

SECTION III: SYLLABI FOR THE EXAMINATION

Note: Candidates are advised to go through the Syllabus published in this Section for the Preliminary Examination and the Main Examination, as periodic revision of syllabus has been done in several subjects.

Part A—Preliminary Examination

Paper I - (200 marks)

Duration: Two hours

- Current events of national and international importance.
- History of India and Indian National Movement.
- Indian and World Geography-Physical, Social, Economic Geography of India and the World.
- Indian Polity and Governance-Constitution, Political System, Panchayati Raj, Public Policy, Rights Issues, etc.
- Economic and Social Development-Sustainable Development, Poverty, Inclusion, Demographics, Social Sector Initiatives, etc.
- General issues on Environmental ecology, Bio-diversity and Climate Change - that do not require subject specialization.
- General Science.

Paper II-(200 marks)

Duration : Two hours

- Comprehension;
- Interpersonal skills including communication skills;
- Logical reasoning and analytical ability;
- Decision making and problem solving;
- General mental ability;
- Basic numeracy (numbers and their relations, orders of magnitude, etc.) (Class X level), Data interpretation (charts, graphs, tables, data sufficiency etc. — Class X level);

Note 1 : Paper-II of the Civil Services (Preliminary) Examination will be a qualifying paper with minimum qualifying marks fixed at 33%.

Note 2 : The questions will be of multiple choice, objective type.

Note 3 : It is mandatory for the candidate to appear in both the Papers of Civil Services (Prelim) Examination for the purpose of evaluation. Therefore a candidate will be disqualified in case he/she does not appear in both the papers of Civil Services (Prelim) Examination.

Part B—Main Examination

The main Examination is intended to assess the overall intellectual traits and depth of understanding of candidates rather than merely the range of their information and memory.

The nature and standard of questions in the General Studies papers (Paper II to Paper V) 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. The questions are likely to test the candidate's basic understanding of all relevant issues, and ability to analyze, and take a view on conflicting socio-economic goals, objectives and demands. The candidates must give relevant, meaningful and succinct answers.

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The scope of the syllabus for optional subject papers (Paper VI and Paper VII) for the 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, Medical Science and law, the level corresponds to the bachelors' degree.

Syllabi of the papers included in the scheme of Civil Services (Main) Examination are given as follows :—

QUALIFYING PAPERS ON INDIAN LANGUAGES AND ENGLISH

The aim of the paper is to test the candidates' ability to read and understand serious discursive prose, and to express ideas clearly and correctly, in English and Indian language concerned.

The pattern of questions would be broadly as follows :

- (i) Comprehension of given passages.
- (ii) Precis Writing.
- (iii) Usage and Vocabulary.
- (iv) Short Essays.

Indian Languages :—

- (i) comprehension of given passages.
- (ii) Precis Writing.
- (iii) Usage and Vocabulary.
- (iv) Short Essays.
- (v) Translation from English to the Indian Language and vice-versa.

Note 1 : The papers on Indian Languages and English will be of Matriculation or equivalent standard and will be of qualifying nature only. The marks obtained in these papers will not be counted for ranking.

Note 2 : The candidates will have to answer the English and Indian Languages papers in English and the respective Indian language (except where translation is involved).

PAPER-I

Essay: Candidates may be required to write essays on multiple topics. 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.

PAPER-II

General Studies-I: Indian Heritage and Culture, History and Geography of the World and Society.

- Indian culture will cover the salient aspects of Art Forms, literature and Architecture from ancient to modern times.
- Modern Indian history from about the middle of the eighteenth century until the present- significant events, personalities, issues.
- The Freedom Struggle — its various stages and important contributors/contributions from different parts of the country.
- Post-independence consolidation and reorganization within the country.

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- History of the world will include events from 18th century such as industrial revolution, world wars, redrawing of national boundaries, colonization, decolonization, political philosophies like communism, capitalism, socialism etc.— their forms and effect on the society.
- Salient features of Indian Society, Diversity of India.
- Role of women and women’s organization, population and associated issues, poverty and developmental issues, urbanization, their problems and their remedies.
- Effects of globalization on Indian society.
- Social empowerment, communalism, regionalism & secularism.
- Salient features of world’s physical geography.
- Distribution of key natural resources across the world (including South Asia and the Indian sub-continent); factors responsible for the location of primary, secondary, and tertiary sector industries in various parts of the world (including India).
- Important Geophysical phenomena such as earthquakes, Tsunami, Volcanic activity, cyclone etc., geographical features and their location—changes in critical geographical features (including water-bodies and ice-caps) and in flora and fauna and the effects of such changes.

PAPER-III

General Studies- II: Governance, Constitution, Polity, Social Justice and International relations.

- Indian Constitution—historical underpinnings, evolution, features, amendments, significant provisions and basic structure.
- Functions and responsibilities of the Union and the States, issues and challenges pertaining to the federal structure, devolution of powers and finances up to local levels and challenges therein.
- Separation of powers between various organs dispute redressal mechanisms and institutions.
- Comparison of the Indian constitutional scheme with that of other countries.
- Parliament and State legislatures—structure, functioning, conduct of business, powers & privileges and issues arising out of these.
- Structure, organization and functioning of the Executive and the Judiciary—Ministries and Departments of the Government; pressure groups and formal/informal associations and their role in the Polity.
- Salient features of the Representation of People’s Act.
- Appointment to various Constitutional posts, powers, functions and responsibilities of various Constitutional Bodies.
- Statutory, regulatory and various quasi-judicial bodies.
- Government policies and interventions for development in various sectors and issues arising out of their design and implementation.
- Development processes and the development industry —the role of NGOs, SHGs, various groups and associations, donors, charities, institutional and other stakeholders.
- Welfare schemes for vulnerable sections of the population by the Centre and States and the

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performance of these schemes; mechanisms, laws, institutions and Bodies constituted for the protection and betterment of these vulnerable sections.

