

GBU Entrance Test 2026-27

SYLLABUS

B.Sc. (Hons.) Clinical Psychology,
LLM, M.Sc. (Nuclear Medicine), and Ph.D. Programs



GAUTAM BUDDHA UNIVERSITY
UP Govt. State University

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Ph.D. Programs

The paper shall be divided into the following two sections:

Section A: Research Methodology

Section B: Subject Knowledge

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Undergraduate and Postgraduate Programs

1. B. Sc. (Hons.) Clinical Psychology (Refer Brochure 2026-27: page No. 56)

Section 1: Subject Knowledge

Psychology: Basic concept & definition; Biological Psychology/Biological Basis of Behaviors; Human Development; Intelligence & Theories of Intelligence; Self & Personality; Stress, Health & Psychological Disorders; Types of Psychotherapies; Social Psychology: Attitude, Social; Cognition; Social Influence and Group processes; Memory & Learning; Sensory processes and Perception

Section 2:

Reasoning: Vocabulary Based (Synonyms, Antonyms), English Usage or Grammar, Sentence Correction, fill in the blanks, Jumbled Paragraph, Meaning- Usage Match, Summary Questions, Verbal Reasoning, Facts / Inferences / Judgments, Reading Comprehension

General English: Idioms and phrases, antonyms, related words, etc. Grammar- based questions test the candidate's ability to spot and correct grammatical errors. Generally, tests knowledge of high school-level grammar and includes areas such as subject-verb agreement, use of articles, prepositions, etc.

General Awareness: This section for General knowledge will include questions related to current affairs and business GK at an elementary level

2. LL.M.: (Refer Brochure 2026-27: page No. 56)

This paper contains two sections: (i) English Proficiency & Teaching Research Aptitude and (ii) Subject Awareness

Section 1:

English Proficiency

In this section, candidate we will be provided passages deriving from contemporary or historically significant fiction and non-fiction writing. Each passage will be followed by a series of questions that will require you to demonstrate your comprehension and language skills, including your ability to:

- Read and comprehend the main point discussed in the passage, as well as any arguments and viewpoints discussed or set out in the passage:
- Draw inferences and conclusions based on the passage:
- Passage summary;
- Compare and contrast the different arguments or viewpoints set out in the passage: and
- Understand the meaning of various words and phrases used in the passage.

Teaching/Research Aptitude

There will be certain questions relating to teaching and research areas, such as teaching and learning pedagogy, doctrinal and empirical methods of research.

Section 2:**Subject Awareness**

The paper will be based on the mandatory subjects of the undergraduate programs, which include the following subjects:

Constitutional Law of India, Administrative Law, Jurisprudence, Indian Penal Code, Law of Contract, Family Law (Hindu and Muslim Law), International Law, Human Rights, Environmental Law

3. Master of Science (Nuclear Medicine)

M.Sc. Nuclear Medicine syllabus for Entrance Test (GBU-ET): Admission will be through Entrance test followed by interview.

Entrance Test Syllabus:

Subject	Marks Distribution
• Physics	25
• Chemistry	25
• Biology	20
• Basics of Radiation	10
• General Knowledge	10
• Mathematics & Computer	10
Total	100

Content will be of graduate level

Section 1: Physics and Chemistry

Section 2: Biology; Basics of Radiation; General Knowledge; and Mathematics & Computer

Ph.D. Programs

The question paper shall consist of 100 questions, each carrying equal marks. There shall be no negative marking for incorrect answers. The paper shall be divided into the following two sections:

- **Section A: Research Methodology** – 50 Questions
- **Section B: Subject Knowledge** – 50 Questions

Section A

Research Methodology (Common to all students)

Nature and Purpose of Research: Meaning of research, aim, Nature and scope of research, Prerequisites of research, Types of research: Exploratory, Descriptive and Experimental.

Research Problem: Types of research problems, Characteristics of a good research problem, Hypothesis: Meaning and types of hypothesis, Research proposal or synopsis.

Research Methods: Qualitative and Quantitative

Review of Literature: Purpose of the review, Identification of the literature, and organising the literature.

Data Collection and Analysis: Types of data, Methods of data collection, Sample and Population, Sampling Techniques, Characteristics of a good sample, Tools of Data Collection: Observation method, Interview, Questionnaire, various rating scales, Characteristics of good research tools.

Descriptive Statistics: Tabulation, Organisation, and Tabulation and Graphical Representation of Quantitative data, Measures of Central Tendencies: Mean, Median, Mode, Measures of Variability: Range, Quartile Deviation, Standard Deviation, and Coefficient of variation. Normal Probability Distribution: Properties of normal probability curve, Skewness and Kurtosis, Data analysis with Statistical Packages (MS-Excel, SPSS), Hypothesis Testing, Generalisation and Interpretation.

Research Report: Structure and Components of Research Report, Types of Report, Characteristics of Good Research Report, Bibliographical Entries, Research Ethics.

अनुसंधान पद्धति (सभी छात्रों के लिए सामान्य)

अनुसंधान की प्रकृति एवं उद्देश्य: अनुसंधान का अर्थ, उद्देश्य, प्रकृति एवं क्षेत्र, अनुसंधान की पूर्वपिक्षाएँ, अनुसंधान के प्रकार – अन्वेषणात्मक (Exploratory), वर्णनात्मक (Descriptive) एवं प्रयोगात्मक (Experimental)।

अनुसंधान समस्या: अनुसंधान समस्याओं के प्रकार, एक अच्छी अनुसंधान समस्या की विशेषताएँ, परिकल्पना (Hypothesis) का अर्थ एवं प्रकार, अनुसंधान प्रस्ताव (Research Proposal) अथवा संक्षेपिका (Synopsis)।

अनुसंधान विधियाँ: गुणात्मक (Qualitative) एवं मात्रात्मक (Quantitative) अनुसंधान।

साहित्य समीक्षा (Review of Literature): साहित्य समीक्षा का उद्देश्य, साहित्य की पहचान एवं साहित्य का संगठन।

