feeding and management of animals under draught, flood and other natural calamities.

4. **Genetics and Animal Breeding :** Mendelian inheritance; deviations to Mendelian laws. Expression of genes; Linkage and crossing over; Sex determination, sex influenced and sex limited characters; Blood groups and polymorphism; Chromosome aberrations; Gene and its structure; DNA as a genetic material; Genetic code and protein synthesis; Recombinant DNA technology, Mutations and types of mutations, methods for detecting mutations and rate of mutation.

4.1 **Population Genetics applied to Animal Breeding:** Quantitative and qualitative traits, Hardy Weinberg Law; Population Vs. individual; Gene and genotype frequency, Forces changing gene frequency; Random drift and small populations; Theory of path coefficient; Inbreeding; methods of estimating inbreeding coefficient, systems of inbreeding; Effective population size, Breeding value, estimation of breeding value, dominance and epistatic interactions, partitioning of variation; Genotype a n d environment correlation, genotype x environment interaction; Role of multiple measurements, Resemblance between relatives.

4.2 **Breeding Systems :** Heritability, repeatability, genetic and phenotypic correlations, their methods of estimation and precision of estimates; Aids to selection and their relative merits; Individual, pedigree, family and within family selection; Progeny testing; methods of selection; construction of selection indices and their uses; comparative evaluation of genetic gains through various selection methods; Indirect selection and correlated response; Inbreeding, upgrading, cross-breeding and synthesis of breeds; Crossing of inbred lines for commercial production; Selection for general and specific combining ability; open nucleus breeding system, synthetic population.

Paper-II

SECTION – A

1. Health and Hygiene

1.1. **Histology and Histological Techniques :** Methods of preparation and processing of tissues for histological examination. Microscopy - Bright field microscope and electron microscope. Cytology - structure of cell, organells and inclusions; cell division-cell types-Tissues and their classification-embryonic and adult tissues. Comparative histology of organs- vascular, nervous, digestive, respiratory, musculo-skeletal and urogenital systems, Endocrine glands, Integuments, sense organs.

1.2. **Embryology :** Embryology of vertebrates with special reference to aves and domestic mammals-gametogenesis-fertilization-germ layers-foetal membranes and placentation. T ypes of placenta in domestic mammals. Teratology-twin and twinning, organogenesis -germ layer derivatives -endodermal, mesodermal and ectodermal derivatives.

1.3 **Bovine Anatomy-Regional Anatomy :** Paranasal sinuses of ox-surface anatomy of salivary glands. Regional anatomy of intraorbital, maxillary, mandibuloalveolar, mental and coronal nerve block-Regional anatomy of paravertebral nerves, pudental nerve, median, ulnar and radial nerves-tibial, fibular and digital nerves-Cranial nerves-structures involved in epidural anaesthesia-superficial lymph nodes-surface anatomy of visceral organs of thoracic, abdominal and pelvic cavities-comparative features of locomotor apparatus and their application in the biomechanics of mammalian body.

1.4 **Anatomy of Fowls :** Musculo-skeletal system-functional anatomy in relation to respiration and flying, digestion and egg production.

1.5 **Physiology of blood and its circulation, respiration, excretion, Endocrine glands in health and disease.**

1.5.1 **Blood constituents :** Properties and functions-blood cell formation-Haemoglobin synthesis and chemistry-plasma protein production, classification and properties; coagulation of blood; Haemorrhagic disorders-anticoagulants-blood groups-Blood volume-Plasma expanders-Buffer systems in blood. Biochemical tests and their significance in disease diagnosis.

1.5.2. **Circulation:** Physiology of heart, cardiac cycle, heart sounds, heart beat, electrocardiograms, Work and efficiency of heart, effect of ions on heart function, functions of cardiac muscle, nervous and chemical regulation of heart, effect of temperature and stress on heart, blood pressure and hypertension, Osmotic regulation, arterial pulse, vasomotor regulation of circulation, shock. Coronary and pulmonary circulation, Blood-Brain barrier.

1.5.3 **Respiration :** Mechanism of respiration, Transport and exchange of gases, neural control of respiration, chemoreceptors, hypoxia, respiration in birds.

1.5.4 **Excretion:** Structure and function of kidney, formation of urine, methods of studying renal function, renal regulation of acid-base balance, physiological constituents of urine, renal failure, passive venous congestion. Urinary excretion in chicken, Sweat glands and their function. Biochemical tests for urinary dysfunction.

1.5.5 **Endocrine glands :** Functional disorders, their symptoms and diagnosis. Synthesis of hormones, mechanism and control of secretion, hormonal receptors, classification and function.

1.6. **General knowledge of pharmacology and therapeutics of drugs :** Celluar level of pharmacodynamics and pharmaco-kinetics. Drugs acting on fluids and electrolyte balance. Drugs acting on Autonomic nervous system. Modern concepts of anaesthesia and dissociative anaesthetics. Autocoids. Antimicrobials and principles of chemotherapy in microbial infections. Use of hormones in therapeutics. C hemotherapy of parasitic infections. Drugs and thier residues in the edible tissues of animals. Chemotherapy of neoplastic diseases.

1.7. **Veterinary Hygiene with reference to water, air and habitation :** Assessment of pollution of water, air and soil. Importance of climate in animal health. Effect of environment on animal function and performance. R elationship between industrialization and animal agriculture. Animal housing requirements for specific categories of domestic animals, viz., pregnant cows, milking cows, broiler birds, and sows-stress, strain & productivity in relation to animal habitation.

2. **Veterinary Public Health**

2.1 **Zoonoses :** Classification, definition; role of animals and birds in prevalence and transmission of zoonotic diseases-occupational zoonotic diseases.

2.2. **Epidemiology :** Principles, definition of epidemiological terms, application of epidemiological measures in the study of diseases and disease control, Epidemiological features of air, water and food borne infections.

2.3 **Veterinary Jurisprudence :** Rules and Regulations of animal quarantine. Prevention of animal diseases. State Rules for prevention of animal and animal product borne diseases, S.P. C.A., veterolegal cases-certificates-Materials and Methods of collection of samples for veterolegal investigation.

3. **Extension :** Basic philosophy, objectives, concept and principles of extension. Different Methods adopted to educate farmers under rural conditions. Generation of technology, its transfer and feedback. Constraints in transfer of technology. Animal husbandry programmes for rural development.

SECTION – B

4. **Animal Diseases :**

4.1 Pathogenesis, symptoms, postmortem lesions, diagnosis and control of infectious diseases of cattle, pigs, poultry, horses, sheep and goats.

4.2 Etiology, symptoms, diagnosis, treatment of production diseases of cattle, pig and poultry.

4.3 Deficiency diseases of domestic animals and birds.

4.4 Diagnosis and treatment of nonspecific condition like Impaction, Bloat, Diarrhoea, Indigestion, dehydration, stroke, poisioning.

4.5 Diagnosis and treatment of neurological disorders.

4.6 Principles and methods of immunisation of animals against specific diseases-herd immunity-disease free zones-'zero' disease concept-chemoprophylaxis.

4.7 Anaesthesia-local, regional and general-pre-anaesthetic medication, Symptoms and surgical interference in fractures and dislocation, Hernia, choke, abomasal displacement-Caesarian operations, Rumenotomy, Castrations. Surgical manipulations of luxation of patella and urinary obstructions.

4.8 Disease investigation techniques- collection of Materials for laboratory investigation-Establishment of Animal Health Centres-Procedure of despatching materials for lab investigation.

5. **Milk and Milk Products Technology :**

5.1 **Milk Technology :** Organization of rural milk procurement, collection and transport of raw milk. Quality, testing and grading raw milk, Quality storage, Grades of whole milk, Skimmed milk and cream.

Processing, packaging, storing, distributing and marketing of milk. Defects and their control, Nutritive properties of the following types of milk : Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milk. Preparation of milk cultures and their management, youghurt, Dahi, Lassi and Srikhand. Preparation of flavoured and sterlized milk. Legal standards, Sanitation requirement for clean and safe milk and milk plant equipments.

5.2 **Milk Products Technology :** Selection of raw materials, assembling, production, processing, storing, distributing and marketing of milk products such as Butter, Ghee, Khoa, Chenna, Cheese; Condensed, evaporated, dried milk and baby food; Ice cream and Kulfi; by products; whey products, butter milk, lactose and casein. Testing, Grading, Judging of milk products-BIS and Agmark specifications, legal standards, quality control and nutritive properties. Packaging, processing and operational costs.

6. Meat Hygiene and Technology :

6.1 Meat Hygiene :

6.1.1 Ante-mortem care and management of food animals, stunning, slaughter and dressing operations; abattoir requirements and designs; Meat inspection procedures and judgement of carcass meat cuts-grading of carcass meat cuts-duties and functions of Veterinarians in wholesome meat production.

6.1.2 Hygienic methods of handling meat-spoilage of meat and control measures-Post slaughter physicochemical changes in meat and factors that influence them-Quality improvement methods-Adulteration of meat and detection-Regulatory provisions in Meat trade and Industry.

6.2. **Meat Technology**

6.2.1 Physical and chemical characteristics of meat-meat emulsions-methods of preservation of meat-curing, canning, irradiation, packaging of meat and meat products; Meat products and their formulations.

6.3. **By-products :** Slaughter house by-products and their utilisation-Edible and inedible by-products-social and economic implications of proper utilisation of slaughter house byproducts- Organ products for food and pharmaceuticals.

6.4. **Poultry Products Technology :** Chemical composition and nutritive value of poultry meat, pre-slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat and products. Legal and BIS standards. Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and maintenance. Marketing of poultry meat, eggs and products.

6.5. **Rabbit/Fur Animal farming :** Care and management of rabbits. Disposal and utilization of fur and wool and recycling of waste by-products.

ANTHROPOLOGY

Paper –I

Physical/Biological Anthropology & Human Genetics:

Unit –I:

1.1 Meaning and Scope of Anthropology

1.2 Relationship with other disciplines: History, Sociology, Geology, Economics, Political Science, Psychology, Life Science, and Medical Science.

1.3 Main Branches of Anthropology, their scope and relevance:

a) Social/Cultural Anthropology
b) Physical/Biological Anthropology
c) Archaeological Anthropology

1.4 Living Primates:

Order Primate and Classification of Primates, Comparative morphology, anatomy and phylogeny of man and apes.

Primate Locomotion: Terrestrial and Arboreal adaptation. Skeletal changes due to assumption of erect posture.

1.5 Fossil Evidences of Human Evolution (Phylogenetic status, characteristics and distribution):

a) Pre-pleistocene fossil primates (Oreopithecus)
b) South and East African Hominids: Plesianthropus/Australopithecus Africanus, Paranthropus, Australopithecus
c) Paranthropus – Homo erectus, Homo Erectus Javanicus, Homo Erectus Pekinensis
d) Homo Heidelbergensis
e) Neanderthal M a n – L a -Chapelle Aux Saints (classical type), Mt. Carmelites types (Progressive type)
f) Rhodesian Man
g) Home Sapiens – Cro-Magnon, Grimaldi, Chanceleade.

1.6 Organic Evolution:

Theories of evolution in historical perspective, Pre-Darwinian, Darwinian and Post Darwinian Period (Neo Darwinism). Modern Synthetic theory of evolution. Brief outline of terms and concepts of evolutionary biology: parallelism, convergence, adaptive radiation, mosaic evolution.

1.7 Human Race:

Concept of Race and racism. Biological perspective of race. Different factors responsible for race formation and racial criteria. Role of heredity and environment in determining racial traits. Major races of the world, their distribution and characteristics. Race crossing in man.

Unit –II:

2.1 Concept, scope and major branches of human genetics. Methods for study of genetic principles in human heredity. Pedigree study, Family study, Twin Study, Cytogenetic Method and Biometry.

2.2 Mendelian population. Concept of gene pool and gene frequencies. Hardy Weinberg equilibrium. The factors, which influence gene and genotype frequencies – mutation, isolation, migration, admixture, selection, genetic drift, inbreeding and social selection.

2.3 Consanguineous and non-consanguineous marriage. Effect of consanguineous marriages.

2.4 Mendelian Genetics in Man: Autosomal inheritance, Sex linked and Sex limited inheritance. Inheritance of abnormal traits like hemophilia, thalassemia and colour blindness, Sickle Cell anemia, Albinism, Achodroplasia, Hairy pinna, Baldness and Cleft Palate.

2.5 Lethal and Sub Lethal Sub Lethal Genes: Multifactorial and Polygenic inheritance in Man. Sex Chromosomal aberrations: Klinefelter, Turner, Super female and Inter sex.

2.6 Autosomal aberration: Down Syndrome, Edward and Cri-du-chat Syndromes. Chromosome structure and normal human keryotype.

2.7 Population variation in genetic markers: ABO, Rh Blood Groups.

2.8 Genetic Counseling: Diagnosis of genetic diseases in Man. Mode of inheritance and Risk recurrence. Prenatal diagnosis of genetic disease, indication for pre-natal diagnosis. Techniques for prenatal diagnosis. Genetic disease and Gene Therapy. Gene mapping and Genome Study.

Unit –III:

Concept of Human Growth and development. Stages of Growth – prenatal, natal, infant, childhood, adolescent and maturity.

Factors affecting growth and development – Genetic, Environmental, Hormonal, Nutritional, Cultural and Socio-economic.

Ageing and senescence. Theories and observations – biological and chronological longevity. Human physique and somatotypes. Methods for growth studies.

Unit – IV:

Concept of Reproductive Biology, demography and population study. Reproductive physiology of male and female. Biological aspects of human fertility. Relevance of menarche, menopause and other bioevents to fertility. Fertility patterns and differentials.

Demographic Theories – biological, social and cultural. Demographic methods – census, registration system, sample survey methods.

Population structures and population dynamics. Demographic rates and ratios, life table – structure and utility.

Biological and socio-ecological factors influencing fecundity, fertility, natality and mortality. Methods of studying population growth. Biological consequences of population control and family welfare.

Unit – V:

Application of Physical/Biological Anthropology: Applied human genetics – Paternity diagnosis, genetic counseling and eugenics. Methods and principles of personal identification and reconstruction. Application of Statistical principles in human genetics and Physical Anthropology. Serogenetics and cytogenetics in reproductive biology. DNA technology – prevention and cure of diseases.

Anthropometry in designing of defense and other equipments. Nutritional Anthropometry, Forensic Anthropology, Anthropogenetics in medicine. Anthropology of sports.

Unit – VI:

Cultural Evolution – broad outlines of pre-historic cultures in Europe and India:

a) Paleolithic
b) Mesolithic
c) Neolithic
d) Chalcolithic
e) Copper-Bronze Age
f) Iron Age.

Unit – VII:

Family: Definition and types of family, household. Impact of urbanization, industrialization, education and feminist movements. Universality of family – a critique.

Kinship: Definition of kinship, incest and exogamy. Principles of descent, types and functions. Unilineal, bilateral and double descent. Descent, filiations and complementary filiations. Kinship terminology and Alliance theory.

Marriage: Definition and types, mode of acquiring mates. Regulation of marriage – preferential and prescriptive. Marriage, prestation, dowry and bride price.

Religion: Definitions and functions of religion. Anthropological approaches to the study of religion – evolutionary, psychological and functional. Magic, witchcraft and sorcery; definitions. Functions of key functionaries: priest, shaman, medicine man and sorcerers.

Primitive Economy: Economic Anthropology: Modes of subsistence; hunting gathering, fishing, pastoralism, horticulture. Exchange: gifts, barter, trade, ceremonial exchange and market economy.

Types of political organizations – band, tribe, chiefdom, state, concept of power, authority and legitimacy, social control, law and justice in tribal societies.

Social structure and social organization, Role Analysis and social network. Institutions and groups. Social stratification, principles and forms: status and class, social mobility.

Unit – VIII:

Culture: definition and nature, paradoxes of culture.

Approaches to the study of culture and society – classical evolutionism, neoevolutionism, cultural ecology, historical particularism and diffusionism, structural-functionalism, culture and personality, transactionalism, symbolism, cognitive approach and new ethnography, post structuralism and post-modernism.

Unit – IX:

Concepts of development. Concepts of planning and planned development. Concept of participatory development. Anthropology and Resettlement. Culture ecology and sustainable development. Explanation in anthropological perspectives. Types of comparative methods in social and cultural anthropology. Positivistic approaches.

Unit – X:

Basic techniques of data collection. Interview & observation, participant and non participant, schedules, questionnaire, case study methods, extended case study methods, life histories, genealogical method, Participatory Rapid Rural Appraisal(PRA), focused Group Discussion (FGD). Analysis, Interpretation and Presentation of data.

Unit – XI:

Relevance in understanding of contemporary society. Dynamics of ethnicity at rural, tribal, urban and international levels. Ethnic conflicts and political developments. Concept of ethnic boundaries. Ethnicity and concept of nation state.

Unit – XII:

Concepts and Methods of Ecological Anthropology. Adaptation – social and cultural. Deterministic theories – a critique. Resources – biological, nonbiological and sustainable development. Biological application – climatic, environmental, nutritional and genetic.

Paper –II

Indian Society and Culture:

Unit-I:

Tribal situation in India – biogenetic variability, linguistic and socio-economic characteristics of the tribal populations and their distribution. Problems of the tribal communities – land alienation, poverty, indebtedness, low literacy, unemployment, malnutrition. Development Impact of Projects – problems and issues of Tribal Rehabilitation and Resettlement.

Forest Policy and tribals. Impact of urbanization and Industrialisation on tribal and rural populations.

Unit –II:

Demographic Profile of India – ethnic and linguistic elements in the Indian Population and their distribution.

Unit –III:

The basic structure and nature of traditional Indian Social System – a critique. Varnashram, Purushartha, Karma, Rebirth. Theories on the origin of Caste System, Jajmani System, Structural basis of inequality in traditional Indian Society. Impact of Buddhism, Jainism, Islam and Christianity on Indian Society.

Unit – IV:

Emergence, Growth and Development of Anthropology in India – contributions of the 19th century and early 20th Century scholars and administrators. Contributions of Indian Anthropologists to tribal and caste studies.

Unit –V:

Salient characteristic features of Indian Society. Approaches to the study of Indian Society and Culture. Village studies in India, Changing village India. Linguistics and religious minorities – social, political and economic status.

Unit –VI:

Problems of exploitation and deprivation of Scheduled Castes/Scheduled Tribes and Other Backward Classes. Protective legislations for Scheduled Tribes and Scheduled Castes. Social change and contemporary tribal societies: Impact of modern democratic institutions, PESA Act, Impact of development programmes and welfare measures on tribals and weaker sections. Emergence of ethnicity, tribal movements and quest for identity.

Unit –VII:

Social change and Development among the tribes during colonial and post-Independent India.

Unit –VIII:

History of administration of tribal areas, tribal policies, plans, programmes of tribal development and their implementation. Role of NGOs. Role of Anthropology in tribal and rural development. Contributions of Anthropology to the Understanding of regionalism, communalism, ethnic and political movements.

BOTANY

PAPER-I

Section-A

1. Microbiology and Plant Pathology: Structure and reproduction of viruses and bacteria; Plasmids and their significance; Gene transfer in bacteria (Transformation, Transduction, Conjugation); Applications of microbes in agriculture, industry, medicine and pollution control; General account of infection, Phytoimmunology. Important plant diseases caused by viruses, bacteria, mycoplasma and fungi, Mode of infection and dissemination. Molecular basis of infection and disease resistance/defence; Physiology of parasitism; Fungal toxins.

2. Cryptogams and Gymnosperms : Study of structure and reproduction of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms from evolutionary viewpoint, their distribution in India and their economic potential.

3. Angiosperms : Comparative account of various systems of Angiosperm Classiification; Study of angiospermic families–Magnoliaceae, Ranunculaceae, Brassicaceae (Cruciferae), Rosaceae, Leguminosae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae (Umbelliferae), Asclepiadaceae, Verbenaceae, Solana-ceae, Rubiaceae, Cucurbitaceae, Asteraceae (Composite), Poaceae (Gramineae), Arecaceae (Palmae), Liliaceae, Musaceae, Orchidaceae.

Section-B

4. Anatomy, Embryology and Biostatistics : Anatomy – Structure and function of primary and secondary tissues, Mechanical tissue system, Conducting tissue system, Vascular tissue system, Stomata and their types; Anomalous secondary growth; Anatomy of C_3 and C_4 plants.

Embryology - Development of male and female gametophytes; Pollination; Fertilization; Endosperm and its function; Embryo and patterns of embryo development; Polymbryony and apomixes; Applications of palynology.

Biostatistic-Central tendency, Dispersion, Estimation and hypothesis testing, Significance of standard error, Probability distributions (normal, binomial, poisson), t-test, F-test, Chi-square test, Correlation and regression.

5. Plant Utility and Exploitation: Origin of cultivated plants, Vavilov's centres of origin. Plants as sources for food, fodder, fibres, spices, beverages, drugs, narcotics, insecticides, timber, gums, resins and dyes, latex, cellulose starch and their products; Perfumery; Importance of Ethnobotany in Indian context; Energy plantation; Botanical Gardens and Herbaria.

6. Plant Tissue Culture : Totipotency, requirements for plant tissue culture, cell, tissue, organ culture, polarity, symmetry and differentiation, Cell, tissue and organ culture; Protoplast isolation and culture; Somatic hybrids and Cybrids.

PAPER-II

Section-A

1. Cell Biology: Techniques of Cell Biology, Prokaryotic and eukaryotic cells -Structural and ultrastructural details, Structure and function of extracellular matrix or ECM (cell wall) and membranes-cell adhesion, Membrane transport and vesicular transport; Structure and function of cell organelles (chloroplasts, mitochondria, ER, ribosomes, endosomes, lysosomes, peroxisomes, hydrogenosome), Nucleus, Nucleolus, Nuclear pore complex. Chromatin and Nucleosome; Cell signalling and cell receptors; Signal transduction (G-1 proteins, etc.); Mitosis and Meiosis; Molecular basis of cell cycle; Numerical and structural variations in chromosomes and their significance; Study of polytene, lampbrush and B-chromosomes–structure, behaviour and significance.

2. Genetics, Molecular Biology and Evolution: Development of genetics; Gene versus allele concepts (Pseudoalleles), Quantitative genetics and multiple factors, Linkage and crossing over–methods of gene mapping including molecular maps (idea of mapping function), Sex chromosomes and sex-linked inheritance, Sex determination and Molecular basis of sex differentiation. Mutation (biochemical and molecular basis), Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility), Prions and prion hypothesis; Structure and synthesis of nucleic acids and proteins; Genetic code and regulation of gene expression. Multigene families, Organic evolution-evidences, mechanism and theories; Role of RNA in origin and evolution.

3. Plant Breeding and Plant Biotechnology: Methods of plant breeding - introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method), Male sterility and heterosis breeding, Use of apomixis in plant breeding; Use of molecular markers in plant breeding.

Direct gene transfer methods – Particle gun bombardment, Electroporation, Chemical methods, *Agrobacterium* – mediated gene transfer, Biology of "Crown gall" and "Hairy root" diseases, Ti and Ri plasmids, T-DNA organization and transfer, Screening of transgenic plants, Role of selectable markers and reporter genes, Application of plant transformation for crop improvement – Development of insect-, herbicide-, virus-, fungus- resistant transgenic plants.

Section-B

4. Plant Physiology and Biochemistry : Water relations, Mineral nutrition and ion transport, mineral deficiencies. Photosynthesis–photochemical reactions, photophosphorylation and carbon pathways C_3, C_4 and CAM pathways; Photorespiration; Respiraion-anaerobic and aerobic, including fermentation; Electron transport chain and oxidative phosphorylation; Chemiosmotic theory and ATP synthesis; Nitrogen fixation and nitrogen metabolism; Enzymes, coenzymes, energy transfer and energy conservation; Importance of secondary metabolites.

5. Growth, Development and Stress Physiology : Photomorphogenesis, Pigments as photoreceptors (plastidial pigments and phytochrome); Photoperiodism and flowering, vernalization, senescence; Growth substances-their chemical nature, role and applications in agri-horticulture; Kinetic of growth, growth movements; Dormancy, storage and germination of seed; Fruit ripening - its molecular basis and manipulation; Fruit and seed physiology; Stress physiology (heat, water, salinity, metal).

6. Plant Ecology and Plant Geography: Ecological factors; Concepts and dynamics of community; Plant succession; Concepts of biosphere; Ecosystems and their conservation; Pollution and its control (including phytoremediaion).

Forest types of India -- afforestation, deforestation and social forestry; Endangered plants, endemism and Red Data Books; Biodiversity; Convention of Biological Diversity, Sovereign Rights and Intellectual Property Rights; Biogeochemical cycles; Global warming; Forests of Odisha.

CHEMISTRY

PAPER-I

1. Atomic structure

Quantum theory, Heisenberg's uncertainty principle, Schrodinger wave equation (time independent). Interpretation of wave function, particle in one-dimensional box, quantum numbers, hydrogen atom, wave functions. Shapes of s, p, d and forbitals.

2. Chemical bonding

Ionic bond, characteristics of ionic compounds, factors affecting stability of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and its general characteristics, polarities of bonds in molecules and their dipole moments. Valence Bond Theory (VBT), concept of resonance and resonance energy. Molecular Orbital Theory (MOT); bonding in homonuclear diatomic molecules: H2 U H2 to Ne2 , MOT treatment of NO, CO, HF, CN, CNU , BeH2 and CO2 . Comparison of VBT and MOT, bond order, bond strength, bond length, dipolemoment.