- Issues relating to development and management of Social Sector/Services relating to Health, Education, Human Resources.
- Issues relating to poverty and hunger.
- Important aspects of governance, transparency and accountability, e-governance- applications, models, successes, limitations, and potential; citizens charters, transparency & accountability and institutional and other measures.
- Role of civil services in a democracy.
- India and its neighborhood- relations.
- Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.
- Effect of policies and politics of developed and developing countries on India's interests, Indian diaspora.
- Important International institutions, agencies and fora- their structure, mandate.

PAPER-IV

General Studies-III: Technology, Economic Development, Bio diversity, Environment, Security and Disaster Management

- Indian Economy and issues relating to planning, mobilization, of resources, growth, development and employment.
- Inclusive growth and issues arising from it.
- Government Budgeting.
- Major crops-cropping patterns in various parts of the country, - different types of irrigation and irrigation systems storage, transport and marketing of agricultural produce and issues and related constraints; e-technology in the aid of farmers.
- Issues related to direct and indirect farm subsidies and minimum support prices; Public Distribution System- objectives, functioning, limitations, revamping; issues of buffer stocks and food security; Technology missions; economics of animal-rearing.
- Food processing and related industries in India- scope' and significance, location, upstream and downstream requirements, supply chain management.
- Land reforms in India.
- Effects of liberalization on the economy, changes in industrial policy and their effects on industrial growth.
- Infrastructure: Energy, Ports, Roads, Airports, Railways etc.
- Investment models.
- Science and Technology- developments and their applications and effects in everyday life.

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- Achievements of Indians in science & technology; indigenization of technology and developing new technology.
- Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-technology and issues relating to intellectual property rights.
- Conservation, environmental pollution and degradation, environmental impact assessment.
- Disaster and disaster management.
- Linkages between development and spread of extremism.
- Role of external state and non-state actors in creating challenges to internal security.
- Challenges to internal security through communication networks, role of media and social networking sites in internal security challenges, basics of cyber security; money-laundering and its prevention.
- Security challenges and their management in border areas - linkages of organized crime with terrorism.
- Various Security forces and agencies and their mandate.

PAPER-V

General Studies- IV: Ethics, Integrity and Aptitude

- This paper will include questions to test the candidates' attitude and approach to issues relating to integrity, probity in public life and his problem solving approach to various issues and conflicts faced by him in dealing with society. Questions may utilise the case study approach to determine these aspects. The following broad areas will be covered :
- Ethics and Human Interface: Essence, determinants and consequences of Ethics in-human actions; dimensions of ethics; ethics - in private and public relationships. Human Values - lessons from the lives and teachings of great leaders, reformers and administrators; role of family society and educational institutions in inculcating values.
- Attitude: content, structure, function; its influence and relation with thought and behaviour; moral and political attitudes; social influence and persuasion.
- Aptitude and foundational values for Civil Service, integrity, impartiality and non-partisanship, objectivity, dedication to public service, empathy, tolerance and compassion towards the weaker-sections.
- Emotional intelligence-concepts, and their utilities and application in administration and governance.
- Contributions of moral thinkers and philosophers from India and world.
- Public/Civil service values and Ethics in Public administration: Status and problems; ethical concerns and dilemmas in government and private institutions; laws, rules, regulations and conscience as sources of ethical guidance; accountability and ethical governance; strengthening of ethical and moral values in governance; ethical issues in international relations and funding; corporate governance.
- Probity in Governance: Concept of public service; Philosophical basis of governance and probity; Information sharing and transparency in government, Right to Information, Codes of Ethics, Codes of Conduct, Citizen's Charters, Work culture, Quality of service delivery, Utilization of public funds, challenges of corruption.
- Case Studies on above issues.

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PAPER-VI & PAPER VII**Optional Subject Papers I & II**

Candidate may choose any optional subject from amongst the List of Optional Subjects given in Para 2.

AGRICULTURE**PAPER-I**

Ecology and its relevance to man, natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. Agro ecology; cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans. Climate change—International conventions and global initiatives. Green house effect and global warming. Advance tools for ecosystem analysis—Remote Sensing (RS) and Geographic Information Systems (GIS).

Cropping patterns in different agro-climatic zones of the country. Impact of high-yielding and short-duration varieties on shifts in cropping patterns. Concepts of various cropping, and farming systems. Organic and Precision farming. Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops.

Important features, and scope of various types of forestry plantations such as social forestry, agro-forestry, and natural forests : Propagation of forest plants. Forest products. Agro-forestry and value addition. Conservation of forest flora and fauna.

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

Soil—physical, chemical and biological properties. Processes and factors of soil formation. soils of India. 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, soil testing and fertiliser recommendations, integrated nutrient management Biofertilizers. Losses of nitrogen in soil, nitrogen-use efficiency in submerged rice soils, nitrogen fixation in soils. Efficient phosphorus and potassium use. Problem soils and their reclamation. Soil factors affecting green house gas emission.

Soil conservation, integrated watershed management. Soil erosion and its management. Dry land agriculture and its problems. Technology for stabilising agriculture production in rainfed areas.

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

Farm management, scope, importance and characteristics, farm planning. Optimum resource use and budgeting. Economics of different types of farming systems. Marketing management strategies for development, market intelligence. price fluctuations and their cost; role of co-operatives in agricultural economy; types and systems of farming and factors affecting them. Agricultural price policy. Crop Insurance.

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; Training programmes for extension workers. Role of Krishi Vigyan Kendra's (KVK) in dissemination of Agricultural technologies. Non-Government Organisation (NGO) and self-help group approach for rural development.

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PAPER-II

Cell structure, function and cell cycle. Synthesis, structure and function of genetic material. Laws of heredity. Chromosome structure, chromosomal aberrations, linkage and cross-over, and their significance in recombination breeding. Polyploidy, euploids and aneuploids. Mutation—and their role in crop improvement. Heritability, sterility and incompatibility, classification 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, evolution and domestication of crop plants, center of origin, law of homologous series, crop genetic resources—conservation and utilization. Application of principles of plant breeding, improvement of crop plants. Molecular markers and their application in plant improvement. Pure-line selection, pedigree, mass and recurrent selections, combining ability, its significance in plant breeding. Heterosis and its exploitation. Somatic hybridization. Breeding for disease and pest resistance. Role of interspecific and intergeneric hybridization. Role of genetic engineering and biotechnology in crop improvement Genetically modified crop plants.