डेटा संग्रहण एवं विश्लेषण: डेटा के प्रकार, डेटा संग्रहण की विधियाँ, नमूना (Sample) एवं समष्टि (Population), नमूना चयन तकनीकें (Sampling Techniques), एक अच्छे नमूने की विशेषताएँ, डेटा संग्रहण के उपकरण – अवलोकन विधि (Observation Method), साक्षात्कार (Interview), प्रश्नावली (Questionnaire), विभिन्न मूल्यांकन मापक (Rating Scales), अच्छे अनुसंधान उपकरणों की विशेषताएँ।

वर्णनात्मक सांख्यिकी (Descriptive Statistics): सारणीकरण (Tabulation), मात्रात्मक डेटा का संगठन, सारणीकरण एवं आलेखीय प्रस्तुतीकरण, केन्द्रीय प्रवृत्ति के माप – माध्य (Mean), माध्यिका (Median), बहुलक (Mode), प्रसरण के माप – परास (Range), चतुर्थक विचलन (Quartile Deviation), मानक विचलन (Standard Deviation) एवं परिवर्तन गुणांक (Coefficient of Variation)। सामान्य प्रायिकता वितरण (Normal Probability Distribution): सामान्य प्रायिकता वक्र के गुण, विषमता (Skewness) एवं कुर्तोसिस (Kurtosis), सांख्यिकीय पैकेजों (MS-Excel, SPSS) द्वारा डेटा विश्लेषण, परिकल्पना परीक्षण (Hypothesis Testing), सामान्यीकरण (Generalisation) एवं व्याख्या (Interpretation)।

अनुसंधान प्रतिवेदन (Research Report): अनुसंधान प्रतिवेदन की संरचना एवं घटक, प्रतिवेदन के प्रकार, एक अच्छे अनुसंधान प्रतिवेदन की विशेषताएँ, ग्रंथसूची प्रविष्टियाँ (Bibliographical Entries), अनुसंधान नैतिकता (Research Ethics)।

Section B

1. Ph.D. Management

Human Resource Management: HR challenges; HRM functions; Strategic Management of human resources; Human resource planning; Job analysis; Job evaluation; Recruitment and selection; Training and development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Management of organisational climate and Industrial relations; Human resources accounting and audit; Human resource information system;

Marketing Management: Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering; Analyzing competition; Analyzing consumer markets; Industrial buyer behavior; Market research; Product strategy; Pricing strategies; Designing and managing Marketing channels; Integrated marketing communications; Building customer satisfaction, Value and retention; Services and non-profit marketing; Ethics in marketing;

Financial Management: Goals of finance function; Concepts of value and return; Valuation of bonds and shares; Management of working capital: Estimation and financing; Management of cash, receivables, inventory and current liabilities; Cost of capital; Capital budgeting; Financial and operating leverage; Design of capital structure: theories and practices; Shareholder value creation: dividend policy, corporate financial policy and strategy; Capital and money markets: institutions and instruments; Leasing, hire purchase and venture capital; Regulation of capital market; Risk and return: portfolio theory; Financial derivatives: option, futures, swap.

Operations Management: Fundamentals of operations management; Organizing for production; Aggregate production planning, capacity planning, plant design: process planning, plant size and scale of operations, Management of facilities; Line balancing; Equipment replacement and maintenance; Production control; Supply chain management - vendor evaluation and audit; Quality management; Statistical process control, Six Sigma; Flexibility and agility in manufacturing systems; World class manufacturing; Project management concepts, R&D

management, Management of service operations; Role and importance of materials management, value analysis, make or buy decision; Inventory control, MRP; Waste management.

2. Ph.D. Biotechnology

Biochemistry: Physiochemical properties of amino acids and proteins; Primary, Secondary, Tertiary and Quaternary Structures of proteins, Protein stability and denaturation. Determination of protein structure, vitamins; structure and functions, coenzymes forms and biochemical functions, Enzymes: Nomenclature, Enzyme catalytic mechanisms, Factors affecting enzyme activity, Michalis-Menten kinetics, Isozymes, regulation of enzyme activity, Enzyme inhibition kinetics, Structure organization and function of nucleic acids, carbohydrates and biomolecules, Metabolism, glycolysis, TCA metabolism of lipids nucleic acids and proteins, Various biochemical techniques, Centrifugation, electrophoresis, chromatography and spectroscopy.

Microbiology: Classification of Microorganisms, Classification systems: Numerical Taxonomy, Phylogenetic system, Bacterial taxonomy and Bergey's manual of Bacteriology, Diversity in Bacterial morphology, Structures external to cell wall: Flagella, Pili, Capsule, Sheath. Prosthecae and Stalk, Structure and chemical composition of cell wall, Structure internal to cell wall: Cytoplasmic membrane. Protoplast, Spheroplast, Cytoplasmic inclusions, Genetic material, Growth kinetics, Spores and Cysts, Major Characteristics used in Bacterial genetics (Conjugation, Transformation and Transduction), Metagenomics, Drug resistance, Virus, Protoza, Prions. Role of microorganisms in human health, agriculture and industry.

Molecular Biology: Chemical & physical structure of DNA (Watson Crick Model) as deduced from X-ray diffraction pattern, variability of DNA structure, structure of RNA, Supercoiling, Multiplex structure of DNA & its relevance, Mutagenesis, DNA Damage and repair. Denaturation & Renaturation of nucleic acids, Replication, Transcription and Translation in Prokaryotes and Eukaryotes, Regulation of transcription, Chromatin remodelling, Operons, Promoters and transcription factors. Constitutive and inducible promoters, Transcriptional regulation in bacteriophage lambda, Lytic and lysogenic switch, RNA Processing and RNA editing, post-transcriptional gene regulation, miRNA, SiRNA, Genetic code, Essential components of translation, Post-translational modification, Transport of bacterial proteins: Co-translational and Post-translational mechanisms, Control of gene expression at translational level, Techniques of RNA and protein expression profiling.