3. Solid State

Forms of solids, law of constancy of interfacial angles, crystal systems and crystal classes (crystallographic groups). Designation of crystal faces, lattice structures and unit cell. Laws of rational indices. Bragg's law. X-ray diffraction by crystals. Close packing, radious-ratio rules, calculation of some limiting radius-ratio values. Structures of NaCl, ZnS, CsCl, CaF2 , CdI2 and rutile. Defects in crystals, stoichiometric and nonhstoichiometric defects, impurity defects, semi-conductors. Elementary study of liquid crystals.

4. The gaseous state

Equation of state for real gases, intermolecular interactions, liquefaction of gases and critical phenomena, Maxwell's distribution of speeds, intermolecular collisions, collisions on the wall and effusion.

5. Thermodynamics and statistical thermodynamics

First law of thermodynamics, and heat absorbed in different types of processes; calorimetry, energy and enthalpy changes in various processes and their temperature dependence.

Second law of thermodynamics; entropy as a state function, entropy changes in various processes, entropy–reversibility and irreversibility. Nernst heat theorem and third law of thermodynamics.

Micro and macro states; canonical ensemble and canonical partition function; electronic, rotational and vibrational partition functions and thermodynamic quantities; chemical equilibrium in ideal gas reactions.

6. Phase equilibria and solutions

Phase equilibria in pure substances; phase diagram for a pure substance; phase equilibria in binary systems, partially miscible liquids–upper and lower critical solution temperatures; partial molar quantities, their significance and determination; excess thermodynamic functions and their determination.

7. Electrochemistry

Debye-Huckel theory of strong electrolytes and Debye-Huckel limiting Law for various equilibrium and transport properties.

Galvanic cells, concentration cells; electrochemical series, measurement of e.m.f. of cells and its applications fuel cells and batteries.

Processes at electrodes; double layer at the interface; rate of charge transfer, current density; overpotential; electroanalytical techniques–voltameter, polarography, amperometry, cyclic-voltametry, ion-selective electrodes and their use.

8. Chemical kinetics

Concentration dependence of rate of reaction; defferential and integral rate equations for zeroth, first, second and fractional order reactions. Rate equations involving reverse, parallel, consecutive and chain reactions; effect of temperature and pressure on rate constant. Study of fast reactions by stop-flow and relaxation methods. Collisions and transition state theories.

9. Photochemistry

Absorption of light; decay of excited state by different routes; photochemical reactions between hydrogn and halogens and their quantum yields.

10. Surface phenomena and catalysis

Absorption from gases and solutions on solid adsorbents, adsorption isotherms,– Langmuir, Gibbs and Freundlich isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.

11. Bio-inorganic chemistry

Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), ionophores, photosynthesis–PSI, PSII; nitrogen fixation, oxygen-uptake proteins, cytochromes and ferredoxins.

12. Coordination chemistry

(a) Electronic configurations; introduction to theories of bonding in transition metal complexes. Valence bond theory, crystal field theory and its modifications; applications of theories in the explanation of magnetism and electronic spectra of metal complexes.

(b) Isomerism in coordination compounds. IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans-effect and its theories; kinetics of substitution reactions in square-planar complexes; thermodynamic and kinetic stability of complexes.

(c) Synthesis and structures of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.

(d) Complexes with aromatic systems, synthesis, structure and bonding in metal-olefin complexes, alkyne - complexes and cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization. Compounds with metal-metal bonds and metal atom clusters.

13. General chemistry of 'f' block elements

Lanthanides and actinides; separation, oxidation states, magnetic and spectral properties; lanthanide contraction.

14. Non-Aqueous Solvents

Reactions in liquid NH_3 , HF, SO_2 and H_2SO_4 . Failure of solvent system concept, coordination model of non-aqueous solvents. Some highly acidic media, fluorosulphuric acid and super acids.

Paper-II

1. **Delocalised covalent bonding :** Aromaticity, anti-aromaticity; Homo- aromaticity, non-aromaticity, annulenes, azulenes, tropolones, kekulene, fulvenes, sydnones.

2(a) **Reaction mechanisms :** General methods (both kinetic and non-kinetic) of study of mechanism of organic reactions illustrated by examples–use of isotopes, cross-over experiment, intermediate trapping, stereochemistry; energy diagrams of simple organic reactions, transition states and intermediates; energy of activation; thermodynamic control and kinetic control of reactions.

(b) **Reactive intermediates :** Generation, geometry, stability and reactions of Carbocations, carbanions, free radicals, carbenes, benzynes, nitrenes and enamines..

(c) **Substitution reactions :** SN1, SN2, SNi, SN'1/, SN'2/, SNi'/ and SRN1 mechanisms; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compound including simple heterocyclic compounds–pyrrole, furan, thiophene, indole.

(d) **Elimination reactions :** E1, E2 and E1CB mechanism; orientation in E2 reactions–Saytzeff and Hoffmann; pyrolytic **syn** elimination–acetate pyrolysis, Chugaev and Cope eliminations.
(e) **Addition reactions :** Electrophilic addition to C= and CUC, Nucleophilic addition to >C=O, -C=N, conjugated olefins and carbonyls.

(f) **Rearrangements :** Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer–Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner-Meerwein rearrangements.

3. **Pericyclic reactions :** Classification and examples; Woodward-Hoffmann rules electro cyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5], FMO approach.

4. **Chemistry and mechanism of reactions :** Aldol condensation (including directedaldol condensation), Claisen condensation, Dieckmann, Perkin, Knoevenagel, Wittig, Clemmensen, Wolff-Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski, Sandmeyer, Reimer-Tiemann and Reformatsky reactions.

5. **Polymeric Systems**

(a) **Physical chemistry of polymers :** Polymer solutions and their thermodynamic properties; number and weight average molecular weights of polymers. Determination of molecular weights by sedimentation, light scattering, osmotic pressure, viscosity, end group analysis methods.

(b) **Preparation and properties of polymers :** Organic polymers–polyethylene, polystyrene, polyvinyl chloride, Teflon, nylon, terylene, synthetic and natural rubber. Inorganic polymers–phosphonitrilic halides, borazines, silicones and silicates.

(c) **Biopolymers :** Basic bonding in proteins, DNA and RNA.

6. **Synthetic uses of reagents :** OsO4 , HIO4 , CrO3 , Pb(OAc)4 , SeO2 , NBS, B2 H6 , Na-Liquid NH3 , LiA1H4 NaBH4 **n**-BuLi, MCPBA.

7. **Photochemistry :** Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Norrish-Type II reactions, Photo Fries, di-U-methane rearrangements.

8. **Principles of spectroscopy and applications in structure elucidation**

(a) **Rotational spectra**–diatomic molecules; isotopic substitution and rotational constants.

(b) **Vibrational spectra**–diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(c) **Electronic spectra :** Singlet and triplet states. n› U * and U U * transitions; application to conjugated double bonds and conjugated carbonyls–Woodward-Fieser rules.

(d) **Nuclear magnetic resonance :** Isochronous and anisochronous protons; chemical shift and coupling constants; Application of H NMR to simple organic molecules.

(e) **Mass spectra :** Parent peak, base peak, daughter peak, metastable peak, fragmentation of simple organic molecules, U-cleavage, McLafferty rearrangement

(f) **Electron spin resonance :** Inorganic complexes and free radicals.

CIVIL ENGINEERING

Paper-I

Part-A

Engineering Mechanics, Strength of Materials and Structural Analysis.

Engineering Mechanics :

Units and Dimensions, SI Units, Vectors, Concept of Force, Concept of particle and rigid body. Concurrent, Non Concurrent and parallel forces in a plane, moment of force and Varignon's theorem, free body diagram, conditions of equilibrium, Principle of virtual work, equivalent force system.

First and Second Moment of area, Mass moment of Inertia.

Static Friction, Inclined Plane and bearings.

Kinematics and Kinetics :

Kinematics in Cartesian and Polar Co-ordinates, motion under uniform and nonuniform acceleration, motion under gravity. Kinetics of particle : Momentum and Energy principles, D' Alembert's Principle, Collision of elastic bodies, rotation of rigid bodies, simple harmonic motion, Flywheel.

Strength of Materials :

Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength, Leaf spring. Strain Energy in direct stress, bending & shear.

Deflection of beams : Mecaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method. Torsion of Shafts, Transmission of power, close coiled helical springs, Elastic stability of columns, Euler's Rankine's and Secant formulae. Principal Stresses and Strains in two dimensions, Mohr's Circle, Theories of Elastic Failure, Thin and Thick cylinder : Stresses due to internal and external pressure–Lame's equations.

Structural Analysis :

Castigliano's theorems I and II, unit load method of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution, Kani's method of analysis and column Analogy method applied to indeterminate beams and rigid frames.

Rolling loads and Influences lines : Influences lines for Shear Force and Bending moment at a section of beam. Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses.

Arches : Three hinged, two hinged and fixed arches, rib shortening and temperature effects, influence lines in arches.

Matrix methods of analysis : Force method and displacement method of analysis of indeterminate beams and rigid frames.

Plastic Analysis of beams and frames : Theory of plastic bending, plastic analysis, statical method, Mechanism method.

Unsymmetrical bending : Moment of inertia, product of inertia, position of Neutral Axis and Principle axes, calculation of bending stresses.

SDOF & MDOF, Response spectra, nature of Earthquake forces, frequency and mode shapes, IS 1893, simple methods of designs.

CAD and Computer Applications in Civil Engineering : Simple programming in FORTRAN and C++, awareness on AUTOCAD, STAAD/ SAP. Simple computations on earthworks, road works, analysis of rates, cost estimation.

Part–B

Design of Structures : Steel, Concrete and Masonry Structures.

(BIS, Railway & IRC Codes are permitted)

Structural Steel Design :

Structural Steel : Factors of safety and load factors. Riveted, bolted and welded joints and connections. Design of tension and compression member, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings, slab and gusseted column bases.

Design of highway and railway bridges : Introduction to Railway codes. Through and deck type plate girder, Warren girder, Pratt truss.

Design of Concrete and Masonry Structures :

Concept of mix design. Reinforced Concrete : Working Stress and Limit State method of design–Recommendations of I.S. codes Design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, Isolated and combined footings.

Cantilever and Counterfort type retaining walls.

Water tanks : Design requirements for Rectangular and circular tanks resting on ground, Intz tank.

Prestressed concrete : Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress.

Design of brick masonry as per I.S. Codes

Design of masonry retaining walls.

Part-C

Fluid Mechanics, Open Channel Flow and Hydraulic Machines

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

Kinematics and Dynamics of Fluid flow : Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flownet, methods of drawing flownet, sources and sinks, flow separation, free and forced vortices.

Control volume equation, continuity, momentum, energy and moment of momentum equations from control volume equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes, sluice gates, weirs, orifice meters and Venturi meters.

Dimensional Analysis and Similitude : Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models.

Laminar Flow : Laminar flow between parallel, stationary and moving plates, flow through circular pipes.

Boundary layer : Laminar and turbulent boundary layer on a flat plate, laminar sublayer, smooth and rough boundaries, drag and lift.

Turbulent flow through pipes : Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line, siphons, expansion and contractions in pipes, pipe networks, water hammer in pipes and surge tanks.

Open channel flow : Uniform and non-uniform flows, momentum and energy correction factors, 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, classification of surface profiles, control section, step method of integration of varied flow equation, moving surges and hydraulic bore.

Hydraulic Machines and Hydropower :

Centrifugal pumps–Types, characteristics, Net Positive Suction Head (NPSH), specific speed. Pumps in parallel.

Reciprocating pumps, Air Vessels, Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps.

Hydraulic turbines, Types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed.

Principles of hydropower development: Type, layouts and Component works. Surge tanks, types and choice. Flow duration curves and dependable flow. Storage and pondage. Pumped storage plants. Special features of mini, micro-hydel plants.

Part-D

Geo-technical Engineering

Types of soil, phase relationships, consistency limits, particles size distribution, classifications of soil.

Capillary water and structural water, effectives trees and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits.

Seepage pressure, quick sand condition, compressibility and consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test.

Compaction of soil, field control of compaction. Total stress and effective stress parameters, pore pressure coefficients.

Shear strength of soils, Mohr Coulomb failure theory, Shear tests.

Earth pressure at rest, active and passive pressures, Rankine's theory, Coulomb's wedge theory, earth pressure on retaining wall, sheetpile walls, Braced excavation.

Evaluation of Bearing capacity, Terzaghi and other important theories, net and gross bearing pressure, IS 6403.

Immediate and consolidation settlement, use of IS8002.

Stability of slope, Total Stress and Effective Stress methods, Conventional methods of slices, stability number.

Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests.

Essential features of foundation, types of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinessq's theory, Newmarks's chart, pressure bulb, contact pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from field tests, allowable bearing capacity, Settlement analysis, allowable settlement.

Proportioning of footing, isolated and combined footings, rafts, buoyancy rafts, Pile foundation, types of piles, pile capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles, lateral capacity. Foundation for Bridges. Ground improvement techniques–preloading, sand drains, stone column, grouting, soil stabilisation.

Paper-II

Part-A

Construction Technology, Equipment, Planning and Management

1. Construction Technology :

Engineering Materials :

Physical properties of construction materials : Stones, Bricks and Tiles; Lime, Cement and Surkhi Mortars; Lime Concrete and Cement Concrete, Properties of freshly mixed and hardened concrete, Flooring Tiles, use of ferro-cement, fibre-reinforced and polymer concrete, high strength concrete and light weight concrete. Timber : Properties and uses; defects in timber; seasoning and preservation of timber. Plastics, rubber and damp-proofing materials, termite proofing, Materials, for Low cost housing.

Construction :

Building components and their functions; Brick masonry : Bonds, jointing. Stone masonry. Design of Brick masonry walls as per I.S. codes, factors of safety, serviceability and strength requirements; plastering, pointing. Types of Floors & Roofs. Ventilators, Repairs in buildings.

Functional planning of building : Building orientation, circulation, grouping of areas, privacy concept and design of energy efficient building; provisions of National Building Code.

Building estimates and specifications; Cost of works; valuation.

2. **Construction Equipment :**

Standard and special types of equipment, Preventive maintenance and repair, factors affecting the selection of equipment, economical life, time and motion study, capital and maintenance cost.

Concreting equipments : Weigh batcher, mixer, vibration, batching plant, Concrete pump.

Earth-work equipment : Power shovel hoe, bulldozer, dumper, trailors, and tractors, rollers, sheep foot roller.

3. **Construction Planning and Management :** Construction activity, schedules, job layout, bar charts, organization of contracting firms, project control and supervision. Cost reduction measures.

Network analysis : CPM and PERT analysis, Float Times, cashing of activities, contraction of network for cost optimization, up dating, Cost analysis and resource allocation.

Elements of Engineering Economics, methods of appraisal, present worth, annual cost, benefit-cost, incremental analysis. Economy of scale and size. Choosing between alternatives including levels of investments. Project profitability.

Part-B

Survey and Transportation Engineering

Survey : Common methods of distance and angle measurements, plane table survey, levelling traverse survey, triangulation survey, corrections, and adjustments, contouring, topographical map. Surveying instruments for above purposes. Techeometry. Circular and transition curves. Principles of photogrammetry.

Railways : Permanent way, sleepers, rail fastenings, ballast, points and crossings, design of turn outs, stations and yards, turntables, signals, and interlocking, level-crossing. Construction and maintenance of permanent ways : Superelevlation, creep of rail, ruling gradient, track resistance, tractive effort, relaying of track.

Highway Engineering : Principles of highway planning, Highway alignments. Geometrical design : Cross section, camber, superelevation, horizontal and vertical curves. Classification of roads : low cost roads, flexible pavements, rigid pavements. Design of pavements and their construction, evaluation of pavement failure and strengthening.

Drainage of roads : Surface and sub-surface drainage.

Traffic Engineering : Forecasting techniques, origin and destination survey, highway capacity. Channelised and unchannelised intersections, rotary design elements, markings, sign, signals, street lighting; Traffic surveys. Principle of highway financing.

Part-C

Hydrology, Water Resources and Engineering :

Hydrology : Hydrological cycle, precipitation, evaporation, transpiration, depression storage, infiltration, overland flow, hydrograph, flood frequency analysis, flood estimation, flood routing through a reservoir, channel flow routing-Muskingam method.

Ground water flow : Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential.

Water Resources Engineering : Ground and surface water resource, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation, economics of water resources projects.

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

Canals : Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage below lining.

Water logging : causes and control, drainage system design, salinity and its control.

Canal structures : Elements of cross regulators, head regulators, canal falls, aqueducts, metering flumes and canal outlets.

Diversion head work : Principles and design of weirs on permeable and impermeable foundation, Khosla's theory. Principles of operation of Energy, Dissipators, stilling basin, silt excluders.

Storage works : Types of dams, design, principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage.

Spillways : Spillway types, crest gates, energy dissipation.

River training : Objectives of river training, methods of river training.

Part-D

Environmental Engineering

Water Supply : Estimation of surface and subsurface water resources, predicting demand for water, impurities, of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.

Intake of water : Types of Intakes, pumping and gravity schemes. Water treatment : principles of coagulation, flocculation and sedimentation; slow-; rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

Water storage and distribution : storage and balancing reservoirs : types, location and capacity. Distribution system : layout, hydraulics of pipe lines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, 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, Plumbing in buildings.

Sewage characterisation : BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

Sewage treatment : Working principles, units, Grit chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.

Solid waste : collection and disposal in rural and urban contexts, management of longterm ill-effects.

Environmental pollution : Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control Methods.

COMMERCE & ACCOUNTANCY

Paper-I - Accounting & Finance

Part I - Accounting, Taxation & Auditing

Unit – I - Financial Accounting

Accounting as a financial information system; Impact of behavioural sciences. Accounting Standards e.g., Accounting for Depreciation, Inventories, Gratuity, Research and Development Costs, Construction Contracts, Revenue Recognition, Fixed Assets, Contingencies, Foreign Exchange Transactions, Investments and Government Grants. Problems of Company Accounts relating to Amalgamation, Absorption and Reconstruction of companies and Valuation of Shares and Goodwill.

Unit – II - Cost Accounting

Nature and Functions of Cost Accounting. Job Costing. Process Costing.

Marginal Costing; Techniques of segregating semi-variable costs into fixed and variable costs.

Cost-volume-profit relationship; Aid to decision making including pricing decisions, shutdown etc.

Techniques of Cost Control and Cost Reduction :Budgetary control, Flexible Budgets. Standard Costing and Variance Analysis, Responsibility Accounting, Investment, Profit and Cost centres.

Unit – III - Taxation

Definitions. Basis of Charge. Incomes which do not form part of Total Income.

Simple problems of Computation of income under various heads, i.e., Salaries, Income from House Property, Profits and Gains from Business or Profession, Capital Gains, Income of Other persons included in Assessee's Total Income.

Aggregation of income and Set off/Carry Forward of Loss.

Deductions to be made in Computing Total Income.

Unit – IV - Auditing

Audit of Cash Transactions, Expenses, Incomes, Purchases and Sales.

Valuation and Verification of Assets with special reference to Fixed Assets, Stocks and Debts.

Verification of Liabilities.

Audit of limited companies; Appointment, Removal, Powers, Duties and Liabilities of Company Auditor, Significance of 'true and fair', MAOCARO report (Manufacturing and Other Companies Audit Report Orders).

Auditor's report and qualifications therein.

Special points in the audit of different organisations like Clubs, Hospitals, Colleges, and Charitable Societies.

Part-II - Business Finance and Financial Institutions.

Unit – V - Financial Analysis and Management of working capital.

Finance Function-Nature, Scope and Objectives of Financial Management-Risk and Return relationship.

Financial Analysis as a Diagnostic Tool.

Management of Working Capital and its Components-Forecasting Working Capital needs, Inventory, Debtors, Cash and Credit Management.

Unit – VI - Investment Decisions and Cost of Capital.

Investment Decisions-Nature and Scope of Capital Budgeting-Various types of decisions including Make or Buy and Lease or Buy. Techniques of Appraisal and their applications.

Consideration of Risk and Uncertainty, Analysis of Non-financial Aspects.

Rate of Return on Investments-Required Rate of Return-its measurement- Cost of Capital-Weighted Average Cost-Different Weights.

Unit – VII - Capital Structure and Valuation of Firms and Securities.

Capital Structure-Leverages-Significance of Leverages-Theories of Capital Structure with special reference to Modigliani and Miller Approach. Planning the Capital Structure of a Company; EBIT-EPS Analysis, Cash-flow ability to service debt, Capital Structure Ratios, Other methods.

Concepts of Valuation-Valuation of firm's Fixed Income Securities and Common Stocks.

Dividend and Retention Policy-Residual Theory of Dividend Policy. Other Models-Actual Practices.

Unit – VIII – Raising of Finance and Financial Markets.

Raising finance-short term and long term. Bank finance-norms and conditions.

Financial Distress-Approaching BIFR under Sick Industrial Undertakings Act : Concept of Sickness, Potential Sickness, Cash Loss, Erosion of Net worth.

Money Markets-the purpose of Money Markets, Money Market in India-Organization and working of Capital markets in India. Organization, Structure and Role of Financial Institutions in India. Banks and Investing Institutions-National and International Financial Institutions-their norms and types of financial assistance. Inter-bank lending-its regulation, supervision and control. System of Consortium Finance -Supervision and regulation of Banks.

Monetary and Credit policy of Reserve Bank of India.

Paper-II - Organisation Theory and Industrial Relations

Part-I - Organisation Theory

Unit – I - Nature and Concept of Organisation.

Organisation goals; Primary and Secondary goals, Single and Multiple goals, End-means chain-Displacement, succession, expansion and multiplication of goals. Formal organisation; Type, Structure-Line and Staff, Functional Matrix, Informal Organisation-functions and limitations.

Unit – II - Organisation Theory.

Evolution of Organisation theory;

Classical, Neo-classical and System approach-Bureaucracy; Nature and basis of power, Sources of Power, Power Structure and Politics.

Unit – III - Organisation Behaviour.

Organizational behavior as a dynamic system: Technical, Social and Power systems-interrelations and interactions-Perception-Status system. Theoretical and Empirical foundation of theories and Models of Motivation. Morale and Productivity. Leadership : Theories and Styles.

Unit – IV – Conflict Management.

Management of Conflicts in Organisation-Transactional Analysis. Significance of Culture to Organisations. Limits of Rationality- Organisational Change, Adaptation, Growth and Development. Professional Management Vs. Family Management, Organisational Control and Effectiveness.

Part-II - Industrial Relations.

Unit – V- Concept of Industrial Relations.

Nature and Scope of Industrial Relations, the Socio-Economic set-up, Need for positive approach – Industrial Relation in India.

Workers' Participation in Management; Philosophy, Rationale, Present day state of affairs and Future prospects.

Unit - VI – Manpower Planning.

Role of Personnel Department in Recruitment, Selection, Training and Development, Performance Appraisal.

Unit – VII - Absenteeism and Labour Turnover.

Meaning of absenteeism and Causes of absenteeism in Indian Industries, Labour Turnover – Concept, Causes and Costs, Methods of controlling Labour Turnover.

Unit - VIII - Salary and Wage Administration.

Determination of Wage Policy, Methods of Remuneration, Methods of Incentives schemes, Bonus, wage differentials, Employee Stock Option Schemes,(ESOPs), Sweat Equity, Essential features of a good Remuneration and Incentive Scheme.

ECONOMICS

Paper-I

1 Types of Markets and price determination. Criteria for Welfare improvement. Micro and Macro theories of distribution.

2. Full employment and Says' Law-underemployment equilibrium-Keynes' Theory of employment (and income) determination-Critiques of Keynesian Theory.

3. Functions of money-Measurement of price level changes- the Quantity theory of money, its variants and critiques thereof-Demand for and supply of money-The money multiplier. Theories of determination of Interest rate -Theories of inflation and control of inflation.

4. The modern monetary system- Structure of Money and financial markets and control Banks, non-bank financial intermediaries, Discount House, and Central Bank. Money market instruments, bills and bonds. Goals and instruments of monetary management in closed and open economies. Relation between the Central Bank and the Treasury. Proposal for ceiling on growth rate of money.

5. Public finance and its role in market economy : allocative efficiency, stabilization, distribution and development. Sources of revenue-Forms of Taxes and subsidies, their incidence and effects; Limits to taxation, loans, crowding-out effects, and limits to borrowing. Types of budget deficits-Public expenditure and its effects.

6. **International Economics**

(i) Old and New theories of International Trade.

a) Comparative advantage, Terms of trade and offer curve.

b) Product cycle and Strategic trade theories.

c) (i) Trade as an engine of growth

(ii) Forms of protection.

(iii) Balance of Payments Adjustments : Alternative Approaches.

a) Price versus income, income adjustments under fixed exchange rates.
b) Theories of policy mix.

c) Exchange rate adjustments under capital mobility.

d) Floating Rates and their implications for developing countries;

(iv) (a) IMF and the World Bank.
(b) W.T.O.
(c) Trade Blocks and monetary unions.

7. **Growth and development.**

(i) Theories of growth : Classical and neo-classical theories; The Harrod model; economic development under surplus Labour; wage-goods as a constraint on growth; relative importance of physical and human capitals in growth; innovations and development; Productivity, its growth and source of changes thereof. Factors determining savings to income ratio and the capital-out-put ratio.

(ii) Main features of growth : Changes in Sectoral compositions of income; Changes in occupational distribution; changes in income distribution; changes in savings and investment and in pattern of investment. Case for and against industralization. Significance of agriculture in developing countries.

(iii) Relation between state, planning and growth, Changing roles of market and plans in growth, economic policy and growth.

(iv) Role of foreign capital and technology in growth. The significance of ultinationals.

(v) Welfare indicators and measures of growth-Human development indices-The basic needs approach.

(vi) Concept of sustainable development; convergence of levels of living of developed and developing countries; meaning of self-reliance in growth and development.