Seed production and processing technologies. Seed certification, Seed testing and storage. DNA finger printing and seed registration. Role of public and private sectors in seed production, and marketing. Intellectual Property Rights (IPR) issues, WTO issues and its impact on Agriculture.

Principles of Plant Physiology with reference to plant nutrition, absorption, translocation and metabolism of nutrients. Soil-water-plant relationship.

Enzymes and plant pigments; photosynthesis—modern concepts and factors affecting the process, aerobic and anaerobic respiration; C₃, C₄ and CAM mechanisms. Carbohydrate, protein and fat metabolism. Growth and development; photoperiodism and vernalization. Plant growth substances and their role in crop production. Physiology of seed development and germination; dormancy. Stress physiology—draught, salt and water stress.

major fruits, plantation crops, vegetables, spices and flower crops. package practices of major horticultural crops. Protected cultivation and high tech horticulture. Post-harvest technology and value addition of fruits and vegetables. Landscaping and commercial floriculture. Medicinal and aromatic plants. Role of fruits and vegetables in human nutrition.

Diagnosis of pests and diseases of field crops, vegetables, orchard and plantation crops and their economic importance. Classification of pests and diseases and their management. Intergrated pest and diseases management. Storage pests and their management. Biological control of pests and diseases. Epidemiology and forecasting of major crop pests and diseases. Plant quarantine measures. Pesticides, their formulation and modes of action.

Food production and consumption trends in India. Food security and growing population—vision 2020. Reasons for grain surplus. National and International food policies. Production, procurement, distribution constraints. Availability of foodgrains, per capita expenditure on food. Trends in poverty, Public Distribution System and Below Poverty Line population, Targeted Public Distribution System (PDS), policy implementation in context to globalization. Processing constraints. Relation of food production to National Dietary Guidelines and food consumption pattern. Food based dietary approaches to eliminate hunger. Nutrient deficiency—Micro nutrient deficiency : Protein Energy Malnutrition or Protein Calorie Malnutrition (PEM or PCM), Micro nutrient deficiency and HRD in context of work capacity of women and children. Food grain productivity and food security.

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ANIMAL HUSBANDRY AND VETERINARY SCIENCE

PAPER-I

1. Animal Nutrition :

- 1.1 Partitioning of food energy within the animal. Direct and indirect calorimetry. Carbon—nitrogen balance and comparative slaughter methods. Systems for expressing energy value of foods in ruminants, pigs and poultry. Energy requirements for maintenance, growth, pregnancy, lactation, egg, wool, and meat production.
- 1.2 Latest advances in protein nutrition. Energy protein inter-relationships. Evaluation of protein quality. Use of NPN compounds in ruminant diets. Protein requirements for maintenance, growth, pregnancy, lactation, egg, wool and meat production.
- 1.3 Major and trace minerals—Their sources, physiological functions and deficiency symptoms. Toxic minerals. Mineral interactions. Role of fatsoluble and water—soluble vitamins in the body, their sources and deficiency symptoms.
- 1.4 Feed additives—methane inhibitors, probiotics, enzymes, antibiotics, hormones, oligosaccharides, antioxidants, emulsifiers, mould inhibitors, buffers etc. Use and abuse of growth promoters like hormones and antibiotics—latest concepts.
- 1.5 Conservation of fodders. Storage of feeds and feed ingredients. Recent advances in feed technology and feed processing. Anti-nutritional and toxic factors present in livestock feeds. Feed analysis and quality control. Digestibility trials—direct, indirect and indicator methods. Predicting feed intake in grazing animals.
- 1.6 Advances in ruminant nutrition. Nutrient requirements. Balanced rations. Feeding of calves, pregnant, work animals and breeding bulls. Strategies for feeding milch animals during different stages of lactation cycle. Effect of feeding on milk composition. Feeding of goats for meat and milk production. Feeding of sheep for meat and wool production.
- 1.7 Swine Nutrition. Nutrient requirements. Creep, starter, grower and finisher rations. Feeding of pigs for lean meat production. Low cost rations for swine.
- 1.8 Poultry nutrition. Special features of poultry nutrition. Nutrient requirements for meat and egg production. Formulation of rations for different classes of layers and broilers.

2. Animal Physiology :

- 2.1 Physiology of blood and its circulation, respiration; excretion. Endocrine glands in health and disease.
- 2.2 Blood constituents.—Properties and functions-blood cell formation—Haemoglobin synthesis and chemistry-plasma proteins production, classification and properties, coagulation of blood; Haemorrhagic disorders—anti-coagulants—blood groups—Blood volume—Plasma expanders-Buffer systems in blood. Biochemical tests and their significance in disease diagnosis.
- 2.3 Circulation.—Physiology of heart, cardiac cycle, heart sounds, heart beat, electrocardiograms. Work and efficiency of heart—effect of ions on heart function-metabolism 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 Cerebrospinal fluid-circulation in birds.

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- 2.4 Respiration.—Mechanism of respiration, Transport and exchange of gases-neural control of respiration-Chemo-receptors-hypoxia-respiration in birds.
- 2.5 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 secretion in chicken-Sweat glands and their function. Bio-chemical test for urinary dysfunction.
- 2.6 Endocrine glands.—Functional disorders—their symptoms and diagnosis. Synthesis of hormones, mechanism and control of secretion—hormonal receptors-classification and function.
- 2.7 Growth and Animal Production.—Prenatal and postnatal growth, maturation, growth curves, measures of growth, factors affecting growth, conformation, body composition, meat quality.
- 2.8 Physiology of Milk Production, Reproduction and Digestion.—Current status of hormonal control of mammary development, milk secretion and milk ejection. Male and Female reproductive organs, their components and functions. Digestive organs and their functions.
- 2.9 Environmental Physiology.—Physiological relations and their regulation; mechanisms of adaptation, environmental factors and regulatory mechanisms involved in animal behaviour, climatology—various parameters and their importance. Animal ecology. Physiology of behaviour. Effect of stress on health and production.