Cell Biology: Cells (types, diversity & specialization, role of bio-molecules in cell organization, cellular bioenergetics, metabolism and its regulation); Membrane structure and its functions, transport of micro and macro molecules across plasma membrane; plant cell wall (its composition and synthesis); Mitochondria and chloroplast structure and role in cellular bioenergetics; Nucleus and nuclear envelop, nuclear pore complex transport of RNA and proteins across nuclear membrane., chromosome packing and chromatin remodeling during cell cycle and gene expression ; Chromosomes (physical and chemical nature of gene, structure of viral/ bacterial/eukaryotic genome, genome stability); Structure and function of Endoplasmic reticulum; Golgi complex; peroxisomes, lysosomes and ribosomes, ; Endomembrane system and vesicular transport (endocytic and biosynthetic/ secretory pathways, types of vesicles, protein

sorting); post translation protein uptake; Cell-cell interaction; cytoskeleton; Cell cycle and its control (MPF, CDKs, cyclin, check points), Cancer (DNA viruses and transforming agents, Human tumor viruses, Oncogene, proteins in carcinogenesis, Apoptosis), Cell signaling, Gene expression profiling, microscopy and centrifugation methods.

Immunology: The antigen and concept of self and non-self-discrimination, Antigenicity and immunogenicity, Factors contributing to antigenicity, Epitope mapping Haptens, Humoral and Acquired Cellular Immune Response, The organs and cells involved in the immune response, Lymphocyte traffic, Immunological Methods in Biotechnology (ELISA, RIA etc), Monoclonal Antibodies and Hybridoma Technology, Advantages over polyclonal antibodies, Basics of animal Cell culture, Media constituents, Cell quantitation techniques, Cell lines, Transgenic animals, Reproductive Cloning etc.

Recombinant DNA Technology: Tools of genetic engineering: Restriction endonucleases, DNA polymerases, Ligases, Kinases, Phosphatases, Reverse transcriptase, Exonucleases, Ribonucleases, Proteinases. Cloning Vectors, Plasmids &cosmids, Phages, BAC, YAC, transposons. Radioactive and non-radioactive labelling techniques, Gene cloning, Vectors for heterologous gene expression in bacteria, yeast, animal and plant cells, Expression and purification of recombinant proteins from bacterial and eukaryotic systems. Genomic and cDNA libraries, Chromosome walking, gene tagging, subtraction hybridization, Southern blotting, Northern blotting and western Blotting. Latest techniques in rDNA technology, DNA Fingerprinting, AFP, RFLP, RAPD. DNA Footprinting, PCR and its applications, Sequencing of DNA and proteins, Site-directed mutagenesis, Method of genetic transformation for bacteria, plants and animal cells, Protein and nucleic acid gel electrophoresis, Phage display, Two-hybrid system.

Ecology, Evolution and Environmental Biotechnology

Concepts of Ecology and Ecosystem, Components of ecosystem, Food chain, Food web, Trophic level and Energy flow, Characteristic features, structure and function of the Forest, Grassland, Desert and Aquatic ecosystem, Structure and function of some Indian ecosystems Population ecology, Species interactions, Community ecology, Ecological succession, Applied ecology, Biodiversity and Conservation biology, The Mechanism: Population genetics-population, gene pool, gene frequency, Hardy- Weinberg law, concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, Emergence of evolutionary thoughts, Origin of cells and unicellular evolution, Paleontology and evolutionary history, adaptive radiation and modifications, isolating mechanism, speciation, allopatricity and sympatricity, convergent evolution, sexual selection, co- evolution, Molecular evolution, Centre of evolution of economically important plant and animals. Fermentation technology, Vermiculture technology, Biofertilizer technology, Bioremediation and Phytoremediation, Biosensors.

3. Ph.D. Social Work

History and evolution of Social Work, Methods of Social Work Practice, Areas of Social Work Practice, Poverty, Unemployment and Inequality, Gender Issues and Women Empowerment, Child Rights and Protection, Disability, Mental Health and Geriatric Care, Rural and Urban Community Development, Human Rights, Social Justice and Sustainable Development, Globalization and Social Change, Corporate Social Responsibility (CSR) , NGOs and Civil Society Organizations, Disaster Management and Climate Change, Digital Society and Emerging Social Challenges

4. Ph.D. Economics

Micro Economics: Theory of Production and Costs, Decision making under uncertainty, Attitude towards Risk, Game Theory - Non-Cooperative games, Market Structures, competitive and non-competitive equilibria and their efficiency properties, Factor Pricing, General Equilibrium Analysis, Efficiency Criteria: Pareto-Optimality, Kaldor - Hicks and Wealth Maximization, Welfare Economics: Fundamental Theorems, Social Welfare Function, Asymmetric Information: Adverse Selection and Moral Hazard

Macro Economics: National Income: Concepts and Measurement, Determination of output and employment: Classical & Keynesian Approach, Consumption Function, Investment Function, Multiplier and Accelerator, Demand for Money, Supply of Money, SI-LM Model Approach, Inflation and Phillips Curve Analysis, Business Cycles, Monetary and Fiscal Policy, Rational Expectation Hypothesis and its critique

Statistics and Econometrics: Probability Theory: Concepts of probability, Distributions, Moments, Central Limit theorem, Descriptive Statistics - Measures of Central tendency and dispersions, Correlation, Index Numbers, Sampling methods & Sampling Distribution, Statistical Inferences, Hypothesis testing, Linear Regression Models and their properties-BLUE, Identification Problem, Simultaneous Equation Models- recursive and non-recursive, Discrete choice models, Time Series Analysis

Mathematical Economics: Sets, functions and continuity, sequence, series, Differential Calculus and its Applications, Linear Algebra - Matrices, Vector Spaces, Static Optimization Problems and their applications, Input-Output Model, Linear Programming, Difference and Differential equations with applications

International Economics: International Trade: Basic concepts and analytical tools, Theories of International Trade, International Trade under imperfect competition, Balance of Payments: Composition, Equilibrium and Disequilibrium and Adjustment Mechanisms, Exchange Rate: Concepts and Theories, Foreign Exchange Market and Arbitrage, Gains from Trade, Terms of Trade, Trade Multiplier, Tariff and Non-Tariff barriers to trade; Dumping, GATT, WTO and Regional Trade Blocks; Trade Policy Issues, IMF & World Bank,