Paper-II

I. Indian Economics in Post-Independent Era-Contributions of Vakil, Gadgil and Rao. National and percapita Income; Patterns, Trends, Aggregate and sectoralcomposition and changes therein. Broad factors determining National Income and its distribution; Measures of poverty. Trends in below poverty-line proportion.

II. Employment : Factors determining employment in short and long periods. Role of capital, wage-goods, wage-rate and technology. Measures of unemployment. Relation between income, poverty and employment, and issues of distribution and social justice.

Agriculture-Institutional set-up of land system, size of land holdings and efficiency-Green Revolution and technological changes-Agricultural prices and terms of trade-Role of public distribution and farm-subsidies on agricultural prices and production. Employment and poverty in agriculture-Rural wages-employment schemes growth experience-land reforms. Regional disparities in agricultural growth. Role of Agriculture in export.

III. Industry : Industrial system of India : Trends in Composition and growth. Role of public and private sectors, Role of small and cottage industries. Indian industrial Strategy-Capital versus consumer goods, wage-goods versus luxuries, capital-intensive versus labour-intensive techniques, Sickness and high-cost Industrial policies and their effects. Recent moves for liberalisation and their effects on Indian industry.

IV. Money and banking : The monetary institutions of India: Sources of reserve money, Techniques of money supply regulation under open economy. Functioning of money market in India. Budget deficit and money supply. Issues in Reform of Monetary and Banking Systems.

V. Index numbers of price levels-Course of Price level in post-Independence periodsources and causes of inflation-role of monetary and supply factors in price level determination-policies towards control of inflation. Effects of inflation under open economy.

VI. Trade, balance of payments and exchange : Foreign trade of India; composition and direction shifts in trade policy from import substituion to export promotion. Impact of liberalisation on pattern of trade. India's external Borrowings-the Debt problem. Exchange rate of the rupee; Devaluations, depreciations and their effects on balance of payments- convertibility on current and capital accounts-rupee in an open economy. Integration of Indian economy with world economy-India and the WTO.

VII. Public Finance and Fiscal Policy : Composition of and trends in India's Public Revenue and Expenditure -Role of Taxes (direct and indirect) and subsidies-Fiscal deficits-public expenditures and their significance-Public Finance and Inflation- Debt trap and Limiting Government's debt-Recent fiscal policies and their effects.

VIII. Economic Planning in India :- Strategies for Growth and social justice; Planning and increasing the growth rate.Trends in Savings and investment- Trends in Savings to Income and capital-output ratios-Productivity, its sources, growth and trends-growth versus distribution-Transition from Central Planning to indicative planning-relation between Market and Plan-

EDUCATION

P A P E R – I

Principles of Education and Human Development.

(Part-A)

Unit-I Concept of Education :-

Education – meaning, nature, scope & process with reference to Eastern and Western thoughts.

Education as social process.

Aims of Education-Individual and Social with reference to Eastern and Western views. Objectives of Education at different levels from Elementary to Higher Education , Formal, Nonformal & Informal.

Education and its agencies.

Education for Training in cognitive, affective and Psychomotor domains.

Education in Ancient India – The concept of Dharma, Artha, Kama & Mokhya.

Education and its features in the Vedic system- Budhist system & Islamic system with reference to the concept aims, process and significance .

Unit –II Philosophical foundations of Education.

Contributions of Idealism, Naturalism, Realism, Pragmatism to the present educational system, existentialism, eclecticism.

Contributions of Gandhi, Tagore, Aurobindo, Vivekananda, Froebel, Herbart to the field of Education.

Contributions of Pandit Utkalmani Gopabandhu Dash and Kabibar Radhanath Ray to the development of Education in Odisha.

Unit – III Sociological Foundations of Education.

Meaning and nature of Educational Sociology.

Relationship of Sociology and Education,

Education-as social sub-system :- specific characteristics.

Education and the home

Education and the community with special reference to Indian society.

Education and modernization

Education and politics

Education and religion

Education and culture

Education and democracy

Socialization of the child

Meaning and nature of social change

Education as related to social stratification and social mobility.

Education as related to social equity and equality of educational opportunities.

Constraints on social change in India (Caste, ethnicity, class, language, religion, regionalism).

Education of the socially and economically disadvantaged sections of the society with special reference to Scheduled Castes and Scheduled Tribes, women and rural population.

Unit – IV Development of Modern Indian Education.

Development of Indian Education – During pre independent and Post independent period.

Recommendation of Maculay's Minutes (1835), Woods Despatch, Sargent Plan. Hartog, Committee, Calcutta University Commission, Radhakrishnan Commission.

Secondary Education Commission(1952-54)

Indian Education Commission.(1964-66)

National Education Policy(1968)

National Policy on Education 1986 and Programme of Action, 1992.

(Part- B)

Unit – V Growth and Development.

Concept of Growth, Development and Maturation.

Principles of Development, Factors affecting Development. Dimensions of Development :- Physical, emotional, mental, social & moral.

Problems of adolescents.

Psychology of adult learnes.
Personality:- Concept and development. Type and Traint theory, Pschodynamic Approach, Humanmistic Approach, Indigenous Ideas of self and consciousness : Annamaya, Pranmaya, Monomaya, Vigyanmaya, Anandmaya, Kosa, Atman.

Defence mechanism :- stress, frustration, conflict, coping with confilict:

Unit – VI Teaching Learning Process.

Learning : Concept and process.

Theories of Learning: Conditioning and coqnitive theories with special referent to Thorndike's connectionism, Skinner's operant conditioning, Contributions of Gagne, Ausubel, Bloom, Piaget, Bruner to learning process. Constructivism in Education.

Transfer of Learning, Theories of Transfer.

Motivation : Theories, Techniques of motivating the learners with special reference to Need Hierarchy Theory (Maslow) and Achievement Motivation(Atkinson).

Unit - VII Higher Mental or Cognitive abilities :

Intelligence : Concept, meaning, and measurement of Intelligence, Special reference to S.I. , Model of Intellect (Guilford), Triarehic Theory(Sternberg), Multiple Intelligences (Gardner), Emotional Intelligence (E.I.), Spritual Intelligence (S.I.).

Creativity : It's nature & process. Characteristics of a creative person, Measurement of creativity. Fostering creativity. Thinking , Problem solving, Reasoning, Imagination.

Unit – VIII Evaluation in Education.

Evaluation – concept, types- Placement, Formative, Diagnostic, Summative

Continuous and comprehensive evaluation.

Recent Trends in Evaluation – Grading, Reporting Evaluation results and its interpretation.

Semester system and Question Bank.

Measures of Central Tendencies: – Mean, media and mode

Measures of variability :- range, average deviation quartile deviation & standard deviation.

Standard score :- 'z', score, 'T' score, "c"score & stennine score.

Normal probability curve:- meaning, properties and uses in interpreting testresults.

Monitoring system for programme Evaluation at different levels of Education.

P A P E R – II

TRENDS AND ISSUES IN EDUCATION

Section – A

Unit – I Administration, Management & Supervision of Education

Concept of Administration & Supervision

Educational Management :- Functions & Roles of Management, Interpersonal, Informational, Decision-Making, Conflict Management, Job Analysis, Work Motivation.

Administrative Structure of Education in the State and Centre.

Structure and Functions of UGC,NAAC, AIU, AICTE, NCTE, ICSSR, ICA, CABE, NCERT, NIEPA, CBSE.

SCERT, SIET, ELTI, SRC for A.E, BSE, CHSE.

School Complex, School Improvement Planning and Institutional Planning and Management.

Odisha Examination Act, 1988.

Equality of Educational Opportunities, Universalisation of Elementary Education.

DPEP, Sarvasikshya Abhiyan, NLM.

Finance Management in Education at – Primary, Secondary, Higher, Adult & Nonformal and Technical Education.

Grant in Aid system, Role of Central, State and Local bodies in Education finance. Classification of Educational Expenditures.

Unit – II Issues in Education

Value and Peace Oriented Education – Meaning, Nature, Objectives, & programmes.

Population Education, Adolescent Education.

Adult and Non-formal Education- Need, Problems and Strategies.

Vocationalisation of Education – Need, importance; and programmes.

Distance and Continuing Education – Need, importence and functions.

Education for All.

Work-experience , Socially Useful Productive work.

Environmental Education – need, causes of pollution & preventive measures.

Health, Nutrition & School Hygience.

Unit – III Education of Children with Special Needs.

Identification of Children with special needs.

Education for Mentally challenged, visually impaired, Hearing impaired; and Orthopedically Handicapped children – Characteristics, degree of impairment, Learning disability, Educational programmes, Segregation to Inclusion.

Education of Gifted and Creative children – Characteristics and Educational programmes.

Education for socially and economically disadvantaged children of the society with reference to S.C., S.T., Women and Rural population.

Role of Teachers in the Education of Children with special needs.

Unit –IV Educational Technology.

Meaning and Scope of Educational Technology.

Educational Technology as system approach to education and its characteristics.

Components of Educational Technology – Software and Hardware

Multi-Media Approach in Educational Technology.

Designing Instructional Strategies-Lecture, Team-teaching, Discussion, Pannel Discussion, Seminars, Symposia and Tutorials.

Communication process-Concept of communication, principles, models and barriers.

Programmed learning, Microteaching , Simulated Teaching.

(Part – B)

Unit – V Education & National Development.

Education & Modernisation

Education and Culture

Education and Religion

Education for National Integration and International Understanding.

Education for Human Resource Development.

Education related to social stratification and social mobility.

Unit – VI Teacher Education

Objectives, level specificity of Teacher Education

Strategies for Teacher Education – Pre service, In-service programmes.

Staff development programmes – Oriental course, refresher course.

Summer school, - Linking the programmes to career advancement.

Teacher as a role model,

Teaching as a profession , professional ethics.

Role of Teachers Organisation for development of Primary & Secondary Education and professional development of teachers.

Unit – VII National System of Education

National policy on Education 1986 & Programme of Action 1992 – Aims objectives of Education envisaged in the policy.

Salient features as proposed in NPE for various stages.

Objectives of Vocational Education.

National system of Education – need, objective structure & curriculum.

Concept of ensuring Minimum Learning Out-comes, measures for achieving Minimum Learning Out-comes in each subject area.

Unit – VIII Information Communication Technology (ICT) –

Conceptof computer and types.

Software, Hardware and its application

Operating system, and application software

Preparation & Delivery of Lessons/Lectures by using Computer – Collection, Preparation, presentation, evaluation, reporting.

Use of Internet (WWW) in professional development – Collection & processing of information, presentation, reporting and evaluation.

ELECTRICAL ENGINEERING

Paper-I

Electrical Circuits–Theory and Applications

Circuit components; network graphs; KCL, KVL; circuit analysis methods : nodal analysis, mesh analysis; basic network theorems and applications; transient analysis : RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits and applications; coupled circuits and applications; balanced 3-phase circuits. Two-port networks, driving point and transfer functions; poles and zeros of network functions. Elements of networks synthesis. Filter-theory : design and applications. Active filters. Circuit simulation : Input formats; mathematical modelling; solution of equations; output formats; SPICE.

Signals & Systems

Representation of continuous–time and discrete-time signals; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform, Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals DFT, FFT Processing of analog signals through discrete-time systems.

E.M. Theory

Maxwell's equations, wave propagation in bounded media. Boundary conditions, reflection and refraction of plane waves. Transmission line : Distributed parameter circuits, travelling and standing waves, impedance matching, Smith chart. Waveguides : parallel plane guide, TE, TM and TEM waves, rectangular and cylindrical wave guides, resonators. Planar transmission lines; stripline, microstripline.

Analog Electronics

Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET. Diode circuits : clipping, clamping, rectifier. Biasing and bias stability. FET amplifiers. Current mirror, Amplifiers : single and multi-stage, differential, operational, feedback and power. Analysis of amplifiers; frequencyresponse of amplifiers. OPAMP circuits. Filters; sinusoidal oscillators : criterion for oscillation; single-transistor and OPAMP configurations for oscillators. Function generators and wave-shaping circuits. Power supplies.

Digital Electronics

Boolean algebra; minimisation of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits : arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits : latches and flip-flops, counters and shift-registers. Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories. Programmable logic controller.

Energy Conversion

Principles of electromechanical energy conversion : Torque and emf in rotating machines. DC machines : characteristics and performance analysis; starting and speed control of motors. Transformers : principles of operation and analysis; regulation, efficiency; 3-phase transformers, 3-phase induction machines : Characteristics, speed control. 3-phase synchronous machines : Characteristics, parallel operations. Reactive power control. Special machines : stepper motors, brushless dc motors, permanent magnet motors single-phase motors; Universal Motors.

Power Electronics and Electric Drives :

Semiconductor power devices : diode, transistor, thyristor, triac, GTO , MOSFET and IGBT; static characteristics and principles of operation; triggering circuits; bridge converters : fully-controlled and half-controlled; principles of choppers and inverters; basic concepts of speed control of dc and ac motor drives, applications of variable-speed drives.

Analog Communication

Random variables : continuous, discrete; probability, probability functions. Statististical averages; probability models; Random signals and noise : white noise, noise equivalent bandwidth; signal transmission with noise; signal to noise ratio. Linear CW modulation : Amplitude modulation : DSB, DSB-SC and SSB. Modulators and Demodulators; Phase and Frequency modulation : PM & FM signals; narrowband FM; generation & detection of FM and PM, Deemphasis, Preemphasis. CW modulation system : Superhetrodyne receivers, AM receivers, communication receivers, FM receivers, phase locked loop, SSB receiver, Signal to noise ratio calculation for AM and FM receivers.

Microwaves and Antenna

Electromagnetic radiation, Propagation of waves : ground waves, sky wave, space wave, tropospheric scatter propagation. Extraterrestrial communications. Antenna : Various types, gain, resistance, band-width, beamwidth and polarization, effect of ground. Antenna coupling; high frequency antennas; microwave antennas; special purpose antennas. Microwave Services : Klystron, magnetron, TWT, gun diodes, Impatt, Bipolar and FETs, Microwave integrated circuits. Microwave measurements.

Paper-II

Control Systems

Elements of control systems; block-diagram representation; open-loop & closedloop systems; principles and applications of feed-back. LTI systems : timedomain and frequency-domain analysis. Stability : Routh Hurwitz criterion, rootloci, Nyquist's criterion, Bode-plots, Design of lead-lag compensators. Proportional, PI, PID controllers. State-variable method and application. Principles of discrete-control systems.

Electrical Engineering Materials

Electrical/electronic behaviour of materials : conductivity; free-electrons and band-theory; intrinsic and extrinsic semiconductor, p-n junction; superconductivity. Dielectric behaviour of materials; polarization phenomena; piezoelectric phenomena. Magnetic materials : behaviour and application. Photonic materials : refractive index, absorption and emission of light, optical fibres, lasers and opto-electronic materials.

Microprocessors and microcomputers

8-bit microprocessor : architecture, CPU, module design, memory interfacing, I/O, Peripheral controllers,Application. IBM PC architecture : overview, introduction to DOS, Advanced microprocessors.

Measurement and Instrumentation

Error analysis; measurement of current, voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency. Electronic measuring instruments : multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyser, distortion-meter. Transducers : thermocouple, thermistor, LVDT, strain-guage, piezo-electric crystal. Use of transducers in measurements of non-electrical quantities. Data-acquisition systems.

IC Technology

Overview of IC Technology. Unit-steps used in IC fabrication : wafer cleaning, photo-lithography, wet and dry etching, oxidation, diffusion, ion-implantation, CVD and LPCVD techniques for deposition of poly-silicon, silicon, siliconnitride and silicon di-oxide; metallisation and passivation.

Power Systems : Analysis and Control

Steady-state performance of overhead transmission lines and cables; principles of active and reactive power transfer, Distribution system; Per-unit quantities; Bus admittance and impedance matrices; load flow; economic operation; Symmetrical components, analysis of symmetrical and unsymmetrical faults. Concept of system stability : swing curves and equal area criterion. Flexible AC Transmission Systems (FACTS). Computer control and Automation : Introduction to energy control centres; various states of a power system; SCADA systems and RTUs.

Power system protection

Principles of over current, differential and distance protection. Concept of solid state relays. Circuit brakers. Load frequency control, Reactive power control. Line bus, generator, transformer protection; numeric relays and application of DSP to protection. Computer aided protection.

Non-conventional Energy Sources and Energy Management

Introduction to the energy problem; difficulties with conventional energy sources. Wind-Energy : Basics of Wind turbine aerodynamics; wind-energy conversion systems and their integration into electrical grid. Solar-Energy : Thermal conversion : photo-voltaic conversion. Wave-energy. Importance of Energy Management : Energy audit; energy economics : discount rate, payback period, internal rate of return, life cycle costing.

Digital Communication

Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM), Digital modulation and demodulation schemes : amplitude, phase and frequency keying schemes (ASK, PSK, FSK). Error control coding : error detection and correction, linear block codes, convolution codes. Information measure and source coding. Data networks, 7-layer architecture.

Satellite Communication, Radar and TV

Satellite Communication: General overview and technical characteristics, earth station equipment, satellite link design, CNR of Satellite system. Radar : Basic principles, Pulsed systems : CW Doppler radar, FMCW radar, Phase array radars. Television Systems : Television systems and standards, Black-and White-and Colour-TV transmission and receiver systems.

Fibre Optic System

Multiplexing : Time division multiplexing, Frequency Division multiplexing. Optical properties of materials : Refractive index absorption and emission of light, optical fibres, lasers and optoelectronic materials Fibre optic links.

FISHERY SCIENCE

PAPER-I.

Section-A

1. General Fisheries: Role of fisheries and aquaculture in Indian economy and human health. Fisheries resources of India. Utilization of different aquatic resources for fish production. Geographical distribution of fishes in India. Fisheries education and research in India. Organisational setups in fisheries development at national and international context. Frontier research and global scenario in fisheries and aquaculture. Growth and development of fisheries and aquaculture during different plan periods in India; Fisheries and Aquaculture Regulatory Acts. Disaster awareness related to fisheries and aqua culture.

2. Fishery Biology and Resource Management :

2 .1. Systematics: Classification and taxonomical characteristics of commercially important freshwater, brackish water and marine fishes of Orders Lamniformes, Rajiformes, Torpediniformes, Cypriniformes, Salmoniformes, Siluriformes, Clupeiformes, Anguilliformes, Perciformes (family-Mugilidae, Centropomidae, Serranidae, Teraponidae, Sillaginidae, Carrangidae, Gerridae, Leognathidae, Sciaenidae, Polynemidae, Gobiidae, Scrombridae, Scromberomoidae, Thunnidae, Cichlidae, Stromatidae, Trichiuridae, Anabantidae, Nemipteridae) and shellfishes of Orders Anostraca, Notostraca, Diplostraca, Podocopa, Cladocera, Calanoida, Harpacticoida, Cyclopoida, Caligoida, Thoracica, Acrothoracica, Stomatopoda, Isopoda, Decapoda, Natantia, Raptantia, Macrura, Anomura, Scaphopoda, Pelecypoda, Gastropoda, Cephalopoda, Penaeidae, Palaemonidae, Pandalidae, Sergestidae, Hippolytidae.

2.2 Anatomy and physiology: Anatomy and physiology of cartilaginous fish (*scoliodon,*) bony fishes (Carps, Murrels, Catfish, Seebass), and shell fishes (prawn, shrimp, crab, squids, cuttlefish, *lamellidens*, mussels) with particular reference to their skeletal, digestive, circulatory, respiratory, excretory, reproductive and nervous system. Osmoregulation and migration. Feeding and breeding habits of commercially important finfishes and shellfishes. Age and Growth-growth curve, absolute and relative growth, isogonic and heterogonic growth, Walford growth transformation.

2.3. Reproductive Biology and Endocrinology: Sex ratio, A g e and size at maturity, maturity stages, gonadosomatic index, fecundity, d evelopment of gametes, vitellogenesis structure of sperm and ovum, types of egg, spawning and developmental biology of commercially important finfishes and shellfishes (bonyfish, prawn, shrims and craps) Natural breeding. Seasonality, parental care, and mechanism of hatching. Modes of reproduction, secondary sexual characters and maturation process. Endocrine glands.- Pituitary, thyroid, interrennal, corpuscles of ukaryot, ultimobranchial, gonads, hypothalmo –hypophysial complex, X and Y organ.

2.4. Fisheries Resource: Marine and Inland capture fishery resources of India. Catch statistics, conservation. Fisheries of major riverine systems, estuaries, reservoirs and lakes of India. Cold water fisheries of India. Potential marine fishery resources of the Exclusive Economic Zone of India; Major exploited marine fisheries of India. Conservation and management of marine fishery resources, Socioeconomic issues. Definition of population dynamics. Catch per unit effort, Catchability coefficient, Mortality-determination of Total, Natural & Fishing, Recruitment. Concepts of maximum sustainable yield and maximum economic yield. Application remote sensing in fisheries; Potential fishing zones; Estimation of total catch based on catch and effort data. Single census and multiple census methods of stock assessment. Population models. Marking and tagging techniques. Fisheries regulations (Fleet regulation, mesh regulation, closed seasons, catch quota regulation etc.).

3. Biochemistry and Microbiology:

3.1. Biochemistry: Cell. Structure and function of bimolecules – Amino acids and peptides, Enzymes, Vitamins, Carbohydrate, Protein, Lipid. Metabolism of carbohydrates–ATP cycles, Glycolysis, C itric Acid cycles, Electron Transport, Oxidative phosphorylation. Oxidation of fatty acids and Amino acids. Biosynthesis of carbohydrate, lipid, Amino acids and nucleotides. DNA –structure, Replication and transcription. Protein synthesis. Genetic recombination; C loning; buffers; Normal solutions. Estimation of Protein Lipid, Carbohydrate, Minerals, Trimethyl Amine, Volatile base nitrogen, Total Nitrogen, Non protein nitrogen, Peroxide value, Free fatty acid, Thio barbituric acid value. Spectrophotometry; Chromatography; Electrophoresis; Immuno chemical assay.

3.2. Microbiology: Scope and history of microbiology, Microscopes and microscopy-Optical and electron, staining techniques, wet mount and hanging drop preparations. Procaryotic and ukaryotic cells. Morphplogy, ultra structure, nutrition, growth and reproduction of bacteria, virus, fungi and algae. Control of microorganisms-physical and chemical agents, antibiotics and chemotherapeutics. Bacteriological media. Cultivation and culture characteristics of bacteria. Biochemical, serological and molecular tests f o r identification of bacteria. Host-microbe interaction-process of infections. Immunity-natural and acquired; immunioglobulin – nonspecific and specific. Microorganisms in nutrient cycles-Nitrogen, Sulphur, Phosphorous, Carbon dioxide, Oxygen, Iron and Manganese.

Section-B

4.Aquatic Environment:

4.1. Inland: Inland water ecosystem. Biological communities; phytoplankton, zooplankton, benthos, algae and macrophytes. Productivity; food chain, food web and nutrient cycles. Classification and distribution of lakes, ponds, streams, reservoirs, estuaries, mangroves and flood plain. Wet lands, their physico-chemical and biological characteristics in relation to fisheries and aquaculture.

4.2. Marine: Divisions of marine environment. T o pographic features of seabottom. Major groups of phytoplankton and zooplankton, their geographical and seasonal variation. Physical properties of seawater-temperature, salinity, density, colour, light penetration. Oceanic phenomenon-waves, tides and currents. Major currents of Indian Ocean, El Nino, Tsunami and their effects. Biological communities in rocky, sandy and muddy shores. Boring and fouling organisms. Coral reefs. Oceanographic equipments.

4.3. Aquatic pollution: Organic, inorganic and radioactive pollutants in water bodies and their effects. Bioaccumulation and biomagnifications. Sewage treatment and effluent management.

5. Social Sciences:

5.1 Economics: Definition, scope and role of fishery economics. Economics of fish farming, hatcheries, fishing and processing units. Financial agencies. Project planning, formulation, monitoring and evaluation. Growth and development of fisheries and aquaculture during different plan periods. Fish marketing-marine and inland fish marketing channels in India. Export marketing of fish and fishery products. Marketing management and marketing research. Cooperatives–principles and objective; structure and function of fisherman cooperatives in India. Problems and remedial measures for growth of fisheries cooperatives.

5.2 Extension: Concepts, principles, scope and objectives of fisheries extension. Extension machineries in fisheries development of India. Extension teaching methodsclassification, relative effectiveness of methods; factors affecting choice and use of methods; Extension administration; Organizational structure of Fisheries extension; Role of FFDA, BFDA, NATP, ATMA etc. For development of fisheries and aquaculture. Extension programme planning; Participation of organizations and involvement of people in planning. Socio economic conditions of fisher folk of India. National and international extension agencies.

5.3 Fisheries administration and legislation: Organizational set up in fisheries and aquaculture regulatory programmes. Laws of the sea; Exclusive Economic Zone; Integrated Coastal Zone Management. Indian Fisheries Act-1897. Marine Fisheries Regulatory Acts of different maritime states of India. State Reservoir Fishery Policy of Odisha. Fisheries related land reforms. Odisha Fisheries Act.

5.4 Fishery Statistics: Sampling methods-random, stratified, cluster. Measures of central tendency-mean, mode, median; probability. Concept of theoretical distributionsbinomial, poisson, normal and their fitting to fisheries data. Statistical errors- standard deviation and standard error. Testing of hypothesis- z -test, t-test , chi-square, F-test, nonparametric tests. Correlation- linear and multiple. Regression. Design of experiments.

PAPER-II

Section-A

1. Aquaculture:

1.1. Principles of aquaculture : Definition and scope. History of aquaculture and present global scenario.

1.2. Infrastructure: Survey, soil quality in different regions suitable for fish culture; site selection, design and construction of fish farms, hatcheries and raceways. Design and setting of aquaria for ornamental fishes.