3. Animal Reproduction :

Semen quality.—Preservation and Artificial Insemination—Components of semen, composition of spermatozoa, chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro. Factors affecting semen production and quality, preservation, composition of diluents, sperm concentration, transport of diluted semen. Deep freezing techniques in cows, sheep, goats, swine and poultry. Detection of oestrus and time of insemination for better conception. Anoestrus and repeat breeding.

4. Livestock Production and Management :

- 4.1 Commercial Dairy Farming.—Comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as specialized farming, economic dairy farming. Starting of a dairy farm, Capital and land requirement, organization of the dairy farm. Opportunities in dairy farming, factors determining the efficiency of dairy animal. Heard recording, budgeting cost of milk production, pricing policy; Personnel Management. Developing Practical and Economic rations for dairy cattle; supply of greens throughout the year, feed and fodder requirements of Dairy Farm. Feeding regimes for young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records.
- 4.2 Commercial meat, egg and wool production.—Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry. Supply of greens, fodder, feeding regimes for young and mature stock. New trends in enhancing production and management. Capital and land requirements and socio-economic concept.
- 4.3 Feeding and management of animals under drought, flood and other natural calamities.

5. Genetics and Animal Breeding :

- 5.1 History of animal genetics. Mitosis and Meiosis : Mendelian inheritance; deviations to Mendelian genetics; Expression of genes; Linkage and crossing over; Sex determination, sex influenced and sex limited characters; Blood groups and polymorphism; Chromosome aberrations; Cytoplasmic

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inheritance, Gene and its structure; DNA as a genetic material; Genetic code and protein synthesis; Recombinant DNA technology. Mutations, types of mutations, methods for detecting mutations and mutation rate, Transgenesis.

- 5.2 Population Genetics applied to Animal Breeding—Quantitative Vs. Qualitative traits; Hardy Weinberg Law; Population Vs. Individual; Gene and genotypic 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 deviation; Partitioning of variation; Genotype X environment correlation and genotype X environment interaction; role of multiple measurements; Resemblance between relatives.
- 5.3 Breeding Systems.—Breeds of livestock and Poultry. Heritability, repeatability and 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; Pregnancy 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, out breeding, upgrading, cross-breeding and synthesis of breeds; Crossing of inbred lines for commercial production; Selection for general and specific combining ability; Breeding for threshold characters. Sire index.

6. 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. Problems and constraints in transfer of technology. Animal husbandry programmes for rural development.

PAPER-II

1. Anatomy, Pharmacology and Hygiene :

- 1.1 **Histology and Histological Techniques** : Paraffin embedding technique of tissue processing and H.E. staining—Freezing microtomy—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-types of placenta in domestic mammals-Teratology-twins 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 infraorbital, maxillary, mandibuloalveolar, mental and cornual 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.

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- 1.4 **Anatomy of Fowl.**—Musculo-skeletal system-functional anatomy in relation to respiration and flying, digestion and egg production.
- 1.5 **pharmacology and therapeutics drugs.**—Cellular level of pharmacodynamics and pharmacokinetics. 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—chemotherapy of parasitic infections. Drug and economic concerns in the Edible tissues of animals—chemotherapy of Neoplastic diseases. Toxicity due to “insecticides, plants, metals, non-metals, zootoxins and mycotoxins”.
- 1.6 **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 relationship between industrialisation and animal agriculture—animal housing requirements for specific categories of domestic animals viz. pregnant cows and sows, milking cows, broiler birds—stress, strain and productivity in relation to animal habitation.

2. **Animal Diseases :**

- 2.1 Etiology, epidemiology pathogenesis, symptoms, post-mortem lesions, diagnosis, and control of infectious diseases of cattle, sheep and goat, horses, pigs and poultry.
- 2.2 Etiology, epidemiology, symptoms, diagnosis, treatment of production diseases of cattle, horse, pig and poultry.
- 2.3 Deficiency diseases of domestic animals and birds.
- 2.4 Diagnosis and treatment of non-specific conditions like impaction, Bloat, Diarrhoea, Indigestion, dehydration, stroke, poisoning.
- 2.5 Diagnosis and treatment of neurological disorders.
- 2.6 **Principles and methods of immunisation of animals against specific diseases—hard immunity**—disease free zones—‘zero’ disease concept—chemoprophylaxis.
- 2.7 **Anaesthesia.**—local, regional and general-preanesthetic medication. Symptoms and surgical interference in fractures and dislocation. Hernia, choking abomasal displacement—Caesarian operations. Rumenotomy—Castrations.
- 2.8 **Disease investigation techniques.**—Materials for laboratory investigation—Establishment. Animal Health Centres—Disease free zone.

3. **Veterinary Public Health :**

- 3.1 **Zoonoses.**—Classification, definition, role of animals and birds in prevalence and transmission of zoonotic diseases—occupational zoonotic diseases.
- 3.2 **Epidemiology.**—Principle, 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. OIE regulation, WTO, sanitary and phytosanitary measures.
- 3.3 **Veterinary Jurisprudence.**—Rules and Regulations for improvement of animal quality and prevention of animal diseases—State and Central 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.

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4. **Milk and Milk Products Technology :**

- 4.1 **Market Milk.**—Quality, testing and grading of raw milk. Processing, packaging, storing, distribution, marketing defects and their control. Preparation of the following milks : Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milks. Preparation of cultured milks, cultures and their management, yoghurt, Dahi, Lassi and Srikhand. Preparation of flavoured and sterilized milks. Legal standards. Sanitation requirement for clean and safe milk and for the milk plant equipment.
- 4.2 **Milk Products Technology.**—Selection of raw materials, processing, storing, distributing and marketing milk products such as Cream, Butter, Ghee, Khoa, Channa, Cheese, condensed, evaporated, dried milk and baby food, Ice cream and Kulfi; by-products, whey products, butter milk, lactose and casein. Testing, grading, judging milk products—BIS and Agmark specifications, legal standards, quality control nutritive properties. Packaging processing and operational control. Costing of dairy products.