Public Economics: Market Failure and Remedial Measures, Asymmetric Information, Public Goods, Externality, Regulation of Market - Collusion and Consumers' Welfare, Public Revenue: Tax & Non-Tax Revenue, Direct & Indirect Taxes, Progressive and non-Progressive Taxation, Incidence and Effects of Taxation, Public Expenditure, Public Debt and its Management, Public Budget and Budget Multiplier, Fiscal Policy and its Implications

Money and Banking: Components of Money Supply, Central Bank, Commercial Banking, Instruments and Working of Monetary Policy, Non-banking Financial Institutions, Capital Market and its Regulation

Growth and Development Economics: Economic Growth and Economic Development, Theories of Economic Development - Adam Smith, Ricardo, Marx, Schumpeter, Rostow, Balanced & Unbalanced Growth, Big Push Approach, Models of Economic Growth - Harrod-Domar, Solow, Robinson, Kaldor, Technical Progress - Disembodied & Embodied, Endogenous Growth, Indicators of Economic Development - PQLI, HDI, SDGs, Poverty and Inequalities - Concepts and Measurement, Social Sector Development - Health, Education, Gender

Environmental Economics and Demography: Environment as a Public Good, Market Failure, Coase Theorem, Cost-Benefit Analysis and Compensation Criteria, Valuation of Environmental Goods, Theories of Population, Concepts and Measures - Fertility, Morbidity, Mortality, Age Structure, Demographic Dividend, Life Table, Migration

Indian Economy: Economic Growth in India - Pattern and Structure, Agriculture - Pattern & Structure of Growth, Major Challenges, Policy Responses, Industry - Pattern & Structure of Growth, Major Challenges, Policy Responses, Services - Pattern & Structure of Growth, Major Challenges, Policy Responses, Rural Development - Issues, Challenges & Policy Responses, Urban Development - Issues, Challenges & Policy Responses, Foreign Trade - Structure and Direction, BOP, Flow of Foreign Capital, Trade Policies, Infrastructure Development - Physical and Social, Public-Private Partnerships, Reforms in Land, Labour and Capital Markets, Centre-State Financial Relations and Finance Commissions of India, FRBM, Poverty, Inequality & Unemployment

5. Ph.D. Sociology

Sociological Theory: Classical Sociological Traditions - Emile Durkheim, Max Weber, Karl Marx, Structure-Functionalism and Structuralism - Bronislaw Malinowski, A.R. Radcliffe-Brown, Talcott Parsons, Robert K. Merton, Claude Levi Strauss, Hermeneutic and Interpretative Traditions - G.H. Mead, Karl Mannheim, Alfred Schutz, Harold Garfinkel, Erving Goffman, Clifford Geertz, Post Modernism, Post Structuralism and Post Colonialism - Edward Said, Pierre Bourdieu, Michel Foucault, Jurgen Habermas, Anthony Giddens, Manuel Castells, Indian Thinkers - M.K. Gandhi, B.R. Ambedkar, Radha Kamal Mukherjee, G.S. Ghurye, M.N. Srinivas, Irawati Karve

Basic Concepts and Institutions: Sociological Concepts - Social Structure, Culture, Network, Status and Role, Identity, Community, Diaspora, Values, Norms and Rules, Personhood, Habitus and Agency, Bureaucracy, Power and Authority, Social Institutions - Marriage, Family and Kinship, Economy, Polity, Religion, Education, Law and Customs, Social Stratification - Social Difference, Hierarchy, Inequality and Marginalization, Caste and Class, Gender, Sexuality and Disability, Race, Tribe and Ethnicity, Social Change and Processes - Evolution and Diffusion, Modernization and Development, Social Transformations and Globalization, Social Mobility

Rural and Urban Transformations: Rural and Peasant Society - Caste-Tribe Settlements, Agrarian Social Structure and Emergent Class Relations, Land Ownership and Agrarian Relations, Decline of Agrarian Economy, De-Peasantization and Migration, Agrarian Unrest and Peasant Movements, Changing Inter-Community Relations and Violence, Urban Society - Urbanism, Urbanity and Urbanization, Towns, Cities and Mega-Cities, Industry, Service and Business, Neighbourhood, Slums and Ethnic Enclaves, Middle Class and Gated Communities, Urban Movements and Violence

State, Politics and Development: Political Processes in India - Tribe, Nation State and Border, Bureaucracy, Governance and Development, Public Policy - Health, Education and Livelihoods, Political Culture, Grass-root Democracy, Law and Society, Gender and Development, Corruption, Role of International Development Organizations, Social Movements and Protests - Political Factions, Pressure Groups, Movements based on Caste, Ethnicity, Ideology, Gender, Disability and Region, Civil Society and Citizenship, NGOs, Activism and Leadership, Reservations and Politics

Economy and Society: Exchange, Gift, Capital, Labour and Market, Mode of Production Debates, Property and Property Relations, State and Market - Welfarism and Neoliberalism, Models of Economic Development, Poverty and Exclusion, Factory and Industry Systems, Changing Nature of Labour Relations, Gender and Labour Process, Business and Family, Digital Economy, E-Commerce, Global Business and Corporate, Tourism, Consumption

Environment and Society: Social and Cultural Ecology - Diverse Forms, Technological Change, Agriculture and Biodiversity, Indigenous Knowledge Systems and Ethno-Medicine, Gender and Environment, Forest Policies, Adivasis and Exclusion, Ecological Degradation and Migration, Development, Displacement and Rehabilitation, Water and Social Exclusion,

Disasters and Community Responses, Environmental Pollution, Public Health and Disability, Climate Change and International Policies, Environmental Movements

Family, Marriage and Kinship: Theoretical Approaches - Structure-Functionalist, Alliance and Cultural, Gender Relations and Power Dynamics, Inheritance, Succession and Authority, Gender, Sexuality and Reproduction, Children, Youth and Elderly, Emotions and Family, Emergent Forms of Family, Changing Marriage Practices, Changing Care and Support Systems, Family Laws, Domestic Violence and Crime against Women, Honour Killing