1.3. Aquatic environment management: S o il and water management; Physicochemical and biological indices. Species diversity and control of unwanted fishes. Insect and weed control in fish ponds. Nutrient management. Bioremediation. Biofortilisation. Carrying capacity. Sustainability.

1.4. Types of culture: Extensive, semi-intensive and intensive culture; Cage, pen, recirculatory, running water, waste water, bheel & gheri culture, Candidate species for aquaculture (freshwater, brackish water and mariculture) - Carps (Indian Major Carps, Exotic Carps), air breathing fishes, mahaseer, trouts, seabass, mullets, milkfish, groupers, freshwater prawn, shrimps, crabs, lobsters, mussels, clams, oysters, cuttlefish and sea weeds. Monoculture and Composite fish culture. Agricultural crop and live stock integration in aquaculture practices. Ornamental fish culture and pearl culture.

1.5 Fish nutrition: Culture of fish food organisms; Feeding habits and nutritional requirements of cultivable shellfishes and finfishes; Digestion, assimilation and conversion of feed. Nutritional bioenergetics of fish; Fish feed technology. Feed ingredients, probiotics, essential amino acids. Feed processing and feed dispersal. Anti-nutritional factors, Stress elements.

1.6. Seed production and hatchery management: Seed production and hatchery management of Indian major carps, exotic carps, air breathing fishes, mahseer, trouts, seabass, mullets, milkfish, groupers, fresh water prawns, shrimps and crabs. Brood stock management of fishes and prawns, Hypophysation technique and synthetic agents and their principle in inducing breeding. Chinese circular hatchery and other hatcheries. Bundh and hapa breeding. Stripping. Breeding and seed production of common ornamental fishes.

1.7. Genetics and Biotechnology: Gene and Gene action, Gynogenesis, androgenesis, polyploidy, transgenic fish, sex reversal, selective breeding, hybridization. Milt. Cryopreservation of gametes. Genetic characterization (kryotyping, RAPD, PCR, Isozymes).

1.8 Fish health management: Health management in aquaculture; Disease development process, Defense mechanism in fish and shell fish; Parasitic diseases (protozoa, platyhelminthes, nemato helminthesa, acanthocephala, crustacea, leeches, mollusca). Common bacterial, fungal and viral diseases of carp, ornamental fish, fresh water prawn and brackish water shrimp. Clinical signs and symptom, treatment and prophylaxis. Nutritional and environmental diseases of fish and shellfish and their management. Use of disinfectants, chemicals antibiotics, bioremediators, vaccines and immunostimulants in aquaculture. Quarantine, and health monitoring. Principles of fish disease diagnosis for epidemic and endemic diseases.

Section-B

2.Harvest and Post Harvest Technology

2.1. Fishing Crafts and Gears: Classification of fishing crafts; Dimensions and design of boats; Safety and stability of fishing boats; Care and maintenance of boats; Fishing accessories and deck equipments; Types of marine engines; Fishing methods of India. Modern commercial fishing methods- trawling, purse seining, gill netting and long lining. Classification of gears, yarn numbering, construction and types of twine and ropes, Natural and synthetic material for fishing gears and choice of net materials. Design and fabrication of fishing gears, floats, sinkers, anchors and buoys. Care and preservation of fishing gears.

2.2. Biochemistry of fish: Fish muscle chemistry, Proximate composition of fish; Fish as a source of essential amino acids, n-3 fatty acids, vitamins and minerals. Post mortem changes- rigor mortis, autolysis, microbial putrification, lipid autoxidation. Fresh fish spoilage.

2.3. Freezing: Methods of fish preservation; Handling and transportation of fresh fish. Methods of chilling- icing, refrigerated sea water and chilled sea water stowage of fresh fish. Principles of low temperature preservation of fish - Freezing and cold storage of fishes and shellfishes; Types of freezers- a i r -blast, contact plate, cryogenic and immersion freezing; Refrigeration systems; Cold stores- warehousing and cold chain; Changes associated with frozen fishery products- protein denaturation, lipid oxidation, dehydration, driploss, and their control. Methods of thawing.

2.4. Canning and packaging technology: Types of canning- Conventional, high temperature short time, ultra high temperature. Containers used in canning. Steps in canning- raw material, preparatory treatments, precooking, packing, filling, exhausting, seaming, thermal processing, cooling and storage. Canning of finfish (sardine, mackerel, tuna, seer fish, pomfret, carps, prawns and shrimps) in different filling media. Principles of thermal processing- heat resistance of microorganisms, D-value, and Z-value , heat penetration, graphical method of process calculation, F_0 value; Can defects and spoilage. Packaging materials used for fishery products.

2.5 Cured, Value-added products and byproducts: Cured fish- dried, salted, smoked fish, fermented fishery products. Value added fishery products- breaded and battered products, fish finger, fish cutlet, fish wafer, fish soup powder, fish burger, imitation products, paste products (fish sausage, ham, surimi products), fish pickle. Fishery byproducts- fish meal, fish silage, fish oil, fish protein concentrate, shark fin rays , chitin, chitosan, glucosamine hydrochloride, fish maws, fish glue, pearl essence, isinglass, beche-de-mer, fish peptone, ambergris, agar agar, alginic acid, carrageenan, spirulina.

2.6. Quality Control: Biochemical, microbiological and organoleptic indices of fresh fish; Spoilage microflora associated with fish and fishery products. Food poisoning microbes in fishery products-Salmonella, Clostridium, Stephylococcus, Vibrio, Listeria, Aspargilus and marine algae. Fish quality control - Quality assurance; Quality management; Hazard Analysis Critical Control Points (HACCP); ISO-9000 series, Bureau of Indian Standards (BIS) and International Standards (IS) for fish and fishery products; Quality specifications for export of Indian fishery products to European Union, USA and Japan.

FORESTRY

PAPER – I

PART – "A"

1. Effect of Locality Factors : Climatic factors : Light, temperature, frost, precipitation, dew, humidity, wind; Physiographic factors : altitude, aspect, topography, microclimate, geology and soil, geology and forests, soil conditions; Biotic factors.

2. Forest classification and Distribution : Basis for classification, criteria for delineating forest types in India and Odisha, distribution of forest types, botanical areas : Principal sub-groups, forest types and their distribution : brief description of groups and types, Biodiversity and its preservation, Mangrove forest.

3. Forest Regeneration : Natural regeneration : by vegetative parts, by seeds, ecological requirements for natural regeneration, operations to be carried out for natural regeneration : natural regeneration practice for important species and types:-moist Sal forest, teak forest, bamboo forest, dry deciduous forest, moist deciduous forest, evergreen forest. Artificial regeneration : factors affecting, choice between artificial and natural regeneration, choice of species, choice between sowing and planting, introduction of exotics: procedure for artificial regeneration, seed collection and storage, nursery operation, planting out, maintenance of plantation, Role of in-vitro culture in regeneration.

4. Tending operations and Forest growth : Weeding, cleaning, thinning, thinning types, methods of thinning, factors affecting thinning, thinning in important species, thinning in irregular crops, mixed plantations and coppice crops, improvement felling, girdling, pruning, Climber cutting. Tree growth: height growth. growth in diameter, increment, growth in quality, rate of growth, crop growth.

5. Silviculture of Tree species : Definition, objects of study, relation of silviculture with forestry and its branches, Silviculture of important tree species such as *Acacia auriculifomis, Acacia nilotica, Leucaena leucocephala, Sesbania grandiflora, Cassia siamea, Eucalyptus spc., Casuarina equisetifolia, Shorea robusta, Tectona grandis, Dalbergia sissoo. Gmelina arborea Adina cordifolia. Melia azadirachta, Bambusa arundinacea, Dendrocalamus strictus Terminaeia species, Albizia lebbek, Samanea saman Lagerstroemia flosreginae, Salmalia malbarica.*

PART – "B"

6. Forest Management system : Systems of forest management: Clear felling system, Uniform shelterwood system, Selection system, Coppice system: Single coppice and Coppice with Standard system and Coppice with reserve system. Choice of silvicultural system: systems of management in important forest types, working plan preparation and monitoring.

7. Production foresty : Site productivity, productivity of Indian forests, components of production forestry, evaluation of industrial and commercial demands, management of natural forests for production objectives, plantation of industrial and commercial wood, captive plantations, socio-industrial plantation. Involvement of corporate sector in plantation forestry.

8. Rotation and yield : Rotation, types of rotation:-physical, silvicultural, technical, rotation of maximum volume production; rotation of important species : teak sal, gambhar, eucalyptus: casuarina, subabul, wattles and bomboo, steps for reducing rotation age. Yield; yield regulation, yield from Indian forests, concept of sustained yield: principle, scope and limitation.

9. Forest protection : Forest degradation :-illicit fellings and encroachment, grazing and lopping, forest fires, shifting cultivation, diversion of forest lands. Silvicultural fellings, plant diseases, insects, pests, plant parasites and aggressive weeds, Protection measures:-control of illicit felling and encroachments, control of grazing and lopping, protection from animals, protection against fires, protection against disease, protection against inseet pests, weed control measures.

10. Forest Influences : Forest and climate:- precipitation, temperature, shelterbelt and windbreak effect, humidity frost, snow fall, evapotranspiration : Forest and soil : organic matter and recycling of nutrients. Soil composition and structure, soil temperature, soil moisture, forest and water table, chemical property of soil, biological properties, Forest and hydrological cycle : Forest and interception, Forest and infiltration, forest and runoff, forest and erosion, forest and flood, forest and water yield, forest and avalanche, forest and animals; forest and biodiversity conservation, forest recreation, forest and population. Plant succession : stages of succession, climax formation. Watershed management and Wasteland development. Carbon sequestration by forest plants; Green house effect, Global warming.

PAPER – II

PART – "A"

1. Forest Development in India : (Post-Independence)-Forest Development in Five- year Plan periods, Land use forest area, forest cover of the country and the State in particular.

Environmental conservation : Importance and principles of conservation. Impact of deforestation due to various anthropic activities like mining, construction and developmental projects, forest fire.

2. Forest policy and legislation : Indian Forest Policy of 1894, 1952 and 1988, National Commission on Agriculture 1976) Report on forestry, constitution of Wasteland Development Board, Indian Council of Forestry Research and Education, Forest laws, necessity and general principles; Indian Forest Act, 1927, Forest Conservation Act, 1980, Wildlife (Protection) Act, 1948; Odisha Forest Act, 1972, Odisha Timber and Other Forest Produce Transit Rules, 1980, Odisha Forest (Grazing of Cattle) Rules, 1980.

3. Forest Economics : Fundamental Principles of forest economics, estimation of demand and supply, assessment and protection of market structure; role of corporate financing; socioeconomic analysis and attributes of forest productivity.

4. Wildlife management : Common game animals and birds, wildlife conservation and management, wildlife management principles, National parks and wildlife sanctuaries, project tiger.

5. **Extension Forestry** : Agroforestry : concepts, classification, scope and management; Agroforestry systems under different agroecological zones, selection of species and role of multipurpose trees and Non wood Forest products. Food, folder, and fuelwood security, Research and extension needs; farm forestry; social forestry :- objectives, scope and benefits; Joint forest management, Tribology.

PART – "B"

6. Forest Genetics and Tree Improvement : Tree improvement, its peculiarity compared to annual crop breeding objectives; causes and kinds of variability, provenance, seed source and exotics; principles and methods of tree breeding, vegetative propagation (macro & micro); progeny testing, seed production areas, seed orchards (clonal and seedlings) and their management; hybridization, polyploidee and mutation breeding. Importance of genetic resources conservation and preservation of biodiversity.

7. Forest Mensuration : Methods of measuring diameter, girth, height and volume of trees; form factor; Volume estimation of stand, sampling methods, yield calculation, current annual increment, mean annual increment; sample plots; yield and yield tables; scope and objectives of forest inventory; Aerial survey and remote sensing techniques.

8. Forest surveying & Engineering : Different methods of surveying. Leveling, importance of maps in forestry, maps and map reading; Basic principles of forest engineering, building materials and construction. Roads: objects, classification, general principles and construction. Bridges: Objects, general principles, types, simple design and construction of timber bridges.

9. Wood and its utilization : Wood anatomy of conifers and hardwoods, their physical and mechanical properties. Defects of wood, logging and wood extraction; Process of seasoning wood; Production of composite and improved wood, wood based industries. Uses of natural wood and processed wood.

10. Non-wood Forest products : Definition and scope, gums, resin, oleoresins, fibres, flosses, essential oil yielding plants; tannin dye, oilseeds, nuts, canes, bamboo, bidi leaves, medicinal plants, apiary, sericulture, lac and shellac. Collection, processing and disposal of non-wood forest products.

GEOGRAPHY

Paper-I
Principles of Geography

Section-A

Physical Geography

i) **Geomorphology :** Origin of the earth, Physical conditions of the earth's interior; continental drift; isostasy; plate tectonics; mountain building; volcanism and earthquakes; weathering and erosion, Concepts of geomorphic cycles (Davis and Penck), Landforms associated with fluvial, arid, glacial, coastal and karst region, Polycyclic landforms.

ii) **Climatology :** Temperature and pressure belts of the world; heat budget of the earth; atmospheric circulation; planetary and local winds; monsoons and jet streams; air masses and fronts; temperate and tropical cyclones; types and distribution of precipitation; Koppen's and Thornthwaite's classification of world climate; hydrological cycle; climatic change.

iii) **Oceanography :** Bottom topography of the Atlantic, Indian and Pacific Oceans; temperature and salinity of the oceans; ocean deposits; ocean currents and tides; marine resources and their utilizations, Coral reefs;

iv) **Biogeography :** Genesis of soils; classification and distribution of soils; soil profile; soil erosion and conservation; factors influencing world distribution of plants and animals; problems of deforestation and conservation measures; social forestry, agroforestry.

v) **Environmental Geography :** Concept and types of environment, Environmental degradation and management. Ecosystems and their management; Energy flow and Biogeo- chemical cycles, Global ecological imbalances–problems of pollution, global warming, reduction in bio-diversity and depletion of forests.

Section-B

Human Geography

i) **Perspectives in Human Geography :** Areal differentiation; regional synthesis; dichotomy and dualism; environmentalism; quantitative revolution and locational analysis; radical, behavioural, human and welfare approaches; Cultural regions of the world, Human development indicators.

ii) **Economic Geography :** World economic develpment–measurement and problems; world resources and their distribution; energy crisis; the limits to growth; World agriculture–typology of agricultural regions; Von-Thunen's theory of agricultural location; World industries–locational patterns and locational theories of Weber; Hoover, Losch and Smith, Patterns of world trade.

iii) **Population Geography :** Growth and distribution of world population; demographic atrributes; causes and consequences of migration; concepts of over–, under– a n d optimum population; world population problems. Races of man kind.

iv) Settlement Geography

Types and patterns of rural settlements; hierarchy of urban settlements; Cristaller's Central Place Theory, concept of primate city and rank-size rule; functional classification of towns; sphere of urban influence; rural-urban fringe; satellite town; problems of urbanisation.

v) **Regional Planning :** Concept of region; types of regions and methods of regionalisation; growth centres and growth poles; regional imbalances; multi-level planning; planning for sustainable development. Rostov Model of Stages of Growth. Note : Candidates will be required to answer one compulsory map question pertinent to subjects covered by this paper.

Paper-II
Geography of India with special reference to Odisha

Section-A.

i) **Physical Aspects :** Structure and relief; drainage system and watersheds; physiographic regions; mechanism of Indian monsoons; tropical cyclones and western distrubances; floods and droughts; climatic regions; natural vegetation, soil types and their distributions.

ii) **Resources : C**oncept and types of resources, land, water, energy, minerals, and biotic resources, their distribution, utilisation and conservation; energy crisis.

iii) **Agriculture :** Infrastructure–irrigation, seeds, fertilizers, power; Types of crops agricultural productivity, agricultural intensity, crop combination, land capability; agroand social forestry; Green Revolution - its socio-economic and ecological implications; significance of dry farming; livestock resources and White Revolution; Blue Revolution; agricultural regionalisation; agro-climatic zones.

iv) **Industry :** History of industrial development; locational factors of cotton, jute, iron and steel, fertilizer and paper, industries, industrial complexes and industrial regionalisaiton; new industrial policy; role of multinationals, liberalization and globalisation.

v) **Transport, Communication and Trade :** Road, railway, waterway, airway and pipeline networks and their complementary roles in regional development; growing importance of ports on national and foreign trade, trade balance; free trade and export promotion zones; developments in communication technology and its impact on economy and society.

Section-B

i) **Cultural Setting :** Racial and ethnic diversities; major tribes, tribal areas and their problems; role of language, religion and tradition in the formation of cultural regions; growth, distribution and density of population; demographic attributes–sex-ratio, age structure, literacy rate, work-force, dependency ratio and longivity; migration (interregional, intra-regional and international) and associated problems, population problems and policies.

ii) **Settlements :** Types, patterns and morphology of rural settlements; urban development; Census definition of urban areas; morphology of Indian cities; functional classification of Indian cities; conurbations and metropolitan regions; urban sprawl; slums and associated problems; town planning; problems of urbanisaiton.

iii) **Regional Development and Planning:** Experience of regional planning in India; Five Year Plans; integrated rural development programmes; Panchayati Raj and decentralised planning; command area development; watershed management; planning for backward area, desert, drought-prone, hill and tribal area development; multi-level planning; geography and regional planning.

iv) **Political Aspects :** Geographical basis of Indian federalism; state reorganisation; regional consciousness and national integration; international boundary of India and related issues; disputes on sharing of water resources; India and geopolitics of the Indian Ocean.

v) **Contemporary Issues :** Environmental hazards–landslides, earthquakes, Tsunami, cyclones, floods and droughts, epidemics. Issues related to environmental pollution; changes in patterns of land use; principles of environmental impact assessment and environmental management; population explosion and food security; environmental degradation; Disasters in India and their management. Problems of agrarian and industrial unrest; regional disparities in economic development; concept of sustainable growth and development.

Note : Candidates will be required to answer one compulsory map question pertinent to subjects covered by this paper.

GEOLOGY

Paper-1
Section-A

(i) General Geology and Geotectonics

The Solar System. Meteorites. Origin and interior of the earth. Radioactivity and age of earth. Volcanoes - causes and products, volcanic belts. Earthquakes-causes, effects, earthquake belts, Seismicity of India, intensity and magnitude, seismogram and seismographs.

Island arc. Mid-oceanic ridges. Continental drift. Seafloor spreading. Plate tectonics. Orogeny and epeirogeny.

(ii) Geomorphology and Remote Sensing

Basic concepts of geomorphology. Weathering and mass wasting. Landforms, slopes and drainage. Geomorphic cycles and their interpretation. Morphology and its relation to structures and lithology. Applications of geomorphology in mineral prospecting, civil engineering,. hydrology and environmental studies. Geomorphology of Indian subcontinent.

Aerial photographs and their interpretation - merits and limitations. The Electromagnetic Spectrum. Orbiting Satellites and sensor systems. Indian remote sensing satellites. Satellites data products. Applications of remote sensing in geology. The Geographic Information system and its applications.

(iii) Structural geology

Priniples of geologic mapping and map reading. Study of Toposheets. Stress and strain ellipsoid and stress-strain relationships of elastic, plastic and viscous materials. Behaviour of minerals and rocks under deformation conditions. Folds and faultsclassification and mechanics. Foliations, lineations, joints and unconformities. Superposed deformation. Primary sedimentary structures and their application. Introduction to petrofabrics.

Section-B

(iv) Paleontology

Species- definition and nomenclature. Megafossils and Microfossils. Modes of preservation of fossils. Different kinds of microfossils. Application of microfossils in correlation, Petroleum exploration, paleoclimatic and paleoceanographic studies. Morphology, geological history and evolutionary trend in Cephalopoda, Trilobita, Brachiopoda, Echinoidea and Anthozoa. Stratigraphic utility of Ammonoidea, Trilobita and Graptoloidea. Evolutionary trend in Hominidae, Equidae and Proboscidae. Siwalik fauna. Gondwana flora and its importance.

(v) Stratigraphy and Geology of India

Standard Stratigraphic Time Scale. Principies of stratigraphic correlation. Code of stratighraphic nomenclature. Distribution and classification of Precambrian rocks of India. Study of Phanerozoic rocks of India with reference to lithology, fauna, flora and economic importance. Major boundary problems - Cambrian/Precambrian, Cretaceous/Tertiary. Physiographic and Tectonic division of India. Evolution of the Himalayas. Geology of Odisha.

(vi) Hydrogeology and Engineering Geology

Hydrologic cycle. Vertical distribution of subsurface water. Aquifer, Aquitard, Aquiclude, and Aquifuse. Classification of Aquifers. Hydrologic properties of water bearing formation – Porosity, Permeability, Transmissivity and Storage Coefficient. Ground water provinces of India. Ground water exploration. Quality of Ground Water. Salt water intrusion. Problems and management of ground water. Ground water recharge. Rain water harvesting.

Engineering properties of rocks. Geological investigations for dams, tunnels and bridges. Building stone and road materials – properties and Indian distribution. Landslides-causes, prevention and rehabilitation. Earthquake-resistant structures.

Paper-II
Section-A

(i) Mineralogy

Classification of crystals into systems and classes. International system of crystallographic notation. Spherical and Stereographic Projection. X-ray crystallography. Twinning.

Petrological microscope and accessories. Double refraction. Nicol prism. Optical properties of minerals - Pleochroism, Refractive index, Extinction and extinction angle, Interference colour, Dispersion.

Classification of silicate structures. Occurrence, chemistry, Physical and optical characters of Feldspar, Silica, Pyroxene, Amphibole, Garnet, Olivine and Mica groups. Minerals of Carbonate and sulphide groups.

(ii) Igneous ad Metamorphic Petrology

Generation and crystallisation of magma. Crystallisation of albite-anorthite, diopside-albite-anorthite and diopside-wollastonite-silica systems. Reaction principle. Magmatic differentation and assimilation. Petrogenetic significance of the textures and structrues of igneous rocks. Petrography and petrogenesis of granite, syenite, diorite, basic and ultrabasic rocks, charnockite, anorthosite and alkaline rocks and Carbonatites. Deccan volcanic province.

Types and agents of metamporphism. Metamporphic grades and zones. Phase rule. Facies of regional and contact metamorphism. ACF and AKF diagrams. Textures and structures of metamporphic rocks. Metamorphism of arenaceous, argillaceous and basic rocks. Retrograde metamorphism. Metasomatism and granitisation. Migmatites. Granulite terrains of India.

(iii) **Sedimentology**

Processes of formation of sedimentary rocks. Textures and structures of sedimentary rocks and their significance. Classification of sedimentary rocks. Heavy minerals and their significance. Sedimentary facies and provenance. Sedimentary environments-fluvial, glacial, lacustrine and marine. Sedimentary basins of India.

Section-B

(iv) **Economic Geology**

Ore minerals and gangue, tenor and grade. Classification of mineral deposits. Process of formation of minerals deposits. Controls of ore localisation. Metallogenic epochs and provinces. Geology of the important Indian deposits of aluminium, chromium, copper, gold, iron, lead zinc, manganese, titanium, uranium and thorium and industrial minerals. Deposits of coal and petroleum in India. National Mineral Policy. Conservation and utilization of mineral resources. Marine mineral resources and Law of Sea.

(v) **Mining Geology**

Methods of prospecting - geological, geophysical, geochemical and geobotanical. Techniques of sampling. Estimation of reserves of ore. Methods of exploration and mining of metallic ores, industrial minerals and marine mineral resources. Mineral beneficiation and ore dressing.

(vi) **Geochemistry and Environmental Geology**

Cosmic abundance of elements. Geochemical classification of elements. Structure and their compostion of earth and distribution of elements. Trace elements. Geochemical cycle. Elements of crystal chemistry-types of chemical bonds, coordination number. Isolmorphism and polymorphism.

Natural hazards-floods, landslides, coastal erosion, earthquakes and volcanic activity and their mitigation. Environmental impact of urbanization, open cast mining, industrial and radioactive waste disposal, use of fertilizers, dumping of mine waste and fly-ash. Pollution of ground and surface water, marine pollution. Environment protection legislative measures in India.

HISTORY

Paper-I
Section-A

1. Sources of early Indian history.

2. Early pastoral and agricultural communities.

3. The Indus Civilization: its origins, nature and decline.

4. Patterns of settlement, economy, social organization and religion in India (c. 2000 to 500 B.C.) .

5. Evolution of society and culture: evidence of Vedic texts (Samhitas to Sutras).

6. Life & Teachings of Mahavira and Buddha. Contemporary society. Early phase of state formation and urbanization.

7. Rise of Magadha; the Mauryan empire. Ashoka's inscriptions; his dhamma**.** Nature of the Mauryan state.

8. Post-Mauryan period in India: Political and administrative history,. Society, economy, culture and religion. Tamilaham and its society: the Sangam texts.

9. India in the Gupta and post-Gupta periods (to c. 750): Political history of India; Samanta system and changes in political structure; economy; social structure; culture; religion.

10. Themes in early Indian cultural history: languages and texts; major stages in the evolution of art and architecture; major philosphical thinkers and schools; ideas in science & Technology and mathematics.

11. Kalinga War; Kharavela-achievements.

12. Political History of Odisha (c.4th Century AD – 7th Centry AD).

Section-B

13. India, 750-1200 : Polity, society and economy. Major dynasties and political structures in North India. Agrarian structures. Feudalism in India. Rise of Rajputs. The Imperial Cholas and their contemporaries in South India. Villagle communities in the South. Conditions of women. Commerce-mercantile groups and guilds; towns. Problem of coinage. Arab conquest of Sind; the Ghaznavide empire.