5. **Meat Hygiene and Technology :**

5.1 **Meat Hygiene**

- 5.1.1 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.
- 5.1.2 **Hygienic methods of handling production of 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.

5.2 **Meat Technology**

- 5.2.1 **Physical and chemical characteristics of meat.**—Meat emulsions—Methods of preservation of meat—Curing, canning, irradiation, packaging of meat and meat products, processing and formulations.
- 5.3 **By-products.**—Slaughter house by-products and their utilisation—Edible and inedible by products—Social and economic implications of proper utilisation of slaughter house by-products—Organ products for food and pharmaceuticals.
- 5.4 **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.
- 5.5 **Rabbit/Fur Animal farming.**—Rabbit meat production. Disposal and utilization of fur and wool and recycling of waste by products. Grading of wool.

ANTHROPOLOGY**PAPER-I**

- 1.1 Meaning, Scope and development of Anthropology.
- 1.2 Relationships with other disciplines : Social Sciences, behavioural Sciences, Life Sciences, Medical Sciences, Earth Sciences and Humanities.
- 1.3 Main branches of Anthropology, their scope and relevance :
 - (a) Social-cultural Anthropology.
 - (b) biological Anthropology.
 - (c) Archaeological Anthropology.
 - (d) Linguistic Anthropology.
- 1.4 Human Evolution and emergence of Man :
 - (a) Biological and Cultural factors in human evolution.
 - (b) Theories of Organic Evolution (Pre-Darwinian, Darwinian and Post-Darwinian).
 - (c) Synthetic theory of evolution; Brief outline of terms and concepts of evolutionary biology (Doll's rule, Cope's rule, Gause's rule, parallelism, convergence, adaptive radiation, and mosaic evolution).
- 1.5 Characteristics of Primates; Evolutionary Trend and Primate Taxonomy; Primate Adaptations; (Arboreal and Terrestrial) Primate Taxonomy; Primate Behaviour; Tertiary and Quaternary fossil primates; Living Major Primates; Comparative Anatomy of Man and Apes; Skeletal changes due to erect posture and its implications.
- 1.6 Phylogenetic status, characteristics and geographical distribution of the following :
 - (a) Plio-preleistocene hominids in South and East Africa—Australopithecines.
 - (b) *Homo erectus* : Africa (*Paranthropus*), Europe (*Homo erectus heidelbergensis*), Asia (*Homo erectus javanicus*, *Homo erectus pekinensis*).
 - (c) Neanderthal man—La-chapelle-aux-saints (Classical type), Mt. Carmel (Progressive type).
 - (d) Rhodesian man.
 - (e) *Homo sapiens*—Cromagnon, Grimaldi and Chancelade.
- 1.7 The biological basis of Life : The Cell, DNA structure and replication, Protein Synthesis, Gene, Mutation, Chromosomes, and Cell Division.
- 1.8 (a) Principles of Prehistoric Archaeology. Chronology : Relative and Absolute Dating methods.
 - (b) Cultural Evolution—Broad Outlines of Prehistoric cultures :
 - (i) Paleolithic
 - (ii) Mesolithic
 - (iii) Neolithic
 - (iv) Chalcolithic
 - (v) Copper-Bronze age

(vi) Iron Age

- 2.1 **The Nature of Culture :** The concept and Characteristics of culture and civilization; Ethnocentrism vis-a-vis cultural Relativism.
- 2.2 **The Nature of Society :** Concept of Society; Society and Culture; Social Institution; Social groups; and Social stratification.
- 2.3 **Marriage :** Definition and universality; Laws of marriage (endogamy, exogamy, hypergamy, hypogamy, incest taboo); Type of marriage (monogamy, polygamy, polyandry, group marriage). Functions of marriage; Marriage regulations (preferential, prescriptive and proscriptive); Marriage payments (bride wealth and dowry).
- 2.4 **Family :** Definition and universality; Family, household and domestic groups; functions of family; Types of family (from the perspectives of structure, blood relation, marriage, residence and succession); Impact of urbanization, industrialization and feminist movements on family.
- 2.5 **Kinship :** Consanguinity and Affinity; Principles and types of descent (Unilineal, Double, Bilateral Ambilineal); Forms of descent groups (lineage, clan, phratry, moiety and kindred); Kinship terminology (descriptive and classificatory); Descent, Filiation and Complimentary Filiation; Decent and Alliance.
3. **Economic Organization :** Meaning, scope and relevance of economic anthropology; Formalist and Substantivist debate; Principles governing production, distribution and exchange (reciprocity, redistribution and market), in communities, subsisting on hunting and gathering, fishing, swiddening, pastoralism, horticulture, and agriculture; globalization and indigenous economic systems.
4. **Political Organization and Social Control :** Band, tribe, chiefdom, kingdom and state; concepts of power, authority and legitimacy; social control, law and justice in simple Societies.
5. **Religion :** Anthropological approaches to the study of religion (evolutionary, psychological and functional); monotheism and polytheism; sacred and profane; myths and rituals; forms of religion in tribal and peasant Societies (animism, animatism, fetishism, naturism and totemism); religion, magic and science distinguished; magico-religious functionaries (priest, shaman, medicine man, sorcerer and witch).
6. **Anthropological theories :**
 - (a) Classical evolutionism (Tylor, Morgan and Frazer)
 - (b) Historical particularism (Boas) Diffusionism (British, German and American)
 - (c) Functionalism (Malinowski); Structural—Functionlism (Radcliffe-Brown)
 - (d) Structuralism (L'evi-Strauss and E. Leach)
 - (e) Culture and personality (Benedict, Mead, Linton, Kardiner and Cora-du Bois)
 - (f) Neo—evolutionism (Childe, White, Steward, Sahlins and Service)
 - (g) Cultural materialism (Harris)
 - (h) Symbolic and interpretive theories (Turner, Schneider and Geertz)
 - (i) Cognitive theories (Tyler, Conklin)
 - (j) Post-modernism in anthropology.

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7. **Culture, Language and Communication :**

Nature, origin and characteristics of language; verbal and non-verbal communication; social context of language use.