Science, Technology and Society: History of Technological Development, Changing Notions of Time and Space, Flows and Boundaries, Virtual Community, Media - Print and Electronic, Visual and Social Media, E-Governance and Surveillance Society, Technology and Emerging Political Processes, State Policy, Digital Divide and Inclusion, Technology and Changing Family Relations, Technology and Changing Health Systems, Food and Technology, Cyber Crime

Culture and Symbolic Transformations: Signs and Symbols, Rituals, Beliefs and Practices, Changing Material Culture, Moral Economy, Education - Formal and Informal, Religious Organizations, Piety and Spirituality, Commodification of Rituals, Communalism and Secularism, Cultural Identity and Mobilization, Culture and Politics, Gender, Body and Culture, Art and Aesthetics, Ethics and Morality, Sports and Culture, Pilgrimage and Religious Tourism, Religion and Economy, Culture and Environment, New Religious Movements

6. Ph.D.Education

Philosophy of Education: Meaning of Philosophy, Scope of Philosophical Inquiry, Meaning of Education with Reference to Individual Growth and Development, Origin and Purpose of Human Existence as the Common Denominator between Philosophy and Education, Need for Philosophy of Education, Educational Philosophy of Indian Thinkers - Rabindra Nath Tagore, Mahatma Gandhi, Sri Aurobindo

Sociology of Education: Development and Scope, Difference with Educational Sociology, Sociological Approach, Researches in Sociology of Education

Psychology of Education: Concept, Levels of Learning, Gagne's Types of Learning, Theories of Learning - Edward Thorndike's Connectionism, Ivan Pavlov's Classical Conditioning, B.F. Skinner's Operant Conditioning, Learning by Insight, Hull's Needs Reduction Theory, Tolman's Sign-Gestalt Theory, Kurt Lewin's Field Theory and their Educational Implications, Factors Influencing Learning, Personality - Concept, Development, Structure and Dynamics of Personality, Theories of Personality - Gordon Allport, Hans Eysenck, Psychoanalytic Approach of Sigmund Freud and Erik Erikson, Behavioural Approach - Miller and Dollard, Albert Bandura and Walter, Humanistic Approach - Carl Rogers and Abraham Maslow

Methods of Educational Research: Experimental Research, Normative Survey, Historical Research, Case Study, Developmental Research, Fundamental, Applied, Evaluative and Action Research, Qualitative Research - Phenomenological and Naturalistic Enquiry

Data Analysis: Measures of Central Tendency, Measures of Variability, Correlation, Properties and Uses of Normal Distribution, Standard Scores, Difference between Means, Hypothesis Testing, ANOVA

Comparative Education: Scope and Major Concepts of Comparative Education, Methods in Comparative Education, Role of United Nations Organization in Improving Educational Opportunities among Member Countries, Educational Activities of UNO Organs, Primary and Secondary Education Systems in United States, United Kingdom, Japan and India, Erosion of Moral Values and Ethics

Developing a Research Proposal: Problem and its Sources, Selection and Definition of Problem, Objectives - Primary, Secondary and Concomitant, Hypothesis - Nature, Definition, Types and Sources, Characteristics of a Good Hypothesis, Directional and Non-directional Hypothesis

Educational Evaluation: Concept, Need and Importance, Types and Principles of Evaluation, Benjamin Bloom's Taxonomy, Tools of Measurement - Subjective and Objective Tools, Essay Test, Objective Test, Scales, Questionnaires, Schedules, Inventories, Performance Tests, Characteristics of a Good Measuring Instrument - Validity, Reliability, Norms and Usability, Test Standardization, Norm-Referenced and Criterion-Referenced Tests, Standard Scores, Measures of Central Tendency, Measures of Variability, Normal Probability Curve, New Trends

in Evaluation - CBCS, Outcome Based Education, Grading System, Use of Computer in Evaluation

Teacher Education and Higher Education: Basics of Teacher Education - Meaning, Concept, Scope and Historical Development, Elementary, Secondary and Higher Teacher Education, Privatization, Globalization and Autonomy in Teacher Education, Problems in Teacher Education, Use of ICT in Education, Professional Development, Professional Code of Ethics for Teacher Educators, Trends and Innovative Practices in Teacher Education, Higher Education - Concept, Purpose and History in India, Agencies and their Functions in Higher Education - University Grants Commission, Indian Council of Social Science Research, Indian Council of Medical Research, National Council for Teacher Education, National Assessment and Accreditation Council, Issues and Problems in Higher Education, Higher Education Management - Central, State and Private Universities, University Management and Autonomy, Important Policy Documents - NCF 2005, NCFTE 2009, NEP 2020

7. Ph.D.English

British Poetry and Drama: Major Poets and Literary Movements from the Chaucerian Period to Modernism, Major Works from Elizabethan to Contemporary Drama, including works associated with Geoffrey Chaucer, William Shakespeare, and modern literary traditions

British Fiction and Non-Fiction Prose: British Fiction from the 18th Century to the Modern Era, Prominent Essays and Philosophical Works, including contributions of writers such as Jane Austen, Charles Dickens, Virginia Woolf, and other major prose authors

Indian English Literature: Indian English Literature from the Pre-colonial to the Contemporary Era, including works of Rabindranath Tagore, R.K. Narayan, Mulk Raj Anand, Salman Rushdie, and contemporary Indian English writers

American Literature: Major Literary Movements and Authors from the 17th Century to the Contemporary Era, including writers such as Edgar Allan Poe, Walt Whitman, Ernest Hemingway, Toni Morrison, and other key American authors

Literary Criticism: Classical to Modern Criticism, Literary Movements - Renaissance, Romanticism, Victorianism, Modernism, Postmodernism, including contributions of critics such as Aristotle, Matthew Arnold, T.S. Eliot, and other major literary critics

Literary Theory: Post-World War II Literary Theories - Structuralism, Post-structuralism, Marxism, Feminism, Post-colonialism, Queer Theory, Eco-criticism and related approaches, including theories associated with Roland Barthes, Jacques Derrida, Michel Foucault, Edward Said, and other modern theorists