14. India, 750-1200: Culture, Literature, Kalhana as a historian. Styles of temple architecture; sculpture; Religious thought and institutions: Sankaracharya's Vedanta. Ramanuja. Growth of Bhakti, Advent of Islam in India; Sufism. Indian science. Alberuni and his study of Indian science and civilization.

15. The 13th Century: The Ghorian invasions. Factors behind Ghorian success, Economic, social and cultural consequences; Foundation of Delhi Sultanate. The "Slave" Dynasty. IItutmish; Balban; Early Sultanate architecture.

16. The 14th Century: Alauddin Khalji's conquests, agrarian and economic measures; Muhammad Tughluq's major "projects"; Firuz Tughluq's concessions and public works; Decline of the Sultante; Foreign contacts: Ibn Battuta.

17. Economy Society and Culture in the 13th and 14th centuries. Caste and slavery under Sultanate, Technological changes, Sultanate architecture, Persian literature: Amir Khusrau, Historiography; Zia-ud—din Barani. Evolution of a composite culture, Sufism in North India, Lingayats, Bhakti schools in the south.

18. The 15th and early16th Century (Political History). Rise of Provincial Dynasties: Bengal, Kashmir (Zainul Abedin), Gujarat, Malwa, Bahmanids, The Vijayanagra Empire. Lodis. Mughal Empire, First phase : Babur, Humayun. The Sur Empire : Sher Shah's administration. The Portuguese colonial enterprise.

19. The 15th and early 16th Century (society, economy and culture). Regional cultures and literatures, provincial architectural styles. Society, culture, literature and the arts in Vijayanagara Empire. Monotheistic movements: Kabir and Nanak. Bhakti Movements: Chaitanya, Sufism in its pantheistic phase.

20. Akbar: His conquests and consolidation of empire. Establishment of **jagir** and **mansab** systems. His Rajput policy. Evolution of religious and social outlook. Theory of **Sulh-i-kul** and religious policy. Abul Fazl, thinker and historian. Court patronage of art and technology.

21. Mughal empire during 17th & 18th Centuries . Major policies (administrative and religious) of Jahangir, Shahjahan and Aurangzeb. The Empire and the Zamindars. Nature of the Mughal state. Late 17th Century crisis: Revolts. Shivaji and the early Maratha kingdom; Decline of Mughals . Maratha ascendancy under the Peshwas.

22. Economy and Society, 16th and 17th Centuries. Population. Agricultural and craft production. Towns; Trade and Commerce with Europe through Dutch, English and French companies; Indian mercantile classes. Banking, insurance and credit systems. Conditions of peasants, famines. Condition of Women.

23. Culture during Mughal Empire. Persian literature (including historical works). Hindi and religious literatures. Mughal architecture. Mughal Painting. Provincial schools of architecture and painting. Classical music. Science and technology. Sawai Jai Singh as astronomer. Mystic eclecticism : Dara Shukoh. Vaishnav Bhakti**.** Maharastra Dharma. Evolution of the Sikh community (Khalsa).

24. Medieval Odisha : The Bhaumakaras and the Somavamsis; The Imperial Gangas and Suryavamsi Gajapatis; Cult of Jagannatha.

Paper-II

Section-A

1. Establishment of British rule in India: Factors behind British success against Indian powers-Mysore, Maratha Confederacy and the Punjab as major powers in resistance; Policy of Subsidiary Alliance and Doctrine of Lapse.

2. Colonial Economy : Drain of wealth and "deindustrialisation", Fiscal pressures and revenue settlements (Zamindari, Ryotwari and Mahalwari settlements); Structure of the British Raj up to 1857 (including the Acts of 1773 and 1784 and administrative organisation).

3. Resistance to Colonial rule: Causes, nature and impact of the Revolt of 1857; Reorganization of the Raj: 1858 and after.

4. Socio-cultural impact of colonial rule: Official social reform measures (1828-57); Orientalist-Anglicist controversy; coming of English education and the press; Christian missionary activities;Bengal Renaissance; Social and religious reform movements in Bengal and other areas; Women as focus of social reform.

5. Economy 1858-1914: Railways; Commercialisation of Indian agriculture; Growth of landless labourers and rural indebtedness; Famines; India as market for British industry; Customs removal, exchange and countervailing excise; Limited growth of modern industry.

6. Early Indian Nationalism: Social background; Formation of national associations; Peasant and tribal uprising during the early nationalist era; Foundation of the Indian National Congress; The Moderate phase of the Congress; Growth of Extremism; The Indian Council Act of 1909; Home Rule Movement; The Government of India Act of 1919.

7. Inter-War economy of India: Industries and problem of Protection; Agricultural distress; the Great Depression; Ottawa agreements and Discriminatory Protection; the growth of trade unions; The Kisan Movement; The economic programme of the Congress; Karachi resolution, 1931.

8. Nationalism under Gandhi's leadership: Gandhi's career, thought and methods of mass mobilisation; Rowlatt Satyagraha, Khilafat, Non Cooperation Movement, Civil Disobedience Movement, 1940 Satyagraha and Quit India Movement; States’ People's Movement.

9. Other strands of the National Movement:

a) Revolutionary movements since 1905; (b) Constitutional politics; Swarajists, Liberals, Responsive Cooperation; (c) Ideas of Jawharlal Nehru, (d) The Left (Socialists and Communists); (e) Subhas Chandra Bose and the Indian National Army; (f) Communal strands: Muslim League and Hindu Mahasabha; (g) Women in the National Movement.

10. Towards Freedom: The Act of 1935; Congress Ministries, 1937-1939; The Pakistan Movement; Post-1945 upsurge (RIN Mutiny, Telengana uprising); Constitutional negotiations and the Transfer of Power, 15 August 1947.

11. First phase of Independence (1947-64): Facing the consequences of Partition; Gandhiji's murder; economic dislocation; Integration of States; The democratic constitution, 1950; Agrarian reforms; Building an industrial welfare state; Planning and industrialisation; Foreign policy of Non-alignment; Relations with neighbors.

12. Odisha under Colonial rule and after: British Conquest of Odisha- Khurda Rebellion (1817)-Kandha Rebellions under Dora Bisoyee and Chakra Bisoyee-Resistance Movement under Surendra Sai-Odia Movement-Nationalist Movement-Merger of States.

Section-B

13. **Enlightenment and Modern ideas**

1. Renaissance Background
2. Major Ideas of Enlightenment: Kant, Rousseau
3. Spread of Enlightenment outside Europe
4. Rise of socialist ideas (to Marx)

14. **Origins of Modern Politics**

1. European States System
2. American Revolution and the Constitution.
3. French revolution and aftermath, 1789-1815.
4. British Democratic Politics, 1815-1850; Parliamentary Reformers, Free Traders, chartists.

15. **Industriatization**

1. English Industrial Revolution: Causes and Impact on Society
2. Industrialization in other countries: USA, Germany, Russia, Japan
3. Socialist Industrialization: Soviet and Chinese.

16. **Nation-State System**
    1. Rise of Nationalism in 19th century
    2. Nationalism : state-building in Germany and Italy
    3. Disintegration of Empires through the emergence of nationalities.

17. **Imperialism and Colonialism**
    1. Colonial System (Exploitation of New World, Trans-Atlantic Slave Trade, Tribute from Asian Conquests)
    2. Types of Empire: of settlement and non-settlement: Latin America, South Africa, Indonesia, Australia.
    3. Imperialism and Free Trade: The New Imperialism

18. **Revolution and Counter-Revolution**
    1. 19th Century European revolutions
    2. The Russian Revolution of 1917-1921
    3. Fascist Counter-Revolution, Italy and Germany.
    4. The Chinese Revolution of 1949

19. **World Wars**
    1. 1st and 2nd World Wars as Total Wars: Societal Implications
    2. World War I : Causes and Consequences
    3. World War II : Political Consequence

20. **Cold War**
    1. Emergence of Two Blocs
    2. Integration of West Europe and US Strategy; Communist East Europe
    3. Emergence of Third World and Non-Alignment
    4. UN and Dispute Resolution

21. **Colonial Liberation**
    1. Latin America-Bolivia
    2. Arab World-Egypt
    3. Africa-Apartheid to Democracy
    4. South-East Asia-Vietnam

22. **Decolonization and Underdevelopment**
    1. Decolonization: Break up of colonial Empires: British, French, Dutch
    2. Factors constraining Development : Latin America, Africa

23. **Unification of Europe**
    1. Post-War Foundations : NATO and European Community
    2. Consolidation and Expansion of European Community/European Union.

24. **Soviet Disintegration and the Unipolar World**
    1. Factors in the collapse of Soviet communism and the Soviet Union, 1985-1991
    2. Political Changes in East Europe 1989-1992
    3. End of the Cold War and US Ascendancy in the World
    4. Globalization

HOME SCIENCE

PAPER – I

Section A - Food & Nutrition.

1. Study of Foods : Importance, Composition, nutritive value of Cereals, Pulses, Vegetables and Fruits, Fleshy foods (Meat, Fish, Poultry, Egg), Milk & Milk products, Fats and oils.

2. Study of Nutrients : Classification, sources, function, requirement and deficiencies of Proteins, Fats, Carbohymates, Minerals, Vitamins, Water and Roughages.

3. Utilisation of Food : Digestion, absorption and metabolism of Proteins, Fat and Carbodhydrates. Basal metabolism and factors affecting Basal metabolism methods of measurement of Basal Metabolic Rate (BMR), Total energy requirement and factors affecting requirement.

4. Therapeutic Nutrition : Therapeutic adoption of normal diets, Factors to be considered in planning therapeutic diets. Dietary management in case of Diabetes, Nephritis, Peptic ulcer, Hypertension, Atherosclerosis, Liver Cirrhosis and hepatitis.

5. Food spoilage : Causes of food spoilage and food contamination. Food adulteration and food poisoning measuring quality of food, control of food quality (Codex Alimentarius, Bureau of Indian standards(BIS) FPO, Ag mark, ISI).

6. Malnutrition : Causes and effect of malnutrition on the vulnerable section of the society, effect of malnutrition on national development. Measures to combat malnutrition – National nutrition policy and programmes. Role of ICDS, WHO, UNICEF, NIN, NFI, CFTRI, FTRI, NNMB in combating malnutrition.

Section B - Human Development and Family Studies.

1. Basis of human development : How life begins, role of genetic and environment factors affecting human development, stages and factors affecting pre-natal growth and development.

2. Development of children (0-5 years) : Physical and Motor development, Intellectual development (Piaget's stages of development) Development of emotion.

3. Development of children (0-5 years). Speech development, Social development, Personality development (Role of family, School, Community and Mass Media).

4. Exceptional Children: Meaning, Classification of exceptional children. Management and care of Gifted, Mentally and Physically challenged and Sensory impaired children.

5. Adolescent Development: Physical and sexual development, Social and Emotional changes, Development of aspiration and achievement, Personality development and Family relationships.

6. Family life cycle: Significance, stages and developmental task and problems associated with each stages of family life cycle. Contemporary family problems Marital problems, Financial, Sickness, Accidents, Dowry, Divorce, Old age, Employed Women. Strengthening families through counseling.

PAPER – II

Section A - (i) Family Resource Management

1. Management of family Resources : Time management – Time demand during life cycle, Tools in time management, Leisure time, factors to be considered in making time plan. Energy management – Relation of energy to stages of family life cycle, energy cost of household tasks, work simplification techniques.

2. Money management : Family income, stages of family life cycle and use of money, budgeting, saving and investing the money for future. Supplementing family income.

3. Housing and Interior decoration : Selection of site, house layout, floor plans, space distribution with reference to activities, building components and materials. Furnishing : types (furniture, curtains and draperies, wall treatment, floor covering, upholstery, lighting), planning, obtaining information, evaluating cost, principles of interior designing followed in furnishing the house.

(ii) Textile and clothing -

4. Textile fibers : Classification of textile fibers, according sources and chemical composition, manufacturing process, physical, chemical and other properties of Cotton, Wool, Silk. Rayon, Acrylic, Polyester.

5. Fiber to Fabric : Construction yarn making process, Types of yarns, fabric construction techniques, Weaving, parts of loom, Types of weaves; Fabric finishes (textural finishes, functional finishes) Different dyeing and printing methods.

6. Wardrobe Planning, Colour combination in textile designing, criteria of selection of clothes for different age groups, climatic conditions and occasions for men, women and children.

Section B- Home Science Extension Education

1. Extension Education : Concept, philosophy, objectives and scope of extension education. Role and qualities of extension worker. Need for Home-Science Extension Education.

2. Extension Education & Development : Objectives of Home-Science Extension Education, Development aspects of extension, Extension as a programme and process, Field covered, financing, planning and characteristic of extension.

3. Programme planning : Meaning, nature, principle and scope of programme planning, steps of making a programme characteristic of a good programme planning programme implementation and evaluation.

4. Communication in Extension : Importance, elements of Communication, Communication process, Communication models, scope and purpose o f communication, Communication channels.

5. Community Development : Concept, scope, principles and limitation of Community development and Community Organization, Subject matter of community development. Community Development programmes – objectives, principles and types of community development programmes, Role of Panchayati Raj, Village Schools, Cooperatives, Mahila mandals, Youth and farmers club, Self help Groups, Government and non-Governmental agencies in Extension programmes.

6. Teaching & Learning in extension : Education, extension teaching methods, classification and selection of appropriate method, feature, advantage and limitation of different methods of teaching (mass, group, individual) Audiovisual aids – planning, selection and types of visual, audio and audio-visual aids contribution of audio-visual aids in extension teaching.

LAW

Paper-I
Section-A

Constitutional Law of India

1. Preamble and nature of Indian Constitution
2. General ideas on the fundamental rights
3. Right to equality
4. Right to freedom of speech and expression
5. Right to life and personal liberty
6. Right to Constitutional Remedies
7. Directive principles of State Policies and Fundamental Duties
8. Constitutional position of the President and relation with the Council of Ministers
9. Governor and his Powers
10. Appointment and Transfer of Judges of the Supreme Court and the High Court
11. Supreme Court and High Courts: Powers and Jurisdiction
12. Union Public Service Commission and State Public Service Commissions: Powers and Functions
13. Distribution of Legislative Powers between the Union and the States
14. Administrative Relationship between Union and the States
15. Emergency Provisions
16. Civil Servants: Constitutional safeguards
17. Parliamentary Privileges
18. Amendment of the Constitution
19. Principle of Natural Justice
20. Judicial Review of Administrative Actions.

Section-B

International Law

1. Nature and Definition of International Law
   Relationship between International Law and Municipal Law

2. Individuals , Nationality, Statelessness; Human Rights and procedures available for their enforcement

3. State Recognition and State Succession

4. Treaties: Formation, application & termination

5. United Nations: Its principal organs, powers, and functions:
   General Assembly & Security Council

6. Concept of Human Rights
   Universal Declaration of Human Rights, 1948

7. International Covenant on Civil and Political Rights, 1966

8. International Covenant on Economic, Social and
   Cultural Rights, 1966.

9. International Commission on Human Rights

10. New international economic order and monetary law: WTO, TRIPS, GATT, IMF, World Bank.

Paper-II
Section-A

Law of Crimes:-

1. General Principles of Criminal Liability: mens rea and actus reus, Mens rea in statutory offences

2. Stages of Crime : Preparations and criminal attempts

3. General Exceptions

4. Joint and constructive liability

5. Abetment

6. Criminal conspiracy

7. Offences against the State

8. Offences against public tranqulity

9. Offences against human body

10. Offences against property

11. Offences against Women

12. Defamation

13. Prevention of Corruption Act, 1988.

Law of Torts :

1. Nature and definition

2. Liability based upon fault & strict liability

3. Vicarious liability, State Liability

4. General defences

5. Joint tortfeasors

6. Negligence

7. Defamation

8. Nuisance

9. Conspiracy

10. False imprisonment

11. Malicious Prosecution

12. Consumer Protection Act, 1986.

Section-B

Law of Contracts and Mercantile Law

1. Formation of Contract

2. Factors vitiating consent

3. Void, Voidable, illegal and unenforceable agreements

4. Performance and discharge of contracts

5. Quasi-contracts

6. Consequences of breach of contract

7. Contract of Agency

8. Sale of goods and hire purchase

9. Formation and dissolution of partnership

10. Negotiable Instruments Act, 1881

Negotiable Instruments meaning, Promissory Note, Bill of exchange, Cheque, crossing of cheques and Dishonor of cheques.

LITERATURE OF THE FOLLOWING SUBJECTS

Note (i)- In regard to the languages included in the Eighth Schedule to Constitution, the scripts are given below :-

LANGUAGE		SCRIPT
Hindi	--	Devanagari
Odia	--	Odia
Sanskrit	--	Devanagari
Persian	--	Persian
Urdu	--	Persian

Note (ii)- Candidates should note that the questions not required to be answered in a specific language will be answered inEnglish.

ENGLISH

Objective : The syllabus consists of two papers generally covering the period 1600 – 2000 in English Literature.It is designed to test the ability of the candidate at first-hand and critical reading of the major texts/authors belonging to the period.

Paper – I

Total Number of questions in the paper will be eight. All questions will carry equal marks. The questions will be divided into two Groups : Group-A and Group-B. In each Group there will be four questions.

The candidate shall answer five questions in all. One question in each Group will be compulsory. The candidate will be required to answer three more questions, choosing at least one from each Group. In this way, at least two questions will be attempted from each Group i.e. one compulsory question plus one more. One compulsory question will be the short answer type, another shall be analysis of an unseen passage/poem.

The candidate shall be required to answer **five** questions in all selecting at least one from each Group.

Group A

1. Shakespeare *King Lear* OR *The Tempest*
2. Marlowe *Dr Faustus*
3. John Webster *The Duchess of Malfi*
4. John Donne

"The Good Morrow", "Canonization", "Extasie", "A Valediction : Forbidding Mourning", "The Sunne Rising", "Death, Be Not Proud",

5. John Milton *Paradise Lost* Bks I, II
6. Alexander Pope *Rape of the Lock*
7. William Wordsworth

"Daffodils", "Tintern Abbey", "Ode on Intimations of Immortality", "Three Years She Grew", "She Dwelt Among Untrodden Ways", "Upon Westminster Bridge".

Group B

8. Jonathan Swift *Gulliver's Travels*
9. Jane Austen *Pride and Prejudice*
10. Charles Dickens *Hard Times*
11. Thomas Hardy *Tess of the D' Urbervilles*
12. George Eliot *The Mill on the Floss.*

Paper II

Group-A

1. W.B.Yeats
"Easter 1916", "The Second Coming", "A Prayer for My Daughter", "Sailing to Byzantium", "Among School Children", "Leda and the Swan", "The Lake Isle of Innisfree"

2 . T .S.Eliot *The Waste Land* OR *Four Quartets*

3. Indian Poets

Kamala Das : "My Grand Mother's House", "The Looking Glass"

Nissim Ezekiel : "Enterprise", "Night of the Scorpion"

Jayanta Mahapatra : "The Whore House in a Calcutta Street", "Lost"

R.Parthasarathy : "from Trial", "from Home Coming"

A K Ramanujam : "Love Poem for a Wife I", "A River"

4 John Osborne : *Look Back in Anger*

5 Samuel Beckett: *Waiting for Godot*

6 Henrik Ibsen : *A Doll's House*

7 August Strindberg : *Father*

Group-B

8 James Joyce : *Portrait of the Artist as a Young Man*

9 E M Forster : *A Passage to India*

10 Gopinath Mohanty : *The Ancestor (translation Arun K Mohanty. Published by Central Sahitya Akademi)*

11 Chinua Achebe : *Things Fall Apart*

12 V.S. Naipaul : *A House for Mr. Biswas*

HINDI

Paper-I

Answers must be written in Hindi.

Section-A

1.History of Hindi Language and Nagari Lipi.

I. Evolution of Hindi Language :Apabhransh, Awahatta & Arambhik Hindi.

II. Development of Braj and Awadhi as literary language during medieval period.

III. Early form of Khari-boli in Siddha-Nath Sahitya, Khusero, Sant Sahitya, Rahim etc. and Dakhini Hindi.

IV. Development of Khari-boli and Nagari Lipi during 19th Century.

V. Standardization of Hindi Bhasha & Nagari Lipi.

VI. Development of Hindi as National Language during freedom movement.

VII. The development of Hindi as a National Language of Union of India.

VIII. Scientific & Technical development of Hindi Language.

IX. Development of Hindi as Media Language.

X. Prominent dialects of Hindi and their inter-relationship.

XI. Salient features of Nagari Lipi and the efforts for its reform & Standard form of Hindi.

Section-B

2. History of Hindi Literature.

I. The relevance and importance of Hindi literature and tradition of writing History of Hindi Literature.

II. Literary trends of the following four periods of history of Hindi Literature.

A : Adikal - Sidh, Nath and Raso Sahitya.
Prominent poets - Chandvardai, Khusero, Vidyapati.

B : Bhaktikal - Sant Kavyadhara, Sufi Kavyadhara, Krishna Bhaktidhara and Ram Bhaktidhara.
Prominent Poets - Kabir, Jayasi, Sur & Tulsi.

C: Ritikal : Ritibaddhakavya & Riti Mukta Kavya.
Prominent Poets - Keshav, Bihari, Padmakar and Ghananand.

D : Adhunik Kal
a. Renaissance, the development of Prose, Bharatendu Mandal.
b. Prominent Writers : Bharatendu, Bal Krishna Bhatt & Pratap Narain Mishra.
c. Prominent trends of modern Hindi Poetry : Chhayavad, Pragativad, Proyogvad, Nai Kavita, Navgeet and Contemporary poetry and Janvadi Kavita.
Prominent Poets : Maithili Sharan Gupta, Prasad, Nirala, Mahadevi, Dinkar, Agyeya, Muktibodh, Nagarjun.

III. Katha Sahitya

A. Upanyas & Realism
B. The origin and development of Hindi Novels.
C. Prominent Novelists : Premchand, Jainendra, Yashpal, Renu and Bhism Sahani.
D. The origin and development of Hindi short story.
E. Prominent short Story Writers : Premchand, Prasad, Agyeya, Mohan Rakesh & Mannu Bhandari.

IV. Drama & Theatre

A. The origin & Development of Hindi Drama.

B. Prominent Dramatists : Bharatendu, Prasad, Laxmi Narayan Mishra, Ram Kumar Verma, Mohan Rakesh.

C. The development of Hindi Theature.

V. **Criticism**

A : The origin and development of Hindi criticism : Saiddhantik,Vyavaharik, Pragativadi, Manovishleshanavadi & Nai Alochana.

B : Prominent critics : Ramchandra Shukla, Hajari Prasad Dwivedi, Ram Vilas Sharma & Nagendra.

VI. The other forms of Hindi prose - Lalit Nibandh, Rekhachitra, Sansmaran, Yatra-vrittant.

Paper-II

Answers must be written in Hindi.

This paper will require first hand reading of prescribed texts and will test the critical ability of the candidates.

Section-A

1.	Kabir :	Kabir Granthawali, Ed, Shyam Sundar Das (First hundred Sakhis.)
2.	Surdas :	Bhramargeetsar, Ed. Ramchandra Shukla (First hundred Padas)
3.	Tulsidas :	Ramcharit Manas (Sundar Kand) Kavitawali (Uttar Kand).
4.	Jayasi :	Padmawat Ed. Shyam Sundar Das (Sinhal Dweep Khand & Nagamativiyog Khand)
5.	Bihari :	Bihari Ratnakar Ed. Jagannath Prasad Ratnakar (First 100 Dohas)
6.	Prasad :	Kamayani (Chinta and Shraddha Sarg)
7.	Nirala :	Rag-Virag, Ed. Ram Vilas Sharma (Ram Ki Shakti Puja & Kukurmutta).
8.	Dinkar :	Kurukshetra
9.	Agyeya :	Angan Ke Par Dwar (Asadhya Veena)
10.	Muktiboth :	Andhere Men.

Section-B

1.	Bharatendu :	Andher Nagari.
2.	Mohan Rakesh :	Ashad Ka Ek Din
3.	Ramchandra Shukla :	Chintamani (Part I) (Kavita Kya Hai, Shraddha Aur Bhakti)
4.	Premchand :	Godan, Premchand ki Sarvashreshtha Kahaniyan, Ed. Amrit Rai.
5.	Prasad :	Skandgupta
6.	Yashpal :	Divya
7.	Phaniswar Nath Renu :	Maila Anchal
8.	Mannu Bhandari :	Mahabhoj
9.	Nibandh Nilaya :	Edited by Dr. Satyendra (Bal Krishna Bhatt, Premchand, Gulab Rai, Hajari Prasad Dwivedi, Ram Vilas Sharma, Agyeya, Kuber Nath Rai)

ODIA

Paper-I

Answers must be written in Odia.

Section-A

History of Odia Language

(i) Origin and development of Odia Language; Influence of Austric, Dravidian, Perso-Arabic and English on Odia Language.

(ii) Morphology : Morphemes (free, bound and complex), derivational and inflectional affixes.

(iv) Syntax : Kinds of sentences and their transformations, structure of sentences.

(v) Semantics-Different types of change in meaning; Euphemism.

(vi) Common errors in spellings, grammatical uses and construction of sentences.

Section-B

History of Odia Literature

(i) Historical backgrounds (social, cultural and political) of Odia Literature of different periods.

(ii) Ancient epics, ornate kavyas and padavalis.

(iii) Typical structural forms of Odia Literature (Koili, Chautisa, Poi, Chaupadi, Champu).

(iv) Impact of renaissance with special reference to poetry, fiction and essay.

Paper-II
Answers must be written in Odia.