8. **Research methods in Anthropology :**

(a) Fieldwork tradition in anthropology

(b) Distinction between technique, method and methodology

(c) Tools of data collection : observation, interview, schedules, questionnaire, case study, genealogy, life-history, oral history, secondary sources of information, participatory methods.

(d) Analysis, interpretation and presentation of data.

9.1 **Human Genetics :** Methods and Application : Methods for study of genetic principles in man-family study (pedigree analysis, twin study, foster child, co-twin method, cytogenetic method, chromosomal and karyo-type analysis), biochemical methods, immunological methods, D.N.A. technology and recombinant technologies.

9.2 Mendelian genetics in man-family study, single factor, multifactor, lethal, sub-lethal and polygenic inheritance in man.

9.3 Concept of genetic polymorphism and selection, Mendelian population, Hardy-Weinberg law; causes and changes which bring down frequency-mutation, isolation, migration, selection, inbreeding and genetic drift. Consanguineous and non-consanguineous mating, genetic load, genetic effect of consanguineous and cousin marriages.

9.4 Chromosomes and chromosomal aberrations in man, methodology.

(a) Numerical and structural aberrations (disorders).

(b) Sex chromosomal aberration- Klinefelter (XXY), Turner (XO), Super female (XXX), intersex and other syndromic disorders.

(c) Autosomal aberrations- Down syndrome, Patau, Edward and Cri-du-chat syndromes.

(d) Genetic imprints in human disease, genetic screening, genetic counseling, human DNA profiling, gene mapping and genome study.

9.5 Race and racism, biological basis of morphological variation of non-metric and characters. Racial criteria, racial traits in relation to heredity and environment; biological basis of racial classification, racial differentiation and race crossing in man.

9.6 **Age, sex and population variation as genetic marker :** ABO, Rh blood groups, HLA Hp, transferrin, Gm, blood enzymes. Physiological characteristics-Hb level, body fat, pulse rate, respiratory functions and sensory perceptions in different cultural and socio-economic groups.

9.7 **Concepts and methods of Ecological Anthropology :** Bio-cultural Adaptations—Genetic and Non-genetic factors. Man's physiological responses to environmental stresses: hot desert, cold, high altitude climate.

9.8 **Epidemiological Anthropology :** Health and disease. Infectious and non-infectious diseases, Nutritional deficiency related diseases.

10. **Concept of human growth and Development :** Stages of growth—pre-natal, natal, infant, childhood, adolescence, maturity, senescence.

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—Factors affecting growth and development genetic, environmental, biochemical, nutritional, cultural and socio-economic.

—Ageing and senescence. Theories and observations

—biological and chronological longevity. Human physique and somatotypes. Methodologies for growth studies.

- 11.1 Relevance of menarche, menopause and other bioevents to fertility. Fertility patterns and differentials.
- 11.2 Demographic theories-biological, social and cultural.
- 11.3 Biological and socio-ecological factors influencing fecundity, fertility, natality and mortality.
12. **Applications of Anthropology** : Anthropology of sports, Nutritional anthropology, Anthropology in designing of defence and other equipments, Forensic Anthropology, Methods and principles of personal identification and reconstruction, Applied human genetics—Paternity diagnosis, genetic counselling and eugenics, DNA technology in diseases and medicine, serogenetics and cytogenetics in reproductive biology.

PAPER-II

- 1.1 **Evolution of the Indian Culture and Civilization**—Prehistoric (Palaeolithic, Mesolithic, Neolithic and Neolithic-Chalcolithic), Protohistoric (Indus Civilization). Pre-Harappan, Harappan and post-Harappan cultures. Contributions of the tribal cultures to Indian civilization.
- 1.2 **Palaeo**—Anthropological evidences from India with special reference to Siwaliks and Narmada basin (*Ramapithecus, Sivapithecus and Narmada Man*).
- 1.3. **Ethno-archaeology in India**: The concept of ethno-archaeology; Survivals and Parallels among the hunting, foraging, fishing, pastoral and peasant communities including arts and crafts producing communities.
2. **Demographic profile of India**—Ethnic and linguistic elements in the Indian population and their distribution. Indian population—factors influencing its structure and growth.
 - 3.1 The structure and nature of traditional Indian social system—Varnashram, Purushartha, Karma, Rina and Rebirth.
 - 3.2 **Caste system in India**— Structure and characteristics Varna and caste, Theories of origin of caste system, Dominant caste, Caste mobility, Future of caste system, Jajmani system. Tribe-case continuum.
 - 3.3 Sacred Complex and Nature-Man-Spirit Complex.
 - 3.4. Impact of Buddhism, Jainism, Islam and Christianity of Indian society.
4. Emergence, growth and development in India—Contributions of the 18th, 19th and early 20th Century scholar-administrators. Contributions of Indian anthropologists to tribal and caste studies.
- 5.1 **Indian Village**—Significance of village study in India; Indian village as a social system; Traditional and changing patterns of settlement and inter-caste relations; Agrarian relations in Indian villages; Impact of globalization on Indian villages.
- 5.2 Linguistic and religious minorities and their social, political and economic status.
- 5.3 Indigenous and exogenous processes of socio-cultural change in Indian society: Sanskritization, Government strives to have a workforce which reflects gender balance and women candidates are encouraged to apply.

Westernization, Modernization; Inter-play of little and great traditions; Panchayati Raj and social change; Media and Social change.