Cultural Studies and English Language: Theories of Culture, Media and Society, English Language Teaching, English in India, Language and Communication Studies, Media and Cultural Analysis

8. Ph.D. Hindi

हिंदी भाषा एवं विकास हिंदी की ऐतिहासिक पृष्ठभूमि: प्राचीन, मध्यकालीन और आधुनिक भारतीय आर्य भाषाएँ। अपभ्रंश, अवहट्ट और पुरानी हिंदी, हिंदी की उपभाषाएँ और बोलियाँ। हिंदी शब्द-संपदा, देवनागरी लिपि की विशेषताएँ और मानकीकरण। ध्वनिविज्ञान।

हिंदी साहित्य का इतिहास: कालविभाजन, नामकरण, आदिकाल, भक्तिकाल, रीतिकाल और आधुनिक काल।

हिंदी साहित्य की विधाएँ: हिंदी उपन्यास, कहानी, नाटक, निबंध और आलोचना का विकास और प्रमुख रचनाकार।

वैचारिक पृष्ठभूमि : हिंदी नवजागरण, भारतेन्दु हरिश्चंद्र, मार्क्सवाद, समाजवाद, मनोविश्लेषवाद, अस्तित्ववाद, संरचनावाद, उत्तर-संरचनावाद (विखंडनवाद), नव साम्राज्यवाद, अस्मितामूलक विमर्श, भारतीय काव्यशास्त्र : रस, छंद, अलंकार.

हिंदी कविता (मध्यकाल): प्रमुख कवि (कबीर, मलिक मोहम्मद जायसी, सूरदास, तुलसीदास, मीरा, रसखान, बिहारी, जयशंकर प्रसाद, सूर्यकांत त्रिपाठी निराला, सुमित्रानंदन पंत, महादेवी वर्मा आदि)। **आधुनिक कविता :** छायावाद, प्रगतिवाद, प्रयोगवाद, नई कविता।

हिंदी कहानी : प्रेमचंद, चंद्रधर शर्मा गुलेरी, अज्ञेय, कमलेश्वर, मन्नू भंडारी आदि की प्रमुख कहानियाँ। **हिंदी नाटक :** भारतेन्दु, जयशंकर प्रसाद, मोहन राकेश, हबीब तनवीर, असगर वजाहत आदि के प्रमुख नाटक।

हिंदी निबंध : आचार्य रामचंद्र शुक्ल, हजारी प्रसाद द्विवेदी, विद्यानिवास मिश्र, हरिशंकर परसाई आदि के निबंध। **आत्मकथा, जीवनी और अन्य विधाएँ:** आत्मकथा, रेखाचित्र, संस्मरण, यात्रा वृत्तांत, रिपोर्टाज।

9. Ph.D. History

Historiography and Historical Methods (Common to All Students Appearing for PhD Entrance Exam in History) Definitions of History, Periodisation and Temporal Context, Concepts of Time, Historical Consciousness and Historical Thinking, Facts in History Writing: Objectivity, Narratives and Perspectives, Causation and Generalization in History, Ideology and/in History, Subjectivity and Objectivity Debate, Different Types of sources and their use, Basics of Archiving and Different Approaches to writing history.

Ancient Indian History

Evolution of social structure, gender and sexuality, political process, agrarian relations, art and architecture, urbanization, trade, religion, sacred geography, philosophy, literary culture, intellectual history, cultural history, and historical geography. Beyond these themes, a comprehensive understanding of the historiographical debates and primary sources.

Medieval Indian History

Political, social, economic, and cultural processes of medieval Indian history. Statecraft, the nature of the state to the evolution and transformation of social structures and identities, cultural traditions, political processes, economic processes, and organization including agrarian and urban processes, and material culture of the medieval period.

Modern Indian History

Different Schools of History of Modern Indian History: National, Marxist, Subaltern. (Historiography), Peasants, Labour, Women, and Caste Movements in India, Indian National Movement, Economic History of India, Post Independence India: partition, implementing the Nehruvian model in Economics, the language debate, caste debate, India in Cold War (Non-Alignment, Bandung, UN).

10. Ph.D. Food Processing and Technology

Introduction to Food Technology: -Food attributes (color, texture, flavor etc.), Nutritive value and consumer preferences

Food Spoilage: Sources of microbial contamination of foods, food borne illnesses, water activity and its relation to spoilage of foods, Spoilage of processed products and their detection. Principles and methods of food Preservation: such as heat processing, pasteurization, canning, dehydration, freezing, freeze-drying, fermentation, microwave, irradiation and chemical additives, aseptic preservation, hurdle technology, hydrostatic pressure technology and microwave processing. Use of non-thermal technologies (microfiltration, bacteriofugation, ultra-high voltage electric fields, pulse electric fields, high pressure processing, irradiation, thermosonication).

Fruits and Vegetable Processing: Post harvest handling and storage of fresh fruits and vegetables. Preparation of fruits and vegetables for processing. ZECC (Zero Energy Cool Chambers), Thermal processing and process time evaluation for canned products, aseptic canning, and methods for canning of different fruits & vegetables; Dehydration and associated quality changes during drying and storage of dehydrated products. Intermediate moisture foods. Preparation and utilization of fruits and vegetables

Processing for Milk/Meat / Fish / Poultry Products: Processing industries in India, Milk products processing, Ante mortem inspection, Post mortem examination, Rigor mortis, Factors affecting meat quality. Curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Sausage making. Microbial factors influencing keeping quality of meat, Scope of meat, fish and poultry.

Food grain Processing: Structure, composition of different grains like wheat, rice, barley, oat, maize and millets. Anti-nutritional factors in food grains and oilseeds. Milling of grains.

Food Quality and Regulation: Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability. The principles and practices of food plant sanitation. Food and hygiene regulations. Environment and waste management. Total quality management, good management practices, HACCP and codex in food.