Critical Study of texts -

The paper will require firsthand reading of the text and test the critical ability of the candidate.

Section-A

Poetry

(Ancient)

1. Sarala Das-Gadaparva from Mahabharata.
2. Jaganath Das-Bhagabata- XI Skandha-Jadu Avadhuta Sambada.

(Medieval)

3. Dinakrushna Das-Rasakallola- (Chhandas-16 & 34)
4. Upendra Bhanja-Lavanyabati (Chhandas-1 & 2)

(Modern)

5. Radhanath Ray-Chilika,
6. Mayadhar Manasinha - Mahanadire Jyotsna Vihar
7. Satchidananda Routray- Bajiraut
8. Ramakanta Ratha-Saptama Rutu,

Section-B

Drama :

9. Manoranjan Das- Klanta Prajapati
10. Bijay Mishra-Tata Niranjana

Novel :

11. Fakir Mohan Senapati-Chhamana Athaguntha
12. Gopinath Mohanty-Danapani

Short Story

13. Surendra Mohanty-Maralara Mrutyu (first five stories)
14. Manoj Das-Laxmira Abhisara (first five stories)

Essay :

15. Chittaranjan Das-Taranga O Tadit (first five essays).
16. Chandra Sekhar Rath-Mun Satyadharma Kahuchhi (first five essays)

PERSIAN

PAPER – I

There will be two questions which must be answered in Persian. The remaining questions must be answered either in Persian or in the medium of examination opted by the candidate.

SECTION – A

1. (a) Description of the origin and development of Persian language (To be answered in Persian)

   (b) Applied grammar, Rhetorics, Prosody, Idioms and Phrases frequently used.

   (i) Grammar :- Ism and its kinds, Ism-e-Ishara, Musharun Elaih, Fail and its kinds, Tenses, Gardan, Singular and Plural, Jumle and its kinds.

   (ii) Rhetorics : Tajnees, Istiara, Miratun Nazeer, Laff-o-Nashr, Iham, Husn-e-Taleel, Tajahul-e-Aarifana and Talmeeh.

   (iii) Prosody : Bahr-e-Hazaj, Bahr-e-Rajaz, Bahr-e-Ramal, Bahr-e-Mutaquarib, Bahr-e-Kamil, (Only SALIM Bahren).

SECTION – B

1. Short essay in Persian, 250 words (to be answered in Persian)

2. History of Persian literature in Iran and India : Literary criticism and styles : Trends in classical and modern literature : Socio-cultural influences, development of modern literary genres including drama, novel, short story.

PAPER – II

There will be two compulsory questions one each in textual portions of prose and poetry which are to be answered in Persian. The remaining questions are to be answered either in Persian or in the medium of examinations opted by the candidate. This paper will require first hand reading of the texts prescribed and will be designed to test the candidates critical ability.

SECTION – A

PROSE

1. Nizami Aroozi Samarquandi :
   Chahar Maquala.
   (i) Dabiri,
   (ii) Shairi

2. Qabus washmgir : Qabus Nama
   (i) Dar-shinakhtan-e-Haqq-e-Pidar-wa-Madar,
   (ii) Dar Bishi Justan Az Sukhandani,
   (iii) Dar Talib Ilmi-wa-Faqih wa Fuqaha

3. Sadi Shirazi : Gulistan
   (i) Dar Tasir-e-Suhbat

4. Mohammed Awfi : Jawamiul Hikayat
   (i) First six Hikayat

5. Maulana Abdur Rahman Jami : Intikhab Baharistan-e-Jami : First six Hikayat.

6. Dr. Ghulam Sarwar : Sukhan-e-Nau.
   (i) Fida-e-watan,
   (ii) Rah-e-Nau
   (iii) Sir Syed Ahmed Khan
   (iv) Guftagu-e-Yak Nafar-e-Iran
   (v) Tareekh-e- Adabiyat-e-Iran.

7. Maulana Shibli Nomani : Sherul Ajam Part II & III.

8. Mulla Husain Waiz Kashifi : Akhlagua-e-Muhsini.
   (i) Dar Bayan-e-Sakhawat,
   (ii) Dar Bayan-e-Sabr.
   (iii) Dar Bayan-e-Adl.

SECTION-B

POETRY

1. Firdausi : Shahnama
   (i) Rustum-wa-Sohrab

2. Umar Khayyam : Rubaiyat
   (Radif-Alif & Be)

3. Sadi Shirazi : Bostan,
   Hikayat Dar Tadbeer-e-Padshahan-wa-Takheer Kardan Dar Siyasat.

4. Ameer Khusrau : Dewan-e-Khusyau
   (Radif Alif)

5. Maulana Roam : Masnawi Maanawi
   (First half of first volume)

6. Hafiz Shirazi : (Radif Alif)

7. Urfi Shirazi – Quasaid
   (i) Har Sokhta Jane Ke Ba Kashmir-Dar Ayad
   (ii) Shabe Eid Ke Dar Takyagah-e-Naz-o-Neyam.

8. Allamah Iqbal
   (i) Asrar-e-Khudi

9. Bahar Mashhadi :
   (i) Sukoot-e-Shab
   (ii) Dukhtar-e-Basra

10. Manuchehri :- Quasaid- (Radif Laam & Meem)

11. Syed Ashraf Rushti : Bekas Watan –

NOTE : Taxtual portions of prose and poetry are to be explained in Persian Compulsorily.

SANSKRIT

Paper-I

There will be three questions as indicated in the question paper which must be answered in Sanskrit. The remaining questions must be answered either in Sanskrit or in the medium of examination opted by the candidate.

Section-A

1. Significant features of the grammar, with particular stress on the following subjects : (to be answered in Sanskrit)

(a) Samjna – It, Savarna, Ti, Upadha, Samhita, Vrddhi, Guna, Pratipadika, Sarvanama,
(b) Sandhi - Ac, Hal, Visarga,
(c) Karaka,
(d) Samasa,
(e) Vacyas – Kartari, Karmani and Bhave (voice usages)

2. Origin and development of Sanskrit language

(a) Classification of Indo-European languages
(b) Main characteristics of Vedic Sanskrit language.
(c) Prominent features of Classical Sanskrit language.
(d) Contribution of Sanskrit to linguistic studies.

3. General Knowledge of Literary History of Sanskrit and Principal trends of literary criticism.

(a) History of Vedic Literature (Samhita, Brahmana, Aranyaka and Upanisads)
(b) Ramayana, Mahabharata
(c) The origin and development of literary genres of:
Mahakavya - Asvaghosa, Kalidasa, Bharavi, Magha, Sriharsa, Bhatti,
Rupaka (drama) – Bhasa, Kalidasa, Bhavabhuti, Harsa,
Visakhadatta, Sudraka, Bhattanarayana, Murari,

Katha – Dandin, Subandhu, Bana,
Akhyayika – Bana,
Campu – Nalacampu, Campuramayan,
Khandakavya – Meghaduta and Hamsaduta,
Muktaka Kavya.
Kathasahitya (Fables and Fairytales) – Brhatkatha,
Kathasaritsagara, Pancatantra, Hitopadesa,
Vetalapancavimsati, Dvatrimsatputtalika.

Section-B

4. Essentials of Indian Culture with stress on

a) Purusarthas

b) Samskaras

c) Varnasramavyavastha

d) Arts and fine arts

e) Technical sciences

f) Kautilya's Arthsastra, Adhikarana-I, Prakarana-I, Adhyaya-II – Vidyasamuddesah - Anviksiki Sthapana; Prakarana-VII, Adhyaya-XI – Gudhapurusotpattih,

5. Trends of Indian Philosophy
General outlines on

a) Sankhya b) Yoga
c) Nyaya d) Vaisesika
e) Mimamsa f) Vedanta
g) Carvaka h) Jaina
i) Bauddha

6. Short Essay in Sanskrit (within 300 words)

7. Unseen passage with the questions, to be answered in Sanskrit.

Paper-II

Question from Group 5 is to be answered in Sanskrit only. Question from Groups 1, 2, 3 and 4 are to be answered either in Sanskrit or in the medium opted by the candidate.

Section-A

General study of the following groups:-

Group 1

a) Raghuvamsam-Kalidasa
b) Kumarasambhavam-Kalidasa
c) Kiratarjuniyam-Bharavi
d) Sisupalavadham-Magha
e) Naisadhiyacaritam-Sriharsa
f) Kadambari-Banabhatta
g) Dasakumaracaritam –Dandin
h) Sivarajyodayam-S.B. Varnekar

Group 2

a) Isavasyopanisad
b) Kathopanisad-I Ch.-III, Valli-Verses 10 to 15
c) Bhagavadgita
d) Sundarakanda of Valmiki's Ramayana

Group 3

a) Svapnavasavadattam- Bhasa
b) Abhijnanasakuntalam- Kalidasa
c) Mrcchakatikam-Sudraka
d) Mudraraksasam-Visakhadatta
e) Uttararamacaritam- Bhavabhuti
f) Ratnavali-Sriharsavardhana
g) Venisamharam- Bhattanarayana

Group 4

Short notes in Sanskrit on the following:-
a) Buddhacaritam – Asvaghos b) Meghadutam-Kalidasa
c) Nitisatakam-Bhartrhari d) Pancatantram- Visnusarma
e) Rajatarangini-Kalhana f) Harsacaritam-Banabhatta
g) Amarukasatakam-Amaruka h) Gitagovindam-Jayadeva

Group 5

General outlines on
(a) Samkhyakarika, (b) Tarkasamgraha, (c) Vedantasara, (d) Manusmrti.

Section-B

Questions from Groups 1 and 2 are to be answered in Sanskrit only. (Questions from Groups 3, 4 and 5 are to be answered in Sanskrit or in the medium opted by the candidate).

This Section will require first hand reading of the following selected texts :-

Group 1
(a) Raghuvamsam-Canto I, Verses 1 to 10
(b) Kumarasambhavam-Canto I, Verses 1 to 10
(c) Kiratarjuniyam-Canto I, Verses 1 to 10

Group 2
(a) Isavasyopanisad-Mantras-1, 2, 4, 6, 7, 15 and 18
(b) Bhagavatgita II chapter -verses 13 to 25
(c) Sundarakandam of Valmiki's Ramayana, Canto 15, Verses 15 to 30 (Geeta Press Edition)

Group 3
(a) Buddhacaritam – Canto-III (1 to 10 verses)
(b) Meghadutam-Purvamegha -verses 1 to 10
(c) Nitisatakam-Verses 1 to 10 (Edited by D.D. Kosambi (Bharatiya Vidya Bhavan Publication)
(d) Kadambari-Sukanasopadesa (only)

Group 4
(a) Svapnavasavadattam Act VI
(b) Abhijnansakuntalam Act IV verses 15 to 30 (M.R. Kale Edition)
(c) Uttararamacaritam Act 1 verses 31 to 47(M.R. Kale Edition)

Group 5
(a) Samkhyakarika – Pancavimsatih tattvani,
(b) Tarkasamgraha – Padarthanirupanam,
(c) Vedantasara – Adhikarinirupanam,
(d) Manusmrti-II – Aryavarta, Brahmavarta, Brahmacaridharmah.

General Note – (for both the papers) At least two questions should be answered in Sanskrit selecting one from each section. Devanagari script should be used for answering in Sanskrit.

URDU

Paper-I

Answers must be written in Urdu.

Section-A

Development of Urdu Language

a) Development of Indo-Aryan (i) Old Indo-Aryan (ii) Middle Indo Aryan (iii) New Indo Aryan

b) Western Hindi and its dialects Brij Bhasha Khadi Boli, Haryanavi Theories about the origin of Urdu Language

c) Dakhani Urdu-Origin and development, its significant linguistic features.

d) Social and Cultural roots of Urdu language-and its distinctive features. Script, Phonology, Morphology, Vocabulary.

Section-B

a) Genres and their development : (i) Poetry : Ghazal, Masnavi, Qasida, Marsia, Rubai, Jadid Nazm,

(ii) Prose : Dastan, Novel, Short Story, Drama, Inshaiya, Khutoot, Biography.

b) Significant features of : (i) Deccani, Delhi and Lucknow schools

(ii) Sir Syed movement, Romantic movement, Progressive movement, Modernism (iii) Development of Urdu prose and poetry in Odisha

c) Literary Criticism and its development with reference to Hali, Shibli, Kaleemuddin Ahmad, Ehtisham Hussain, Ale-Ahmad Suroor.

d) Essay writing (covering literary and imaginative topics)

Paper-II
Answers must be written in Urdu.

This paper will require first hand reading of the texts prescribed and will be designed to test the candidate's critical ability.

Section-A

1.	Mir Amman	-	Bagho-Babar
2.	Ghalib	-	Intikhab-e-Khutoot-e Ghalib
3.	Sir Sayed Ahmed Khan	-	Intekhab-e-Mazamin-e Sir Sayed.
4.	Prem Chand	-	Godan
5.	Krishan Chander	-	Ann Data
6.	Abul Kalam Azad	-	Ghubar-e-Khatir

Section-B

1.	Mir	-	Intikhab-e-Kalam-e-Mir (Ed. Abdul Haq.)
2.	Mir Hasan	-	Sahrul Bayan
3.	Ghalib	-	Diwan-e-Ghalib
4.	Iqbal	-	Bal-e-Jibrail
5.	Firaq	-	Gul-e-Naghma
6.	Faiz	-	Dast-e-Saba
7.	Ali Sardar Jafri	-	Patthar-ki-Diwar

MANAGEMENT

Paper-I

The candidate should make a study of the concept and development of management as science and art drawing upon the contributions of leading thinkers of management and apply the concepts to the real life of government and business decision making keeping in view the changes in the strategic and operative environment.

Section-A

I. Managerial Function : Concept and foundations of Management, Managerial role and functions : Planning, Organization, Coordination, Motivation, Staffing, Direction, Control . Analysis of Environmental opportunities and threats, Formulation of Organisational Vision, Mission and Objectives. Decision Making, Concept of good governance – indicators of good governance, Role of agencies like Transparency International, Corporate code of conduct.

II. Organisational Behaviour and Design : Classical and Neoclassical Systems, Delegation of Authority, Design of Strategic Business Units. Theories of motivation and their relevance : Hierarchy of need model, Factor theory, Sources of motivation, Achievement, Power, Money, Affiliation, Communication : Barriers and gateways. Leadership : characteristics, transformational leader and transactional leader, Leader as change agents Understanding group behaviour and group dynamics. Behaviour in small groups, Conflict Management, Managing Change, Innovation in Organizational Design such as Networks, Knowledge Based Enterprises-Systems and Processes.

III. Quantitative Techniques in Decision Making : Classification of data, Averages, Dispersion and Skewness, Product moment, Correlation, Rank correlation, Regression. Time Series Analysis & Forecasting Techniques, Qualitative techniques. Elementary concepts of Binomial, Poisson and Normal Distributions. Tests of Significance 't', 'F' and Chisquare. Linerar Programming-Problem formulation, product mix, product composition, warehousing and transportation problems. Simplex method and Graphical solution. Basic concepts and models of non-linear programming PERT and CPM, Determination of critical path, Crashing. Decision making under uncertainity.

Section-B

IV. Management Control System : Basic concepts, Understanding strategic behaviour. Responsibility Centres : cost centres, profit centres, investment centres. Strategic Planning, Preparation of budgets, Zero Based Budget, Analysis and Evaluation of Performance, Control System in Service Organization. Modern Control Methods, Controlling Global Enterprises: Transfer Pricing : Basis for fixing transfer pricing, Management of Risk.

V. Strategic Cost Management : Cost concepts and classification, Cost-Volume-Profit Analysis, Value Chain : Conceptual issues and Applications. Cost analysis-Activity based costing, Cost Drivers and their measurement. Target Costing. Profit Variance Analysis, Divisional performance vs. Managerial performance.

VI. Business Environment : Concept and Analysis of Macro-business environment: Indian and global. Analysis of structural dimensions of Indian Economy. Directions of change and impact on business decision. Regulatory and promotional Policies. Liberalization, Globalisation and Corporatisation Problems and Prospects.

Paper-II

Section-A

I. Financial Management : Goal of Finance Function. Analysis of Financial Postion: Ratio and Funds Flow Analysis. Concepts of value and return. Valuation of Bonds and Shares. Risk and Return: Portfolio Theory, CAPM and APM. Option Pricing. Financial and Operating leaverage. Design of Capital Structure; Theories and Practices. Management of Working Capital: Estimation and Financing. Management of Cash, Receivables and Inventory and Current Liabilities. Capital and Money Markets: Institutions and Instruments. Leasing, Hirepurchase and veartur capital mergers and acquistions. Shareholder Value Creation: Dividend Policy, Corporate financial policy and strategy., Management of corporate distress and restructuring strategy. Regulation of capital market.

II. Marketing Management : Concept and strategy. Analysis of marketing environment and planning process. Understanding and selecting target markets: Marketing Research, Consumer Behaviour. Segmentation, Targeting and Postitioning., Product management. Distribution channels and logistics. Public Distribution System. Marketing Communciation, Brand Management. personal selling and management of salesforce. Pricing decisions. Understanding competitive strategy. Design, implementation and control. Services and non-profit marketing. Social Marketing. Creating global competitive Advantage: Analysis, formulation, implementation and control. Evaluation of marketing function. Ethics in marketing: Consumer protection. E-Business.

III. International Business : International Business Environment: Changing composition of trade in goods and services. Emerging areas of trade. Evaluation of International Trade Policies-instruments of trade policy, institutions of international business GATT//WTO, Trims and Trips-Labour conditions and environmental issues. trade in services and agri products. role of IMF, World Bank, UNCTAD. Regional Economic Cooperation. Export Marketing Management-Overseas market research, Export pricing and finance. Management of risk. Export-import procedures. Tole of intermediaries and documentation.

Section-B

IV. Operation and Materials Management : Fundamentals of Operations Management. Organising for Production. Aggregate Production Planning, Capacity Planning, Plan Design: Process planning plant size and scale of operations. Management of facilities. Equipment replacement and maintenance. Production cotnrol. Supply Chain Management-Vendor Evaluation and Audit. Quality Management.

Role and importance of Materials Management , Material Handling, Value Analysis, Quality control, Make or Buy Decision. Codification, Standardisation of spare parts inventory. Inventory Control. Two Bin System. Waste Management, Purchasing process and procedure. International Buying. Business process reengineering, Business process outsourcing.

V. Management Information System : Conceptual foundations of Information System. Information Resource Management. System Development-Overview of Systems and Design. System Development Management life-cycle, Designing on-line and Distributed environments. Implementation and Control of Project. Trends in Information Technology. Managing Data Resources-Organising Data. DSS and RDBMS.

VI. Human Resource Development : Concept and Policies. Man-power planning; recruitment, Selection, trainging, development, promotion and transfer. Performance Measurement, Balanced score card and other methods, job evaluation, job enrichment. Compensation Management. Employee Morale and Productivity. Management of Organisational Climate and Industrial Relations. Humans Resource Accouting and Audit.

MATHEMATICS

Paper-I

Section – A

1. **Abstract Algebra :**

   (i) Integers, Congruences.

   (ii) Groups, Subgroup, Normal Subgroups, Permutation groups, Homomorphism, Isomorphism, Counting Principles, Sylow's Theorem, Caley's Group.

   (iii) Rings, Integral Domain, Field, Subring, Homomorphism, Ideal, Principal Ideal Ring, Maximal Ideal, Polynomial rings, Unique Factorization Theorem.

2. **Linear Algebra :**

   (i) Vector space, Linear dependence, Independence, Subspaces, Basis, Dimension, Finite Dimensional Vector space, Linear Transformation, Rank-nullity Theorem.

   (ii) Matrices, Determinants, Igenvalue, Igenvectors, Row-column reduction, Echelon form, Orthogonal, Symmetrical, Skew-symmetrical, Unitary, Hermitian Matrices.

3. **Analytic Geometry :**

   (i) 2-D Geometry : Straight lines, Pairs of lines, Circle, System of Circles, Conic sections.

   (ii) 3-D Geometry : Planes, Lines, Skew-lines, Sphere, Intersection of Plane and sphere, Cone, Cylinder, Conicoids, Tangent plane to conicoids .

Section – B

1. **Real and Complex Analysis :**
   (i) Real Analysis : Real number system, Order relation, Bounds, l.u.b. g.l.b., Cauchy sequence, Completeness, Compactness, Continuity, Uniform Continuity of functions, Riemann-Theory of Integration, Fundamental Theorem of calculus, Convergence of sequence and series, Uniform convergence.
   (ii) Complex Analysis : Analytic function, Cauchy Riemann Equation, Cauchy Integral Formula, Taylor, Laurent's series, Singuralities, Poles, residues, Contour Integral.

2. **Calculus :**

(i) Functions of one variable : Limit, Continuity, Differentiability, Meanvalue theorem, Maxima, Minima.

(ii) Asymptotes and Curvatures : Rectification, Area , Volume and Surface area of revolution (Equations in Cartesian and Parametric forms only)

(iii) Functions of several variables : Limit, Continuity, Differentiability, Jacobians, Euler's theorem.

(iv) Improper integrals : Convergence, Gamma and Beta functions./

(v) Multiple integrals : Double and Triple integrals and their Evaluations.

3. **Vector Analysis :**

(i) Dot and Vector products, Vector and scalar Triple Products.

(ii) Differentiation of Vector functions, Divergence, Gradient, Curl of Vectors (in Cartesian forms only).

(iii) Green, Gauss and Stokes theorems and applications.

(iv) Tangent, normal and binormal of curves in space, serret-frenet formulas.

Paper – II

Section – A

1. **Numerical Analysis :**

(i) Interpolation : Lagrange, Newton divided difference forms, Forward and back ward interpolation polynomials.

(ii) Approximations : Least squares approximations and curve fitting.

(iii) Numerical solution of non-linear equations : Bisection, Secant, Newton-Raphson and fixed point iteration techniques.

(iv) Numerical differentiation and integration: Differentiation formulas involving differences, Newton-Cotes rules, Compound rules, Gauss – Legendre 2 and 3 point rules.

(v) Numerical solution. of I.V.P.: Euler method, Taylor's method, Runge-Kutta Method of order two

2. **Graph Theory :**

Simple graphs, Regular, Complete graphs, Bipartite graphs, Matrix representation of graphs, Connected graphs, Isomorphic graphs, Trees, Planar graph, Hamiltonian and Eulerian graphs, Vertex colouring of graphs and Chromatic number.

3. **Ordinary and Partial differential equations.**
   (i) Linear first order O.D.E.
   (ii) Higher order linear differential equations with constant and variable coefficients.
   (iii) Series solution of O.D.E.
   (iv) Solution of O.D.E. by Laplace transformation techniques.
   (v) Solution of equations $Pdx + Qdy + Rdz=O$ and $dx/P = dy/Q = dz/R$
   (vi) Char pits method for partial differential equations.
   (vii) Linear second order P.D.E. and solutions.

Section – B

1. **Computer programming** :
   (i) Flow charting and algorithms.
   (ii) Basics of Fortran language, arithmetic and logical operations, Arithmetc and Logical Statements.
   (iii) GO TO and Computed GO TO Statements, Arithmetic and Logical IF, IF… THEN….ELSE Statements, DO Loops.
   (iv) Arrays and subscripted variables.
   (v) Functions, Subprograms and Subroutines.
   (vi) Programme writing in Fortran.

2. **Mechanics and Hydrodynamics.**
   (i) Statics : Law of parallelogram of forces, Equilibrium of forces, Couple and Moments, Frictions.
   (ii) Dynamics : Laws of motion, D' Alemberts principle, Motion of a particle in a plane, Projectiles, Motion of rigid bodies, Moment of inertia.
   (iii) Hydrodynamics : Equation of continuity, Euler equation of motion (in Cartesian forms) Stream lines, Path Line, Potential flow, Stream functions and Potential functions, Sources, Sinks and Image system with respect to Plane and Circle.

I

3. **Operations Research :**
   (i) Formulation of L.P.P., Graphical solution.
   (ii) Simplex method and Duality.
   (iii) Transportation and Assignment problems.

MECHANICAL ENGINEERING

Paper-I

1. **Theory of Machines**

Kinematic chain. Mechanisms and inversions. Motor Vehicle steering gears. Hookes' Joint. Toothed gears. Tooth profiles. Interference. Gear Trains. Compound gears. Differential. Cam profiles. Displacement, velocity and acceleration of cam followers. Flywheel and Turning moment diagram. Governors, Stability, Sensitivity, Isochronism and hunting. Governor effort and power. Controlling force and effect of friction. Balancing of revolving masses. Balancing of single and multicylinder engines. Friction and lubrication. Hydrodynamic theory of lubrication. Linear free and forced vibration of single and two degree freedom mechanical systems with or without damping. Critical speeds and whirling of shafts. Vibration of beams. Torsional vibration.

2. **Mechanics of Solids :**

Stress and strain for materials in tension, compression and shear. Relation between elastic constants for an isotropic, linear elastic and homogeneous materials. Unilaxial Loading. Thermal stresses Stress-strain diagrams for ductile and brittle materials. Stress and strain in two dimensions, Principal planes, Mohr's circle, Strain rosette. Bending moment and shear force diagrams. Composite beams. Bending stresses. Shear stress distribution. Slope and deflection in beams. Torsion of circular shafts. Helical springs. Combined stresses. Theories of failure. Thick and thin walled pressure vessels. Rotating discs and shrunk fit. Struts and columns. Energy principles. Strain energy due to bending, twisting and axial load. Castigliano's theorem. Reciprocal Theorem. Slope and deflection by energy methods.

3. **Engineering Materials :**

Basic concepts on structure of solids, Crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials. Iron-carbon equilibrium diagram TTT-diagram. Heat treatment of steels. Plastics, Ceramics and composite Materials, common applications of various materials.