- 6.1 Tribal situation in India**—Bio-genetic variability, linguistic and socio-economic characteristics of the tribal populations and their distribution.
- 6.2 Problems of the tribal Communities**—Land alienation, poverty, indebtedness, low literacy, poor educational facilities, unemployment, under-employment, health and nutrition.
- 6.3** Developmental projects and their impact on tribal displacement and problems of rehabilitation. Development of forest policy and tribals. Impact of urbanisation and industrialization on tribal populations.
- 7.1** Problems of exploitation and deprivation of Scheduled Castes, Scheduled Tribes and Other Backward Classes. Constitutional safeguards for Scheduled Tribes and Scheduled Castes.
- 7.2** Social change and contemporary tribal societies : Impact of modern democratic institutions, development programmes and welfare measures on tribals and weaker sections.
- 7.3** The concept of ethnicity; Ethnic conflicts and political developments; Unrest among tribal communities; Regionalism and demand for autonomy; Pseudo-tribalism. Social change among the tribes during colonial and post-Independent India.
- 8.1** Impact of Hinduism, Buddhism, Christianity, Islam and other religions on tribal societies.
- 8.2** Tribe and nation state—a comparative study of tribal communities in India and other countries.
- 9.1** History of administration of tribal areas, tribal policies, plans, programmes of tribal development and their implementation. The concept of PTGs (Primitive Tribal Groups), their distribution, special programmes for their development. Role of N.G.O.s in tribal development.
- 9.2** Role of anthropology in tribal and rural development.
- 9.3** Contributions of anthropology to the understanding of regionalism, communalism and ethnic and political movements.

BOTANY

PAPER-I

1. Microbiology and Plant Pathology :

Structure and reproduction/multiplication of viruses, viroids, bacteria, fungi and mycoplasma; Applications of microbiology in agriculture, industry, medicine and in control of soil and water pollution; Prion and Prion hypothesis.

Important crop diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes; Modes of infection and dissemination; Molecular basis of infection and disease resistance/defence; Physiology of parasitism and control measures. Fungal toxins. Modelling and disease forecasting; Plant quarantine.

2. Cryptogams :

Algae, fungi, lichens, bryophytes, pteridophytes-structure and reproduction from evolutionary viewpoint; Distribution of Cryptogams in India and their ecological and economic importance.

3. Phanerogams :

Gymnosperms : Concept of Progymnosperms. Classification and distribution of gymnosperms. Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their structure and reproduction.

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General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Type of fossils and their study techniques.

Angiosperms : Systematics, anatomy, embryology, palynology and phylogeny.

Taxonomic hierarchy; International Code of Botanical Nomenclature; Numerical taxonomy and chemotaxonomy; Evidence from anatomy, embryology and palynology.

Origin and evolution of angiosperms; Comparative account of various systems of classification of angiosperms; Study of angiospermic families— Magnoliaceae, Ranunculaceae, Brassicaceae, Rosaceae, Fabaceae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae, Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Poaceae, Areaceae, Liliaceae, Musaceae and Orchidaceae.

Stomata and their types; Glandular and non-glandular trichomes; Unusual secondary growth; Anatomy of C₃ and C₄ plants; Xylem and phloem differentiation; Wood anatomy.

Development of male and female gametophytes, pollination, fertilization; Endosperm—its development and function. Patterns of embryo development; Polyembryony, apomixes; Applications of palynology; Experimental embryology including pollen storage and test-tube fertilization.

4. **Plant Resource Development :**

Domestication and introduction of plants; Origin of cultivated plants, Vavilov's centres of origin. Plants as sources for food, fodder, fibres, spices, beverages, edible oils, drugs, narcotics, insecticides, timber, gums, resins and dyes; latex, cellulose, starch and its products; Perfumery; Importance of Ethnobotany in Indian context; Energy plantations; Botanical Gardens and Herbaria.

5. **Morphogenesis :**

Totipotency, polarity, symmetry and differentiation; Cell, tissue, organ and protoplast culture. Somatic hybrids and Cybrids; Micropropagation; Somaclonal variation and its applications; Pollen haploids, embryo rescue methods and their applications.

PAPER-II

1. **Cell Biology :**

Techniques of cell biology. Prokaryotic and eukaryotic cells—structural and ultrastructural details; Structure and function of extracellular matrix (cell wall) and membranes-cell adhesion, membrane transport and vesicular transport; Structure and function of cell organelles (chloroplasts, mitochondria, ER, dictyosomes, ribosomes, endosomes, lysosomes, peroxisomes; Cytoskeleton and microtubules; Nucleus, nucleolus, nuclear pore complex; Chromatin and nucleosome; Cell signalling and cell receptors; Signal transduction Mitosis and meiosis; molecular basis of cell cycle. Numerical and structural variations in chromosomes and their significance; Chromatin organization and packaging of genome; Polytene chromosomes; B-chromosomes—structure, behaviour and significance.

2. **Genetics, Molecular Biology and Evolution :**

Development of genetics, and gene versus allele concepts (Pseudoalleles); Quantitative genetics and multiple factors; Incomplete dominance, polygenic inheritance, multiple alleles; Linkage and crossing over of gene mapping including molecular maps (idea of mapping, function); Sex chromosomes and sex-linked inheritance; sex determination and molecular basis of sex differentiation; Mutations (biochemical and molecular basis); Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility).

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Structure and synthesis of nucleic acids and proteins; Genetic code and regulation of gene expression; Gene silencing; Multigene families; Organic evolution-evidences, mechanism and theories.

Role of RNA in origin and evolution.

3. Plant Breeding, Biotechnology and Biostatistics :

Methods of plant breeding—introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method); Mutation, polyploidy, male sterility and heterosis breeding. Use of apomixes in plant breeding; DNA sequencing; Genetic engineering—methods of transfer of genes; Transgenic crops and biosafety aspects; Development and use of molecular markers in plant breeding; Tools and techniques—probe, southern blotting, DNA fingerprinting, PCR and FISH. Standard deviation and coefficient of variation (CV). Tests of significance (Z-test, t-test and chi-square tests). Probability and distributions (normal, binomial and Poisson). Correlation and regression.

4. Physiology and Biochemistry :

Water relations, mineral nutrition and ion transport, mineral deficiencies. Photosynthesis—photochemical reactions, photophosphorylation and carbon fixation pathways; C₃, C₄ and CAM pathways; Mechanism of phloem transport, Respiration (anerobic and aerobic, including fermentation)—electron transport chain and oxidative phosphorylation; Photorespiration; Chemiosmotic theory and ATP synthesis; Lipid metabolism; Nitrogen fixation and nitrogen metabolism. Enzymes, coenzymes; Energy transfer and energy conservation. Importance of secondary metabolites. Pigments as photoreceptors (plastidial pigments and phytochrome). Plant movements; Photoperiodism and flowering, vernalization, senescence; Growth substances—their chemical nature, role and applications in agri-horticulture; growth indices, growth movements. Stress physiology (heat, water, salinity, metal); Fruit and seed physiology. Dormancy, storage and germination of seed. Fruit ripening—its molecular basis and manipulation.