11. Ph.D.Environmental Science

Earth Environment - Ecosphere and its components (atmosphere, hydrosphere, lithosphere (geosphere), and biosphere), Global (climate change, biodiversity loss, acid rain, depletion of ozone layer, and pollution of international waters), and national (Indian) environment issues

Environmental Factors- Physical (Light, temperature, pressure, precipitation, and wind). Chemical (gases and pollutants) and Biological (aerospora and pathogens)

Ecology- An interdisciplinary science and its importance

Ecosystem- Concept, types and importance; Structure-trophic levels, homeostasis, food transfer (food chain and web, detritus pathway); Functions (biogeochemical cycles-C, N, P and S) and energy flow (Laws of thermodynamics, pathway of energy), Ecological pyramids; Ecosystem perturbations (grazing, browsing, trampling, burning and industrialization)

Population- Definition, characteristics, population growth

Ecological Succession- Definition, Types, Mechanism of succession

Biomes- Concept, classification and distribution; Major terrestrial biomes, fresh water ecosystems, Marine ecosystems

Environmental Chemistry: Classification of elements, stoichiometry, Gibb's energy, Chemical Bonding, Chemical reactions and equations

Atmospheric Chemistry: Thermo-chemical and photo-chemical reactions in atmosphere, Oxygen and ozone chemistry, photochemical smog

Aquatic Chemistry: Chemistry of natural waters (fresh water and marine), physico-chemical properties of water

Chemistry of Toxic Products: Pesticides-Classification and their effects, Heavy metals - Bio-chemical aspects of heavy metals, Carcinogens in air

Soil Properties: Physical properties; Soil texture and structure, bulk density, pore space, soil air, soil temperature, soil water; Chemical properties- Soil colloids, Soil organic matter; Biological properties of soil

Soil Conservation: Soil erosion and soil conservation; Desertification-definition, factors causing desertification, desertification control; Biofertilizers

Air Pollution: Sources and types of air pollutants; Impact of air pollutants on human health, plants, animals and materials; Control of air pollution.

Noise Pollution: Sources; Impact of noise and vibrations on human health; Noise control and abatement measures

Water Pollution: Types and sources, eutrophication-concept, causes, effects and control measures; Impact of water pollution on humans, plants and animals; Wastewater treatment-primary, secondary and advanced treatment methods

Marine Pollution: Sources and factors responsible for marine pollution, effects of marine pollution, control of marine pollution

Soil Pollution: Sources (agricultural, industrial, mining and dumping) of soil pollution; Effect of soil pollution; Incidences of fluorosis, arseniosis and goitre in India; Control of soil pollution

Radioactive Pollution: Sources, biological effects, and health hazards associated with radiation, control of radioactive pollution

Thermal Pollution: Sources, Heat islands-causes and Consequences, Chemical and Biological Effects of Thermal Pollution, Control of Thermal Pollution

Biodiversity- Concept, types, National (Indian) and global status of biodiversity; threats to biodiversity, Invasive species

Biodiversity Hotspots- Definition and basis of identification, global occurrence

Biodiversity Conservation- *In-situ* conservation practices-protected area network (Preservation plot, National park, Wildlife Sanctuary, Conservation reserve, Community reserve, On-farm conservation and Biosphere reserve); *ex-situ* conservation practices-Botanic garden, homestead garden, Arboretum, Bamboo setum, fernaria, Cacteria, herbarium, Zoo, Aquarium, and *in-vitro* conservation practices-gene bank, cryobank (pollen and spore bank) and DNA library

Sustainable Development (SD): Concept; Sustainable Development Goals

Waste - Definition and categories; Sources; Concepts of waste reduction, 3R and 5R concept

Waste Treatment Technologies: Incineration, Composting, Vermi-composting, Waste disposal in landfills

Hazardous Wastes - Definition, sources, and characteristics; e-waste, Fly ash, Plastic waste

12. Ph.D. Mathematics

Analysis:Elementary set theory, finite, countable, and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, and infimum. Sequences and series, convergence, limsup, liminf. Bolzano-Weierstrass theorem, Heine-Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra:Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigen values and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

Complex Analysis:Algebra of complex numbers, the complex plane, polynomials, power series, transcendental - functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz Lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra:Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in $\mathbb{Z}$, congruences, Chinese Remainder Theorem, Euler's ϕ -function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology:Basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Ordinary Differential Equations (ODEs):Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogeneous and non homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General

solution of higher-order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat, and Wave.

Numerical Analysis: Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite, and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Fluid Mechanics: Real and Ideal fluids, Basic flow concepts, Viscosity, Laminar and Turbulent flows, Reynolds Number, Eulerian and Lagrangian description of fluid motion, steady and unsteady flows, Couette-Poiseuille flows. Equations of mass and momentum (Euler equation).

Probability and Distributions:

Descriptive statistics, exploratory data analysis. Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate), Binomial, Poisson, Normal distributions, expectation, and moments. Independent random variables, marginal and conditional distributions.

Operations Research:

Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Job sequences, Game theory, Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, MIMIC with limited waiting space, M/G/1.

13. Ph.D. Physics

Mathematical Method of Physics: Vector Algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems. Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, $SU(2)$, $O(3)$; Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

Electromagnetic theory: Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot—savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interface; Scalar and vector potential; Gauge invariance; Electromagnetic wave in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel's Law, interface, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides.

Quantum Mechanics: Wave-particle duality; Wave function in coordinate and momentum representation; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schrodinger equation (time-dependent and time-independent); Eigen value problem such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; time independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection Rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

Thermodynamic and Statistical Physics: Laws of thermodynamics and their consequence; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro-and macro states; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free energy and connection with thermodynamic quantities; First-and second—order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random Walk and Brownian motion; introduction to non-equilibrium processes; Diffusion equations.

Electronics:

Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and hetero junction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronics devices, including solar cells, photo detectors, and LEDs; High frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators, and similar circuits); A/D and D/A converters; Microprocessors and microcontroller basics.

Experimental Techniques and data analysis: Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signals conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation; amp feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car integrator, modulation techniques.