4. **Manufacturing Science :**

Pattern, Gating and risering system, casting defects, special casting process, welding :- Gas welding, arc welding, resistance welding, thermit welding, Tool geometry and nomenclature ASA, ORS and NRS, types of chips, cutting variable, Chip reduction coefficient, Merchant's force diagram, velocity relationship and Kronenberg's relationship. Ernest & Merchant angle relationship, Lee-shafer relationship-cutting fluid, Tool wear, Taylor's tool life equation, Economics of metal machining, Jigs and fixtures.

NC, CNC, ECM, EDM, AJM, USM; LBM, Plasma machining, High energy rate forming.

5. **Manufacturing management :**

Production Planning and Control, Forecasting-Moving average, exponential smoothing, Operations sheduling; assembly line balancing. Product development. Breakeven analysis, Capacity planning. PERT and CPM.

Control Operations : Inventory control-ABC analysis. EOQ model. Materials requirement planning. Job design, Job standards, work measurement, Quality management-Quality control. Operations Research : Linear programming-Graphical and Simplex methods. Transportation and assignment models. Single server queuing model.

Value Engineering : Value analysis, for cost/value. Total quality management and forecasting techniques. Project management.

6. **Elements of computation** :

Computer Organisation, Flow charting. Features of Common Computer Languages-C, FORTRAN, Elements of d Base and elementary programming.

Paper-II

1. **Thermodynamics :**

Basic concept. Open and closed systems, Applications of Thermodynamic Laws, (Zeroth, First and Second Laws), Gas equations, Clapeyron equation, Availability, Irreversibility and Tds relations, reciprocating air compressors.

2. **I.C. Engines, Fuels and Combustion:**

Spark ignition and compression ignition engines, Four stroke engines and Two stroke engines, mechanical, thermal and volumetric efficiency, Heat balance. Combustion process in S.I. and C.I. engines, preignition detonation in S.I. engine, Diesel knock in C.I. engine, Choice of engine fuels, Octane and Cetane ratings. Alternate fuels, Carburetion and Fuel injection, Engine emissions and control. Solid, liquid and gaseous fuels, stoichometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

3. **Heat Transfer, Refrigeration and Air Conditioning** :

One and two dimensional heat conduction, Heat transfer from extended surfaces, heat transfer by forced and free convection. Heat exchangers. Fundamentals of diffusive and convective mass transfer, Radiation laws, heat exchange between black and non black surfaces, Network Analysis. Heat pump, refrigeration cycles(Air refrigeration, vapour compression and absorption refrigeration) and systems, Condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling load calculations, solar refrigeration.

4. **Turbo-Machines and Power Plants :**

Continuity, Momentum and Energy Equations. Adiabatic and Isentropic flow, fanno lines, Rayleigh lines. Theory and design of axial flow turbines and compressors, Flow through turbo-machine balde, cascades, centrifugal compressor. Dimensional analysis and modelling. Selection of site for steam, hydro, nuclear and stand-by power plants, Selection base and peak load power plants, Modern High pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

PHILOSOPHY

PAPER – I

Section-A

History of Philosophy (Western)

1.	Plato :	Theory of Ideas.
2.	Aristotle :	Form, Matter and Causation.
3.	Descartes :	Cartesian Method, Certain Knowledge, God, Mind – Body Dualism.
4.	Spinoza :	Substance, Attribute, Modes, Pantheism.
5.	Leibnitz :	Monads, Pre-established Harmony.
6.	Locke :	Theory of Knowledge, Rejection of Innate Ideas, Substance and Qualities.
7.	Berkeley :	Immaterialism, God, Criticism of Representative Theory of Perception.
8.	Hume :	Theory of knowledge, Scepticism, Self, Causality.
9.	Kant :	Reconciliation of Empiricism and Rationalism, Space, Time, Categories,Possibility of Synthetic Apriori Judgments, Ideas of Reason, Antinomies,Criticism of the Proofs for the Existence of God.
10.	Hegel :	Dialectical Method, Absolute Idealism.
11.	Precursors of Linguistic Analysis :	Moore (Defense of Common Sense, Refutation ofIdealism), Russell (Theory of Description).
12.	Logical Positivism :	Theory of Verification and Rejection of Metaphysics.
13.	Phenomenology :	Hussrel.
14.	Existentialism :	Kierkegaard, Sartre.

Section-B

(Indian Philosophy)

1. Carvaka : Theory of Knowledge, Materialism.
2. Jainism : Theory of Reality, Saptabhangi Nyaya, Bondage and Liberation.
3. Buddhism : Pratityasamutpada, Ksanikavada, Nairatmyavada, Nirvana, Vijnanavada, Sunyavada.
4. Samkhya : Theory of Causation, Prakriti, Purusa, Theory of Evolution.
5. Nyaya & Vaisesika : Theory of Pramana, Self, Liberation, Proofs for the Existing of God, Categories, Theory of Causation, Atomistic Theory of Creation.
6. Mimamsa : Theory of Knowledge and Error.
7. Vedanta : Sankara and Ramanuja on Brahman, Isvara, Atman, Jiva, Jagat, Maya, Moksa.

Paper – II

Section-A

Socio-Political Philosophy

1. Political Ideals : Equality, Justice, Liberty,
2. Individual and State.
3. Democracy : Concept and Forms.
4. Socialism and Marxism.
5. Humanism.
6. Secularism.
7. Human Rights.
8. Theories of Punishment.
9. Coexistence and Violence, Sarvodaya.
10. Gender Equality.
11. Scientific Temper and Progress.
12. Philosophy of Ecology.

Section – B

Philosophy of Religion

1. Notions of God : Personalistic, Impersonalistic, Naturalistic.
2. Proofs for the Existence of God and their criticism.
3. Grounds for Disbelief in God and their criticisms.
4. Problem of Evil.
5. Religious Language, Reason, Revelation and Mysticism.
6. Karma, Rebirth and Reincarnation.
7. Soul, Disembodied Existence and Immortality.

PHYSICS

Paper-I

Section-A

1. **Classical Mechanics**

(a) **Particle dynamics**

Centre of mass and laboratory coordinates, conservation of linear and angular momentum. The rocket equation. Rutherford scattering, Galilean transformation, intertial and non-inertial frames, rotating frames, centrifugal and Coriolis forces, Foucault pendulum.

(b) **System of particles**

Holonomic and non-holonomic constraints, degrees of freedom, generalised coordinates and momenta. Lagrange's equation and applications to linear harmonic oscillator, simple pendulum and central force problems. Cyclic coordinates, Hamilitonian, Lagrange's equation from Hamilton's principle.

(c) **Rigid body dynamics**

Eulerian angles, inertia tensor, principal moments of inertia. Euler's equation of motion of a rigid body, force-free motion of a rigid body. Gyroscope.

2. **Special Relativity, Waves & Geometrical Optics**

(a) **Special Relativity**

Michelson-Morley experiment and its implications. Lorentz transformations-length contraction, time dilation, addition of velocities and Doppler effect, mass-energy relation and its simple application to decay process. Minkowski diagram, four dimensional momentum vector.

(b) **Waves**

Simple harmonic motion, damped oscillation, forced oscillation and resonance. Beats. Stationary waves in a string. Pulses and wave packets. Phase and group velocities.

(c) **Geometrical Optics**

Laws of relfection and refraction from Fermat's principle. Matrix method in paraxial optics-thin lens formula, nodal planes, system of two thin lenses, chromatic and spherical aberrations.

3. **Physical Optics**

(a) **Interference**

Interference of light-Young's experiment, Newton's rings, interference by thin films, Michelson interferometer. Multiple beam interference and Fabry-Perot interferometer. Holography and simple applications.

(b) **Diffraction**

Fraunhofer diffraction-single slit, double slit, diffraction grating, resolving power. Fresnel diffraction - half-period zones and zones plates. Fresnel integrals. Application of Cornu's spiral to the analysis of diffraction at a straight edge and by a long narrow slit. Diffraction by a circular aperture and the Airy pattern.

(c) **Polarisation and Modern Optics**

Production and detection of linearly and circularly polarised light. Double refraction, Quarter wave plate. Optical activity. Lasers-Einstein A and B coefficients. Ruby and He-Ne lasers. Characteristics of laser light-spatial and temporal coherence. Focussing of laser beams. Three-level scheme for laser operation. Principles of fibre optics, pulse dispersion in single mode fibre.

Section-B

4. **Electricity and Magnetism**

(a) **Electrostatics and Magnetostatics**

Laplace and Poisson equations in electrostatics and their applications. Energy of a system of charges, multipole expansion of scalar potential. Method of images and its applications. Potential and field due to a dipole. Force and torque on a dipole in an external field. Dielectrics, polarisation. Solutions to boundary-value problems-conducting and dielectric spheres in a uniform electric field. Magnetic shell, uniformly magnetized sphere. Ferromagnetic materials, hysteresis, energy loss.

(b) **Current Electricity**

Kirchhoff's laws and their applications. Biot-Savart law, Ampere's law, Faraday's law, Lenz' law. Self-and mutual-inductances. Mean and rms values in AC circuits. LR, CR and LCR circuits- series and parallel resonance. Quality factor. Principle of transformer.

5. **Electromagnetic Theory & Black Body Radiation**

(a) **Electromagnetic Theory**

Displacement current and Maxwell's equatons. Wave equations in vacuum, Poynting theorem. Vector and scalar potentials. Gauge invariance, Lorentz and Coulomb gauges. Electromagnetic field tensor, covariance of Maxwell's equations. Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics. Fresnel's relations. Normal and anomalous dispersion. Rayleigh scattering.

(b) **Blackbody radiation**

Balckbody radiation, Wien displacement law and Rayleigh-Jeans law. Planck radiation law, Stefan-Boltzmann law.

6. **Thermal and Statistical Physics**

(a) **Thremodynamics**

Laws of thermodynamics, reversible and irreversible processes, entropy. Isothermal, adiabatic, isobaric, isochoric processes and entropy change. Otto and Diesel engines, Gibbs' phase rule and chemical potential. Van der Waals equation of state of a real gas, critical constants. Maxwell-Boltzman distribution of molecular velocities, transport phenomena, equipartition and virial theorems. Dulong-Petit, Einstein, and Debye's theories of specific heat of solids. Maxwell relations and applications. Clausius-Clapeyron equation. Adiabatic demagnetisation, Joule-Kelvin effect and liquefaction of gases.

(b) **Statistical Physics**

Ensembles - Microcanonical, Canonical and Grand-canonical ensembles. Maxwell-Boltzmann distribution law. Gibbs paradox.

Paper-II

Section-A

1. **Quantum Mechanics I**

Inadequacies of classical mechanics-Black Body Radiation Spectrun, Photo Electric Effect, Compton Effect, Stability of atom. de-Broglie relation, Wave-particle dualitiy. Schroedinger equation and expectation values. Uncertainty principle. Solutions of the one-dimensional Schroedinger equation-free particle, Gaussian wave-packet, particle in a box, particle in a finite well, linear harmonic oscillator. Reflection and transmission by a potential step and by a rectangular barrier. Use of WKB formula for the life-time calcuation in the alpha-decay problem.

2. **Quantum Mechanics II & Atomic Physics**

(a) **Quantum Mechanics II**

Particle in a three dimensional box, Eigen values and eigen functions of angular momentum operators, spherical harmonics. The hydrogen atom. Half angular momentum and spin.

(b) **Atomic Physics**

Stern-Gerlach experiment, electron spin, fine structure of hydrogen atom. L-S coupling, J-J coupling. Spectroscopic notation of atomic states. Zeeman effect.

3. **Molecular Physics**

Elementary theory of rotational, vibratonal and electronic spectra of diatomic molecules. Raman effect and molecular structure. Laser Raman spectroscopy. Importance of neutral hydrogen atom, molecular hydrogen and molecular hydrogen ion in astronomy. Fluorescence and Phosphorescence. Elementary theory and applications of NMR. Elementary ideas about Mossbaur spectroscopy.

Section-B

4. **Nuclear Physics**

Basic nuclear properties-size, binding energy, angular momentum, parity, magnetic moment. Semi-empirical mass formula and applications. Mass parabolas. Ground state of deuteron, magnetic moment and non-central forces. Meson theory of nuclear forces. Salient features of nuclear forces. Shell model of the nucleus-successes and limitations. Violation of parity in beta decay. Gamma decay and internal conversion. Q-value of nuclear reactions. Nuclear fission and fusion, energy production in stars. Nuclear reactors.

5. **Particle Physics & Solid State Physics**

(a) **Particle Physics**

Classification of elementary particles and their interactions. Conservation laws. Quark structure of hadrons. Field quanta of electroweak and strong interactions. Elementary ideas about Unification of Forces, Planck mass, Planck length, Planck time,. Planck temperature and Planck energy.

(b) **Solid State Physics**

Cubic crystal structure. Band theory of solids- conductors, insulators and semiconductors. Elements of superconductivity, Meissner effect, Josephson junctions and applications. Elementary ideas about high temperature superconductivity.

6. **Electronics**

Intrinsic and extrinsic semiconductors. p-n-p and n-p-n transistors. RC amplifiers, characteristics of class-A, B & C amplifiers, Push-pull amplifiers, Phase-shift oscillators, Hartley oscillators, Op-amps. FET, JFET and MOSFET. Digital electronics-Boolean identities, De Morgan's laws, Logic gates and truth tables. Simple logic circuits. Thermistors, solar cells. Fundamentals of microprocessors and digital computers. Principles of amplitude and frequency modulation and de-modulation, Super-heterodyne receivers. Ionospheric propagation of radio frequency waves.

POLITICAL SCIENCE AND INTERNATIONAL RELATIONS

Paper-I

Political Theory

Section-A

1. pproaches to the study of political theory: historical, normative and empirical.

2. Theories of state: Liberal, , Marxist, , Post-colonial.

3. State Sovereignty: Monistic and Pluralistic theories; globalisation and the State.

4. Democracy: Democratic theory-classical and contemporary

5. Human Rights:. Theories of Human Rights; Theories of Justice, Equality and Revolution, Political obligation;

6. Theories of Political Culture and Political Economy.

7. Political Ideologies: Nature of Ideology; Liberalism, Socialism, Marxism, Fascism and Gandhism.

8. Theories of Power and Hegemony: Pareto, Mosca, Mitchels, C. Wright Mills, Weber and Gramsci.

9. Indian Political Thought: Manu, Kautilya, M.N. Roy, Gandhi and Ambedkar

10. Western Political Thought: Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, J S Mill, Hegel and Marx, Lenin, and Mao Zedong.

Section-B

Indian Government and Politics

1. Indian Nationalism: Raja Ram Mohan Roy, Dadabhai Naoroji, Tilak, Gandhi, Nehru, Subhas Bose and Ambedkar.

2. Indian freedom struggle : Constitutionalism, Revolutionary movements Non Cooperation,Civil Disobedience and Quit India, Role of women in freedom struggle.

3. Constitutional Development in the pre- Independence Era: Morley-Minto Reforms; Montagu-Chelmsford Reforms;; Government of India Act, 1919 and 1935; and Cripps Mission.

4. Socio- economic dimensions of the nationalist movement: The communal question and the demand for partition; backward caste movements, Trade union and Peasant movements, Civil rights movement.

5. Salient Features of the Indian Constitution: The Preamble, Fundamental Rights and Duties, Directive Principles; federalism, parliamentary system; amending procedures; judicial review.

6. The Executive System: President, Prime Minister and the Council of Ministers; Governor, Chief Minister and the State Council of Ministers. The Bureaucracy. 7. Parliament: -Lok Sabha and Rajya Sabha and Parlimentary Committees.

8. Judiciary: The Supreme Court and the High Courts; Judicial Activism; .

9. Statutory institutions/commissions-UPSC, Election Commission, Comptroller and Auditor General, Backward Classes Commission, National Commission for women; National Human Rights Commission; Minorities Commission.
10. Party System : ideology and social base of parties; fragmentation and regionalization; patterns of coalition politics; trends in electoral behaviour; Pressure groups;.

11. Class, caste, backward class and Dalit movements ; Tribal people's movements, gender in Indian politics and women's movements; ethnicity; communalism, and politics of regionalism.

12. Planning and Socio- Economic Development : Role of the Planning Commission; Socio- political dimensions of economic reforms.

13. Local Governance: Panchayati Raj and municipal government; significance of 73rd and 74th Amendements. Women's empowerment.

14, State Politics in Odisha: Social bases of Odia Nationalism; Freedom Movement and Praja Mandal Movements, in Odisha; Integration of Princely States in Odisha; Coalition Politics, People's Movement and Women's Movement.

Paper – II

International Politics

Section-A

International Politics

1. International System: Evolution; The Modern State and Sovereighn State System

2. Concepts of International politics : Power, balance of power, national interest, collective security.

3. Theories of International politics: Idealist, Realist, Systems, Decision-making and Game Theory.

4. Determinants of foreign policy : Ideology, Domestic compulsions, geopolitics, and global order.

5. Origin and decline of Cold War, New World Order.

6. Major issues of world politics : Cuban Missile Crisis; Vietnam War, Oil Crisis, Collapse of the Soviet Union, Yugoslav Crisis Afghan Crisis, Iraq War,.

7. Non-alignment : Nonaligned Movement; Its relevance in the post cold war era.

8. Disarmament and Arms Control;

9. The evolution of the international economic order-from Bretton woods to WTO, the North-South dimension.

10. UN and its specialized agencies

11. Regional organizations: ASEAN, EU, SAARC

13. Global Concerns :, Human Rights, Ecology, Gender Justice

Section-B

India and the World

1. Indian Foreign Policy : Historical origins, determinants; the institutions of policymaking;continuity and change.

2. The Non-Alignment Movement : India's Contribution to NAM; Its contemporary relevance.

3. India and the major powers : USA, EU, China, and Russia.

4. India and its neighbours: Pakistan, Sri Lanka, Bangladesh, Nepal.

5. Conflict and co-operation in South and South East Asia : Kashmir, SAARC. ASEAN

6. India's Nuclear Policy: PNE, NPT,CTBT

7. India and the UN System : India's role in UN Peace Keeping and global disarmament.

8. India and the international economic order; WTO, IMF, IBRD, Globalization

PSYCHOLOGY

Paper-I

Foundations of Psychology

Section-A

1. Introduction : Psychology as a Science : Definitions and perspective. Psychology in relation to other social and natural sciences. Use of interdisciplinary approach.

2.**Methods of Psychology:** Characteristics and components of methods in psychology (induction, deduction and introspection). Observation, Survey, Laboratory and field experiments. Clinical and Case study. Experimental and quasi experimental methods.

3. **Research methods and quantitative analysis** : Major steps in psychological research (problem statement, hypothesis formulation, research design, sampling, tools of data collection, analysis and interpretation and report writing). Methods of data collection (interview, observation, questionnaire and case study). Application of statistical techniques (t-test, one-way ANOVA, correlation and chi-square tests).

4. **Development of Human Behaviour** : The nature, origin and development. Role of genetic and environmental factors in determining human behaviour. Influence of cultural factors and socialisation. Influence of child rearing practices and its impact on the growth and development of the individual.

5. **Attention and perception :** Attention – Determinants of attention including set and characteristics of stimulus. Definition and concept of perception, biological and cultural factors in perception. Perceptual organisation-influence of past experiences, Perceptual defence Space and depth perception, size estimation and perceptual readiness.

6. **Learning :** Concepts and theories of learning (Pavlov, Skinner). The processes of extinction, discrimination and generalisation. Programmed learning, self instructional learning, concepts, types and the schedules of reinforcement. Modelling and social learning, Cognitive view of learing.

7. **Memory :** Concepts and definition of memory and forgetting, 7+/-2 concept and chunking; Encoding, storage and retrieval. Factors influencing retention and foregetting. Theories of forgetting (Repression, Decay and Interference theories).

Section-B

8. **Thinking and Problem Solving :** Concept formation processes. Reasoning and problem solving. Creative thinking and fostering creativity. Information processing. Decision making and judgment.

9. **Intelligence and Aptitude :** Concept and definition of Intelligence and aptitude, Nature and theories of intelligence. Measurement of Intelligence and aptitude. Concepts and measurement of emotional and multiple intelligence.

10. **Motivation and Emotion :** Definition and concepts. Theories and physiological basis of motivation and emotion. Measurement of motivation and emotion Motivation and emotion-their effects on behaviour.

11. **Personality :** Concept and definition of personality. Theories of personality (psychoanalytical, humanistic, behaviouristic, trait and type approaches). Measurement of personality (projective tests, self report measures). The Indian approach to Personality. Training for personality development.

12. **Language and Communication :** Human language-properties, structure and linguistic hierarchy, Language acquisition-predisposition, critical period hypothesis. Theories of language development (Skinner, Chomsky), Process and types of communication. Effective communication and training.

13. **Attitudes, Values and Interests :** Definitions, concepts of attitudes, values and interests. Formation and maintenance of attitudes. Measurement of attitudes, values and interests. Techniques of attitude change, strategies for fostering values.

14. **Recent Trends :** Computer application in the Psychological laboratory and psychological testing. Artificial Intelligence. Psychocybernetics. Study of consciousness-sleep-wake schedules; dreams, stimulus deprivation, meditation, hypnotic/drug induced states. Extrasensory perception.

Paper-II

Psychology : Issues and Applications

Section-A

1. **Psychological Measurement of Individual Diference :** The nature of individual differences. Characteristics and construction of standardized psychological tests. Types of psychological tests. Use, misuse and limitation of psychological tests. Ethical issues in the use of psychological tests.

2. **Well being and Mental Disorders :** Concept of health, positive health, well being and ill health. Mental disorders (Anxiety disorders, mood disorders, schizophrenia and delusional disorders; personality disorders, substance abuse disorders). Causal factors in mental disorders. Factors influencing positive health, well being, life style and quality of life.

3. **Therapeutic Approaches :** Psychodynamic therapies. Behaviour therapies. Client centered therapy. Cognitive therapies. Indigenous therapies (Yoga, Reiki, Meditation) Biofeedback therapy. Prevention and rehabilitation of the mentally ill.

4. **Work Psychology and Organisational Behaviour :** Personnel selection and training. Use of Psychological tests in the industry. Training and human resource development. Theories of work motivation. Leadership and participatory management. Advertising and marketing.

5. **Application of Psychology to Educational Field :** Psychological principles underlying effective teaching-learning process.Learning styles. Gifted, retarded, learning disabled and their training. Training for improving memory and better academic achievement. Personality development and value education, Educational, vocational guidance and Career counselling. Use of Psychological tests in educational institutions.

6. **Community Psychology :** Definition and concept of Community Psychology. Role of community psychologists in social change. Use of small groups in social action. Arousing community consciousness and action for handling social problems. Group decision making and leadership for social change.

7. **Rehabilitation Psychology :** Primary, secondary and tertiary; prevention programmes-role of psychologists. Organising of services for rehabilitation of physically, mentally and socially challenged persons including old persons. Rehabilitation of persons suffering from substance abuse, juvenile delinquency, criminal behaviours. Rehabilitation of victims of violence. Rehabiliation of HIV/.AIDS victims.

Section-B

8. **Application of Psychology to disadvantaged groups :** The concepts of disadvantaged, deprivation and socially deprived. Social, physical, cultural and economic consequences of disadvantaged and deprived groups. Educating and motivating the disadvantaged towards development.

9. **Psychology and the problem of social integration :** The concept of social integration. The problem of caste, class, religion and language conflicts and prejudice. Nature and manifestation of prejudice between the ingroup and outgroup. Casual factors of such conflicts and prejudices. Psychological strategies for handling the conflicts and prejudices. Measures to achieve social integration.

10. **Application of psychology in Information Technology and Mass media :** The present scenario of information technology and the mass media boom and the role of psychologists. Selection and training of psychology professionals to work in the field of IT and mass media. Multilevel marketing. Impact of TV and fostering value through IT and mass media. Psychological consequences of recent developments in Information Technology.

11. **Application of Psychology in the field of Defence :** The concept of Military psychology, Aviation psychology and Psychological warfare. Role of Military psychologists in the defence. Selection, recruitment and training of personnel. Facilitating the process of adjustment of personnel to military life-Role of Counselling. Devising Psychological tests for defence personnel. Psychological disorders due to war. Human engineering in Defence.

12. **Psychology and Economic development :** Achievement motivation and economic development. Characteristics of entrepreneurial behavior. Motivating and Training people for entrepreneurship and economic development. Women Entrepreneurs.

13. **Application of psychology to environment and related fields :** Environmental psychology-effects of noise, pollution and crowding. Population psychology-psychological consequences of population explosion and high population density. Motivating for small family norms. Impact of rapid scientific and technological growth on degradation of environment.

14. **Other applications of psychology :** Sports psychology-improving performance of sports personnel, Psychology and understanding of political behaviour. Voting behaviours. Psychology of corruption and strategies to deal with Psychology of terrorism.

PUBLIC ADMINISTRATION

Paper-I
Administrative theory

Section-A

1. **Basic Concepts** : Meaning, Scope and Significance of Public Administration; Public and Private Administration; Evolution of the discipline; New Public Administration; Public Choice Approach; State versus Market; New Public Management Perspective; Good Governance.

2. **Principles and Theories of Organisation** : Hierarchy, Unity of Command, Spa of Control, Authority and Responsibility, Coordination, Supervision, Centralisation and Decentralisation, Delegation; Classical Theory, Scientific Management Theory, Bureaucratic Theory, Human Relations Theory, Behavioural Approach, Systems Approach.

3. **Structure of Public Organisations** : Chief Executives – types, functions; Forms of Public Organisations – Ministries and Departments, Corporations, Companies, Boards, Commissions; Headquarters and Field Relationship; Line and Staff.