5. Ecology and Plant Geography :

Concept of ecosystem; Ecological factors. Concepts and dynamics of community; Plant succession. Concepts of biosphere; Ecosystems; Conservation; Pollution and its control (including phytoremediation); Plant indicators; Environment (Protection) Act.

Forest types of India—Ecological and economic importance of forests, afforestation, deforestation and social forestry; Endangered plants, endemism IUCN categories, Red Data Books; Biodiversity and its conservation; Protected Area Network; Convention of Biological Diversity, Farmers' Rights; and Intellectual Property Rights; Concept of Sustainable Development; Biogeochemical cycles. Global warming and climatic change; Invasive species; Environmental Impact Assessment; Phytogeographical regions of India.

CHEMISTRY

PAPER-I

1. Atomic Structure :

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 and d orbitals.

2. Chemical bonding :

Ionic bond, characteristics of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and

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its general characteristics, polarities of bonds in molecules and their dipole moments; Valence bond theory, concept of resonance and resonance energy; Molecular orbital theory (LCAO method); bonding H_2 , He_2 , NO , CO , HF , CN^- , Comparison of valence bond and molecular orbital theories, bond order, bond strength and bond length.

3. Solid state :

Crystal systems; Designation of crystal faces, lattice structures and unit cell; Bragg's law; X-ray diffraction by crystals; Close packing, radius ratio rules, calculation of some limiting radius ratio values; Structures of $NaCl$, ZnS , $CsCl$, CaF_2 ; stoichiometric and nonstoichiometric defects, impurity defects, semi-conductors.

4. The gaseous state and Transport Phenomenon :

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

5. Liquid State :

Kelvin equation; Surface tension and surface energy, wetting and contact angle, interfacial tension and capillary action.

6. Thermodynamics :

Work, heat and internal energy; first law of thermodynamics.

Second law of thermodynamics; entropy as a state function, entropy changes in various processes, entropy-reversibility and irreversibility, Free energy functions; Thermodynamic equation of state; Maxwell relations; Temperature, volume and pressure dependence of U , H , A , G , C_p and C_v , α and β ; J-T effect and inversion temperature; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Nernst heat theorem, introductory idea of third law of thermodynamics.

7. Phase equilibria and solutions :

Clausius-Clapeyron equation; 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.

8. 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 : amperometry, ion selective electrodes and their use.

9. Chemical kinetics:

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

10. Photochemistry:

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

11. Surface phenomena and catalysis:

Adsorption from gases and solutions on solid adsorbents; Langmuir and B.E.T. adsorption isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.

12. Bio-inorganic chemistry:

Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), oxygen-uptake proteins, cytochromes and ferredoxins.

13. Coordination chemistry :

- (i) Bonding in transition of 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.
- (ii) 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.
- (iii) EAN rule, Synthesis structure and reactivity of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.
- (iv) 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.

14. Main Group Chemistry:

Boranes, borazines, phosphazenes and cyclic phosphazene, silicates and silicones, Interhalogen compounds; Sulphur—nitrogen compounds, noble gas compounds.

15. General Chemistry of 'f' Block Element:

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

PAPER-II**1. Delocalised covalent bonding :**

Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, fulvenes, sydnones.

2. (i) **Reaction mechanisms** : General methods (both kinetic and non-kinetic) of study of mechanisms or organic reactions : isotopies, method cross-over experiment, intermediate trapping, stereochemistry; energy of activation; thermodynamic control and kinetic control of reactions.
- (ii) **Reactive intermediates** : Generation, geometry, stability and reactions of carbonium ions and carbanions, free radicals, carbenes, benzyne and nitrenes.
- (iii) **Substitution reactions** :—S_N 1, S_N 2, and S_N i, mechanisms ; neighbouring group

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participation; electrophilic and nucleophilic reactions of aromatic compounds including heterocyclic compounds—pyrrole, furan, thiophene and indole.

(iv) **Elimination reactions** :—E1, E2 and E1cb mechanisms; orientation in E2 reactions—Saytzeff and Hoffmann; pyrolytic *syn* elimination—acetate pyrolysis, Chugaev and Cope eliminations.

(v) **Addition reactions** :—Electrophilic addition to C=C and C≡C; nucleophilic addition to C=O, C=N, conjugated olefins and carbonyls.

(vi) **Reactions and Rearrangements** :—(a) Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer-Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner—Meerwein rearrangements.

(b) Aldol 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.

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

4. (i) **Preparation and Properties of Polymers**: Organic polymers polyethylene, polystyrene, polyvinyl chloride, teflon, nylon, terylene, synthetic and natural rubber.

(ii) Biopolymers: Structure of proteins, DNA and RNA.

5. **Synthetic Uses of Reagents**:

OsO₄, HIO₄, CrO₃, Pb(OAc)₄, SeO₂, NBS, B₂H₆, Na-Liquid NH₃, LiAlH₄, NaBH₄, *n*-BuLi, MCPBA.

6. **Photochemistry** :—Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Type II reactions.

7. **Spectroscopy**:

Principle and applications in structure elucidation :

(i) **Rotational**—Diatomic molecules; isotopic substitution and rotational constants.

(ii) **Vibrational**—Diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(iii) **Electronic**—Singlet and triplet states. *n*→*π** and *π*→*π** transitions; application to conjugated double bonds and conjugated carbonyls Woodward-Fieser rules; Charge transfer spectra.

(iv) **Nuclear Magnetic Resonance (¹HNMR)**: Basic principle; chemical shift and spin-spin interaction and coupling constants.

(v) **Mass Spectrometry** :—Parent peak, base peak, metastable peak, McLafferty rearrangement.

CIVIL ENGINEERING

PAPER-I

1. **Engineering Mechanics, Strength of Materials and Structural Analysis.**

1.1 **Engineering Mechanics :**

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