4. **Administrative Behaviour** : Leadership, Policy Formulation, Decision Making, Communication, Motivation, Morale.

5. **Accountability and Control**: Concepts; Legislative, Executive and Judicial Control; Citizen and Administration; Civil Society, People's Participation, Right to Information; Corruption in Administration, Machinery for redressal of Citizens' grievances, Citizens' Charter.

Section – B

6. **Administrative Law and Administrative Reforms** : Delegated Legislation; Administrative Adjudication; Administrative Reforms – Process, Techniques, O & M, Work study, Work management, Information Technology.;

7. **Comparative Public Administration and Development Administration** : Comparative Public Administration – Meaning, Nature, Scope; Models – Bureaucratic and Ecological; Development Administration – Meaning, Nature and Scope; Bureaucracy and Development; Development Administration and Administrative Development.

8. **Public Policy**: Relevance of Public Policy; Process of Policy Formulation; Policy Implementation; Evaluation.

9. **Personnel Administration** : Objectives; Recruitment, Training, Position Classification, Performance Appraisal, Promotion, Pay and Service Conditions, Employer-employee relations, Grievance redressal mechanisms, Integrity; Code of Conduct.

10. **Financial Administration**: Budget – Concepts, Forms, Formulation, Execution; Performance Budgeting; Accounts; Audit.

Paper – II

Section – A

1. **Evolution of Indian Administration** : Ancient Period, Medieval Period, Modern Period up to 1947.

2. **Constitutional Framework** : Preamble, Salient Features of Indian Constitution, Federalism, Fundamental Rights, Directive Principles of State Policy.

3. **Central Administration in India** : President; Prime Minister, Council of Ministers; Central Secretariat; Cabinet Secretariat; Prime Minister's Office; Ministries and Departments, Advisory Bodies, Boards and Commissions, Field Organisations, Planning Commission, Finance Commission, Election Commission.

4. **State Administration with special reference to Odisha**: Governor, Chief Minister, Secretariat, Chief Secretary, Directorate, District Administration, Block Administration.

5. **Local Government** : Evolution; 73rd and 74th Constitutional Amendments; Rural and Urban Local Governments in Odisha – Structures, Functions, Finances, Problems and Prospects; Major Rural and Urban Development Programmes and their management.

Section – B

6. **Public Services :** All India Services – Constitutional Provision, Role, Functions; Central Services – Nature, Functions; Recruitment, Training, Promotion, Union Public Service Commission; State Services; Odisha Public Service Commission.

7. **Control of Public Expenditure**: Parliamentary Control, Estimates Committee, Public Accounts Committee, Committee on Public Undertakings, Comptroller and Auditor General of India, Ministry of Finance.

8. **Machinery of Planning** : Planning Commission – Composition, Functions, Role; National Development Council; Planning Process – National Planning, State Planning, District Planning.

9. **Welfare Administration** : Human Rights – National Human Rights Commission; Odisha Human Rights Commission; Machinery for Welfare administration at the National and State levels, Central Social Welfare Board and State Social Welfare Boards, Special organizations for the welfare of the Scheduled Castes and Scheduled Tribes, Welfare Programmes for Women and Children.

10. **Major Issues in Indian Administration**: Centre-State Relations; Political and Permanent Executive Relations; Administrative Culture and Ethics; Corruption in Indian Administration – Lok Pal and Lok Ayuktas; Environmental Issues – Disaster Management; Criminalisation of Politics and Administration; New Economic Policy and Public Undertakings; IT and Indian Administration.

SOCIOLOGY

Paper-I

Foundations of Sociology

1. Sociology-The Discipline: Sociology as a science and as an interpretative discipline; impact of Industrial and French Revolution on the emergence of sociology; sociology and its relationship with history, economics, political science, psychology and anthropology.

2. Scientific Study of Social Phenomena : Problem of objectivity and value neutrality; issue of measurement in social science; elements of scientific method-concepts, theory and fact, hypothesis; research designs-descriptive, exploratory and experimental, content analysis.

3. Techniques of data collection and analysis : Participant and quasi-participant observation; interview, questionnaire and schedule case study, sampling-size, reliability and validity, scaling techniques-social distance and Likert scale.

4. **Pioneering contributions to Sociology:**

a) Karl Marx : Historical materialism, alienation and class struggle.

b) Emile Durkheim : Division of labour, social fact, religion and society, suicide.

c) Max Weber : Social action, ideal types, authority, bureaucracy, protestant ethic and the spirit of capitalism.

d) Talcott Parsons : Social system, pattern variables.

e) Robert K. Merton: Latent and manifest functions, anomie, conformity and deviance, reference groups.

5. Marriage and Family : Types and forms of marriage; family-structure and function; personality and socialization; Social control; family, lineage, descent and property; changing structure of family and marriage in modern society; divorce and its implications; role conflicts.

6. Social Stratification : Concepts-hierarchy, inequality and stratification; theories of stratification-Marx, Davis and Moore and Melvin Tumin's critique; forms and functions; classdifferent conceptions of class; class-in-itself and class-for-itself; caste and class; caste as a class.

7. Social Mobility : Types of mobility-open and closed models; intra-and inter-generational mobility; vertical and horizontal mobility; social mobility and social change.

8. Economic System : Sociological dimensions of economic life; the impact of economic processes on the larger society; social aspects of division of labour and types of exchange; features of pre-industrial and industrial economic system; industrialisation and social change; social determinants of economic development.

9. Political System : The nature of power-personal power, community power, power of the elite, class power, organisational power, power of the un-organised masses; authority and legitimacy; pressure groups and political parties; voting behaviour; modes of political participation-democratic and authoritarian forms.

10. Educational System : Education and Culture; equality of educational opportunity; social aspects of mass education; problems of universalisation of primary education; role of community and state intervention in education; education as an instrument of social control and social change; education and modernisation.

11. Religion : Origins of religious beliefs in pre-modern socieites; the sacred and the profane; social functions and dysfunctions of religion; monistic and pluralistic religion; organised and unorganised religions; semitism and antisemitism; religion, sect and cults; magic, religion and science.

12. Social Change and Gender Issues: Social construction of gender, Equality vrs. Differences, impact of globalization on women, emergence of feminist thought, gender issues.

Paper-II

1. Historical Moorings of the Indian Society :

Traditional Hindu social organisation; socio-cultural dynamics through the ages; impact of Buddhism, Islam, and the West, factors in continuity and change.

2. Caste System :

Origin of the caste system; cultural and structural views about caste; mobility in caste; caste among Muslims and Christians; change and persistence of caste in modern India; issues of equality and social justice; views of Gandhi and Ambedkar on caste; caste on and Indian polity; Backward Classes Movement; Mandal Commission Report and issues of social backwardness and social justice; emergence of Dalit consciousness, backward caste movement.

3. Class Structure :

Class structure in India, agrarian and industrial class structure; emergence of middle class; emergence of classes among tribes; elite formation in India.

4. Marriage, Family and Kinship:

Marriage among different religious and tribal groups, its changing trends and its future; family-its structural and functional aspects-its changing forms; regional variations in kinship systems and its socio-cultural correlates; impact of legislation and socioeconomic change on marriage and family; generation gap.

5. Agrarian Social Structure :

Peasant society and agrarian systems; land tenure systems-historical perspectives, social consequences of land reforms and green revolution; feudalism-semi-feudalism debates; emerging agrarian class structure; peasant movements.

6. Industry and Society :

Path of industrialisation, occupational diversification, trade unions and human relations; market economy and its social consequences; economic reforms liberalisation, privatisation and globalisation.

7. Political Processes :

Working of the democratic political system in a traditional society; political parties and their social base; social structural origins of political elites and their orientations; regionalism, pluralism and national unity; decentralisation of power; panchayati raj and nagarpalikas and 73rd and 74th constitutional amendments.

8. Education :

Directive Principles of State Policy and primary education; educational inequality and change; education and social mobility; the role of community and state intervention in education; universalisation of primary education; Total Literacy Campaigns; educational problems of disadvantaged groups.

9. Religion and Society :

Size, growth and regional distribution of different religious groups; educational levels of different groups; problems of religious minorities; communal tensions; secularism; conversions; religious fundamentalism, religious reform movements.

10. Tribal Societies :

Distinctive features of tribal communities and their geographical spread; problems of tribal communities-land alienation, health and nutrition, education; tribal development efforts after independence; tribal policy-isolation, assimilation and integration; issues of tribal identity.

11. Social Change and Development:

Endogenous and exogenous sources of change and resistance to change; processes of change-sanskritisation and modernisation; agents of change-mass media, education and communication; problems of change and modernisation; structural contradictions and breakdowns; Migration, Determinants and consequences of population growth, population policy and family welfare programmes, child welfare programmes.

12. Major Social Issues

Poverty, indebtedness, bonded labour, unemployment, depletion of forests, development related displacement, corruption, alcoholism, AIDS, drug addiction, violence against women, dowry. Child labour; Maternal and infant mortality rate in Odisha.

STATISTICS

PAPER - I

Section – A

Probability :

Unit – I

Sample space and events, probability measure and probability space, random variable as a measurable function, distribution function of a random variable, discrete and continuous-type random variable, probability mass function, probability density function, vector-valued random variable, marginal and conditional distributions, stochastic independence of events and of random variables, expectation and moments of a random variable, conditional expectation, convergence of a sequence of random variables in distribution and in probability almost everywhere, their criteria and inter-relations, Borel-Cantelli lemma, Chebyshev's and Khinchine's weak law of large numbers, strong law of large numbers and Kolmogorov's theorem, Glivenko-Cantelli theorem.

Unit - II

Probability generating function, characteristic function, inversion theorem, Laplace transform, determination of distribution by its characteristic function, Lindberg and Levy forms of central limit theorem, standard discrete and continuous probability distributions, their inter-relations and limiting cases. (Bernoulli, Binomial, Negative binomial, Poisson, Normal, Cauchy, Beta and Gamma), Exponential family of distributions and their properties.

Linear Models and Multivariate Analysis

Unit – III

Linear statistical models, theory of least squares and analysis of variance, Gauss-Markov theorem, normal equations, least squares estimates and their properties, test of significance and interval estimates based on least squares theory in one-way, two-way and three-way classified data, regression analysis, linear regression, curvilinear regression and orthogonal polynomials, multiple regression, multiple and partial correlations, estimation of variance and covariance components, MINQUE theory.

Unit – IV

Multivariate normal distribution, Marginal and conditional distributions, Distributions of linear and quadratic functions of multivariate normal, Independence of the distribution of quadratic functions. Wishart's distribution, Mahalanobis D^2 and Hotelling's T^2 statistics and their applications and properties, discriminant analysis, canonical correlatons, principal component analysis, elements of factor analysis.

Section – B

Statistical Inference

Unit-I

Consistency, unbiasedness, efficiency, sufficiency, minimal sufficiency, completeness, ancillary statistic, factorization theorem, derivation of sufficient statistics for the exponential family of distribution, uniformly minimum variance unbiased (UMVU) estimation, Rao-Blackwell and Lehmann-Scheffe theorems, Cramer-Rao inequality for single and several-parameter family of distributions, minimum variance bound estimator and its properties, Chapman-Robbins inequality, Bhattacharya's bounds, estimation by methods of moments, maximum likelihood, least squares, minimum chi-square and modified minimum chi-square, properties of maximum likelihood estimator, idea of asymptotic efficiency, Loss and Risk functions, idea of prior and posterior distributions, Bayes' and minimax estimators.

Unit – II

Non-randomised and randomised tests, critical functions, MP tests, Neyman-Pearson lemma, UMP tests, monotone likelihood ratio, generalised Neyman-Pearson lemma, similar regions and unbiased tests, UMPU tests for single and several-parameter families of distributions, likelihood ratio and its large sample properties, chi-square goodness of fit test and its asymptotic distribution. Confidence bounds and its relation with tests. Kolmogorov's test for goodness of fit and its consistency, sign test, Wilcoxon signedrank test and their consistency, Kolmogorov-Smirnov two-sample test, run test, Wilcoxon-Mann-Whitney U-test and median test, their consistency and asymptotic normality. Wald's SPRT and its properties, OC and ASN functions, Wald's fundamental identity, application to Binomial, Poisson and Normal distributions only.

Sampling Theory and Design of Experiments

Unit – III

An outline of fixed-population and super-population approaches, distinctive features of finite population sampling, sampling designs, simple random sampling with and without replacement, stratified random sampling, systematic sampling and its efficiency for structural populations, cluster sampling, two-stage and three-stage sampling, ratio, product and regression methods of estimation involving one or more auxiliary variables, two-phase sampling, probability proportional to size sampling with and without replacement, the Hansen-Hurwitz and the Horvitz-Thompson estimators, non-negative variance estimation with reference to the Horvitz-Thompson estimator, non-sampling errors, Warner's randomised response technique.

Unit – IV

Fixed effect model (one-way and two-way classification), random and mixed effect models (one-way and two-way classification), Basic principles of design, CRD, RBD, LSD and their analyses and efficiencies, missing plot technique, factorial designs : 2^n, 3^2 and 3^3, confounding in factorial experiments, split-plot, strip-plot and simple lattice designs, incomplete block designs, concepts of orthogonality and balance, BIBD.

PAPER – II

Section - A

Industrial Statistics

Unit – I

Process and product control, general theory of control charts, different types of control charts for variables and attributes, concept of 3s limits, $\bar{X}$, R, s, p, np and c charts, cumulative sum chart, V-mask. Single, double, multiple and sequential sampling plans for attributes, OC, ASN, AOQ and ATI curves, concepts of producer's and consumer's risks, AQL, LTPD and AOQL, sampling plans for variables, use of Dodge-Romig table.

Unit – II

Concepts of reliability, maintainability and availability, reliability of series and parallel systems, Hazard functions, I.F.R. and D.F.R. distributions survival models (exponential, Weibull, lognormal, Rayleigh, and bath-tub), problems in life-testing, censored and truncated experiments for exponential models.

Quantitative Economics and Official Statistics

Unit – III

Concept of time series, additive and multiplicative models, Determination of trend, seasonal, cyclical and random components, Box-Jenkins method, tests for stationery of series, ARIMA models and determination of orders of autoregressive and moving average components, forecasting. Commonly used index numbers:- Laspeyre's, Paasche's and Fisher's ideal index numbers, chain-base index number, uses and limitations of index numbers, index number of wholesale prices, consumer price index number, index numbers of agricultural and industrial production, test for index numbers like proportionality test, time-reversal test, factor-reversal test, circular test and dimensional invariance test. General linear model, ordinary least squares and generalised least squares methods of estimation, problem of multicollinearlity, consequences and solutions of multicollinearity, autocorrelation and its consequeces, heteroscedasticity of disturbances and its testing, test for independence of disturbances.

Unit – IV

Present official statistical system in India relating to population, agriculture, industrial production, trade and prices, methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics, various official agencies responsible for data collection and their main functions.

Section – B :

Optimization Techniques

Unit – I

Different types of models in Operational Research, their construction and general methods of solution, simulation and Monte-Carlo methods, the structure and formulation of linear programming (LP) problem, simple LP model and its graphical solution, the simplex procedure, the two-phase method and the M-technique with artificial variables, the duality theory of LP and its economic interpretation, sensitivity analysis, transportation and assignment problems, rectangular games, two-person zero-sum games, methods of solution (graphical and algebraic). Replacement of failing or deteriorating items, group and individual replacement policies, concept of scientific inventory management and analytical structure of inventory problems.

Unit – II

Simple models with deterministic and stochastic demand with and without lead time, storage models with particular reference to dam type. Homogeneous discrete-time Markov chains, simple properties of finite Markov chains, transition probability matrix, classification of states and ergodic theorems, homogeneous continuous-time Markov chains, Poisson process, elements of queueing theory, M/M/1, G/M/1 and M/G/1 queues.

Demography and Psychometry

Unit – III

Demographic data from census, registration, NSS and other surveys, and their limitations and uses; definition, construction and uses of vital rates and ratios, measures of fertility, reproduction rates, morbidity rate, standardized death rate, Infant mortality rate, nuptiality, complete and abridged life tables, construction of life tables from vital statistics and census returns, uses of life tables, logistic and other population growth curves, fitting of a logistic curve, population projection, stable population 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, health statistics.

Unit - IV

Methods of standardization of scales and tests, Z-scores, standard scores, T-scores, percentile scores, intelligence quotient and its measurement and uses, validity of test scores and its determination, use of factor analysis and path analysis in psychometry.

ZOOLOGY

PAPER-1

Section-A (Non-chordata and chordata)

UNIT – I - Non-chordata:

General features : General organization and classification if invertebrates (up to order); Origin of metazoa; Origin of coelomacoelomata, pseudocoelomata and eucoelomata, protostomes and deuterostomes; Symmetry in animals.

Protozoa : Locomotion, nutrition and reproduction in protozoa; Parasitic protozoa; Life history of *Paramaecium*, *Monocystis*, *Plasmodium* and *Trypanosoma*.

Porifera : Canal system; Skeleton; Reproduction in sponges. **Coelenterata :** Polymorphism in coelenterata; Coral and coral reefs; structure and life history of *Obelia* and *Aurelia.*

Helminthes : Structure and life history of *Fasciola, Taenia* and *Ascaris*; Parasitic adaptations.

UNIT – II - Non chordata

Annelida : Metamerism; Coelom; Segmental organs; Structure and life history of *Nereis*, earthworm and leech; Excretory and nervous system of annelida.

Arthropoda : Structure and affinities of Peripatus; Structure and life history of Palaemon, scorpion and cockroach; Larval forms and parasitism in crustacea; Vision in insecta; Respiration in arthropoda; Mouth parts of insects.

Mollusca : Foot and respiration in mollusca; Torsion and detorsion in gastropoda; Structure and life history of *Pila, Sepia, Unio.*

Echinodermata : Water vascular system; Larval forms and their phylogenetic significance; Life history of *Asterias*.

UNIT - III Chordata

General features : General organization and classification of chordata up to order; Origin of chordata.

Protochordata : Salient features and affinities of protochordate groups (hemichordata, cephalochordata and urochordata).

Cyclostomes and Pisces : Structure and affinities of cyclostomes and Dipnoi; Lateral line receptors; Accessory respiratory structures; Scales; Migration in fishes; General features of *Scoliodon* and *Anabas*.

Amphibia : Origin and evolution of amphibia; Neoteny; Parental care; Structural peculiarities and affinities of Urodela and Apoda.

UNIT – IV - Chordata

Reptiles : Origin of reptiles; Adaptive radiation; Skull types; Poisonous and non-poisonous snakes of India; Mechanism of snake bite; Venom composition and mode of action; *Sphenodon*.

Aves : Origin of birds; Flight adaptation; Migration; Palate; Flightless birds.

Mammals : Origin of mammals; Dentition; Aquatic mammals; Prototheria and Metatheria.

Comparative anatomy : Origin and evolution of aortic arches, heart, brain, kidney, skin and endocrine glands (Pituitary, thyroid, parathyroid, adrenal and gonads) in different vertebrate groups.

Section – B

(Ecology, Ethology, Bio-statistics and Economic Zoology)

UNIT – I

Ecology : Concept and components of ecosystem (energy flow, food chain, food web, ecological pyramids and productivity); Abiotic factors (soil, light and temperature); Biotic factors; Biogeochemical cycles (carbon, nitrogen and sulphur); Ecological niche; Biotic community; Concept of population, Ecological succession; Pollution of air, water and soil, Global warming; Ozone layer depletion; Acid rain.

Biodiversity : Types of biodiversity (á, â and ã); Mega biodiversity countries; Biodiversity indices; Key stone species; Biodiversity conservation (*in situ* a n d *ex situ*); Germplasm conservation; Intellectual property rights and patents; Biodiversity hot spots in India; Resource management; Wildlife and its management; Endangered species; Wildlife in Odisha.

NIT – II

Ethology : Concept and method of studying animal behavior; Role of hypothalamus, hormones and pheromones in regulation of behavior; Physiological basis of behavior; Types and Mechanism of learning; Biochemical basis of memory; Social behavior in insects and primates; Biological clock; Courtship, mating and parental care; Orientation; Navigation; Homing and migration; Tidal, seasonal and circadian systems.

UNIT – III

Economic Zoology : Apiculture; Sericulture; Lac culture; Induced breeding and carp culture; Pearl culture; Fresh water prawn culture; Insect and rodent pests of crops and stored grains and their control; Major infectious and communicable diseases (malaria, tuberculosis, cholera, plague, AIDS), their vectors, pathogens and prevention; Helminth parasites in man.

UNIT – IV

Bio-statistics : Methods of sampling; Graphical representation of data; Measurement of central tendency; Standard deviation; Standard error; Probability distributions (Binomial, Poisson and Normal); Null hypothesis; Tests of significance (x^2-, t- and Ftest); Simple correlation; Regression.

Instrumentation : Basic principles and applications of light microscope and electron microscope (TEM and SEM) Electrophoresis; Chromatography; Colorimetry; Autoradiography, Flame photometry, G.M. counter, Scintillation counter; Immuno electrophoresis and Immunoblotting.

PAPER – II

Section – A

UNIT – I

Cell Biology : Ultra structure of animal cell; Cell cycle; Ultra structure and function of cell organelles (plasma membrane, mitochondria, Golgi complex, endoplasmic reticulum, ribosome, lysosome and nucleus); Organisation of eukaryotic chromosomes; Cell division- mitosis and meiosis; Spindle and mitotic apparatus; Chromosome movement; Cancer cells.

UNIT – II

Genetics : Gene structure and function; Watson-Crick model; DNA replication; Mechanism of gene regulation in prokaryotes and eukaryotes; Types of RNA; Genetic code and Wobble hypothesis; Protein synthesis; Molecular basis of mutation; Mendel's laws of inheritance; Linkage and linkage maps; Crossing over; Sex chromosomes; Sex determination, Sex-linked inheritance; Structural rearrangements; Interaction of genes; Multiple factor inheritance; Human genetics- normal and abnormal karyotypes; Genes and diseases.

UNIT – III

Evolution : Origin of life; Evidences and theories of organic evolution (Darwinism, Lamarckism); Natural selection; Synthetic theory of Evolution; Hardy-Weinberg law; Genetic drift; Mimicry, Role of mutation and isolation in evolution; Fossilization and dating of fossils; Evolution of horse, elephant and camel; Ancestry of man.

Systematics : Species concept; Principles of classification; Biological nomenclature; International code of Zoological Nomenclature(ICZN); Importance of anatomy, cytology, biochemistry and physiology in taxonomy; Molecular taxonomy and Numerical taxonomy; Theories of distribution of animals; Zoogeographical realms of the world.

UNIT – IV

Molecular Biology and Biotechnology : Recombinant DNA, Restriction endonucleases, cloning technology : Plasmids, cosmids and Phagemids as cloning vectors; c-DNA; DNA sequencing, RAPD, RFLP analysis and Human genome project; Polymerase chain reaction and DNA fingerprinting; Signal transduction. Biotechnology in the Welfare of human race; Gene library; Production of transgenic animals and genetically modified organisms; Application of biotechnology in medicine, waste management and food production; Industrial biotechnology and production of biopharmaceuticals; Gene therapy and new age medicines.

Section – B

UNIT – I

Biochemistry : Structure of carbohydrates, lipids, amino acids, proteins and nucleic acids; Saturated and unsaturated fatty acids; Cholesterol; Glycolysis; Krebs cycle; Electron transport and oxidative phosphorylation; Cyclic AMP, its structure and role; Classification of enzymes, enzyme action and kinetics; Vitamins; Coenzymes; Membrane structure and function, pH and buffers, Henderson-Hasselbach equation; Thermodynamics and living processes, ATP and Bioenergetics.

UNIT – II

Physiology and Endocrinology : Composition of blood; Pigments of respiration; Blood coagulation; Blood groups; O_2 and CO_2 transport; Cardiac cycle; Breathing and its regulation; Structure of nephron; Urine formation; Acid-base balance; Structure of neuron; Conduction of impulse through the axon and synapse; Neurotransmitters; Mechanism of vision and hearing; Structure and mechanism of contraction of skeletal muscles; Digestion and absorption of principal food stuff; Function of pituitary, thyroid, parathyroid, adrenal, pancreas, and gonads; Pheromones in insects and mammals; Biosynthesis, regulation of secretion and mechanism of action of steroid and peptide hormones, Hormones of G-I tract; neuropeptides; Physiology of reproduction and artificial insemination; Homeostasis.

UNIT – III

Developmental Biology : Ultra structure of gametes; Gametogenesis; Types of eggs; Fertilization; Cleavage; Gastrulation and fate maps of frog and chick; Mammalian placenta and its function. Organizer concept, Organogenesis of central nervous system, heart and kidney in vertebrates; Stem cells and mechanism of differentiation; Morphogenesis and morphogen, Genetic regulation of development; Homeotic genes; ageing, cell death and programmed cell death; Metamorphosis in frog and insects– Cellular, Biochemical and Physiological features; Regeneration; Blastogenesis; *in vitro* fertilization and embryo transfer.

UNIT – IV

Microbiology : Structure of prokaryotes, Cellular organization of bacteria; Bacterial cell wall; Classification of bacteria; Bacterial transformation, transduction, conjugation, transfection; Antibiotics and their mode of action; Structure, classification, molecular architecture of virus(TMV, T_4 and ë virus); lysogeny and lytic phages; Bacterial and viral diseases. **Immunology :** Innate and acquired immunity; Antigen antibody interaction; Types of antibody; Primary and secondary immunity, B and T cells, Humoral and cell- mediated immune response; Hypersensitivity, Autoimmunity and auto immune diseases, Transplantation immunology; Vaccines and their preparation; Immunobiology of cancer.