Atomic and Molecular Physics: Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS&JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank—Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

Condensed Matter Physics: Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding of solids Elastic properties, phonons, lattice specific heat; Free electron theory and electronic specific heat; response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type-I and type-II superconductors, Josephson Junctions; Defects and dislocations; Ordered phase of matter, translational and orientational order, kinds of liquids crystalline order; Conducting polymers; Quasicrystals

14. Ph.D Applied Chemistry

Inorganic Chemistry: Chemical Periodicity, Structure and Bonding in Homo- and Heteronuclear Molecules, Shapes of Molecules (VSEPR Theory), Concepts of Acids and Bases, Hard-Soft Acid Base Concept, Non-aqueous Solvents, Main Group Elements and their Compounds - Allotropy, Synthesis, Structure and Bonding, Industrial Importance of Compounds, Transition Elements and Coordination Compounds - Structure, Bonding Theories, Spectral and Magnetic Properties, Reaction Mechanisms, Inner Transition Elements - Spectral and Magnetic Properties, Redox Chemistry, Analytical Applications, Organometallic Compounds - Synthesis, Bonding, Structure and Reactivity, Organometallics in Homogeneous Catalysis, Cages and Meta-clusters, Analytical Chemistry - Separation, Spectroscopic, Electroanalytical and Thermoanalytical Methods, Bioinorganic Chemistry - Photosystems, Porphyrins, Metalloenzymes, Oxygen Transport, Electron-transfer Reactions, Nitrogen Fixation, Metal Complexes in Medicine, Characterisation of Inorganic Compounds by IR, Raman, NMR, EPR, Mössbauer, UV-Vis, NQR, MS, Electron Spectroscopy and Microscopic Techniques, Nuclear Chemistry - Nuclear Reactions, Fission and Fusion, Radio-analytical Techniques and Activation Analysis

Physical Chemistry: Basic Principles of Quantum Mechanics - Postulates, Operator Algebra, Exactly Solvable Systems, Particle-in-a-box, Harmonic Oscillator, Hydrogen Atom, Shapes of Atomic Orbitals, Orbital and Spin Angular Momenta, Tunneling, Approximate Methods of Quantum Mechanics - Variational Principle, Perturbation Theory up to Second Order in Energy and Applications, Atomic Structure and Spectroscopy - Term Symbols, Many-electron Systems and Antisymmetry Principle

Organic Chemistry: Organic Reactive Intermediates - Generation, Stability and Reactivity of Carbocations, Carbanions, Free Radicals, Carbenes, Benzynes and Nitrenes, Organic Reaction Mechanisms involving Addition, Elimination and Substitution Reactions with Electrophilic, Nucleophilic or Radical Species, Determination of Reaction Pathways, Common Named Reactions and Rearrangements and their Applications in Organic Synthesis, Organic Transformations and Reagents - Functional Group Interconversion including Oxidation and Reduction, Common Catalysts and Reagents (Organic, Inorganic, Organometallic and Enzymatic), Chemo-, Regio- and Stereoselective Transformations, Concepts in Organic Synthesis - Retrosynthesis, Disconnection, Synthons, Linear and Convergent Synthesis, Umpolung of Reactivity and Protecting Groups, Asymmetric Synthesis - Chiral Auxiliaries, Methods of Asymmetric Induction, Substrate-, Reagent- and Catalyst-controlled Reactions, Determination of Enantiomeric and Diastereomeric Excess, Enantio-discrimination, Optical and Kinetic Resolution, Pericyclic Reactions - Electrocyclisation, Cycloaddition, Sigmatropic Rearrangements and Related Concerted Reactions, Principles and Applications of Photochemical Reactions in Organic Chemistry, Synthesis and Reactivity of Common Heterocyclic Compounds containing O, N and S Heteroatoms, Chemistry of Natural Products - Carbohydrates, Proteins and Peptides, Fatty Acids, Nucleic Acids, Terpenes, Steroids and Alkaloids, Biogenesis of Terpenoids and Alkaloids, Structure Determination of Organic Compounds by IR, UV-Vis, ^1H NMR, ^{13}C NMR and Mass Spectroscopic Techniques

15. Ph.D. Electrical Engineering

Circuits and Networks: Circuit's Elements and Theorems, Transient Response and Steady State Response for Sinusoidal and Arbitrary Inputs, Properties of Networks, Resonant Circuits, Three-phase Circuits, Transfer Function, Two-port Networks, Network Synthesis.

Power Electronics, Electrical Machines & Drives: Electric and magnetic fields and associated laws, DC machines, Separately Excited, Series and Compound Machines, Induction Machines – Squirrel Cage and Wound Rotor, Synchronous Machines, Methods of Speed Control of DC and Induction Machines, Transformers, Testing of Machines, AC/DC Drives, Thyristor controlled reactors, characteristics and applications of power semiconductor devices. PWM techniques, UPS and SMPS, Power semiconductor devices, Inverters, Converters, and choppers.

Power Systems: Analysis of Transmission lines, Excitation System, Load Flow analysis, Economic Operation of Power System, Power System Stability and control, Automatic Generation Control, Fault Analysis, Power System Protection, Relays & Circuit breakers, FACTS Devices, power quality, HVDC & HVAC transmission, Electric Power Generation, Power Stations, Renewable Energy Sources and their applications, Energy management systems. Genetic Algorithms, Fuzzy Logic Algorithms, Neural Networks.

Instrumentation and Control: Units, Standards, Electrical measurements, Measurement of resistance, capacitance and frequency, Errors and analysis, Analog and Digital Measuring Instruments, Bridges and Potentiometers, Sensors and Transducers, Electronic measuring instruments, Data Acquisition Systems, Mathematical Modeling of Control Systems, Control System Components-electromechanical, hydraulic and pneumatic components, Transfer Function, Block Diagrams, Signal Flow Graphs, Stability analysis of Linear Systems using Routh array, Nyquist plot, Bode plot and Root locus. State Space Model. P, PI, PID Controllers, Basic concepts of compensator design, Discrete Data Systems, State Variable representation, Digital & Optimal Control systems.

Analog, Digital Circuits and Micro-processors: Semiconductor physics, diodes and transistors, various electronic devices and applications, switching behavior, biasing circuits, frequency response, small signal and large signal amplifiers, multi-stage and feed-back amplifiers, Oscillators. Coupling methods push pull and OPAMs, wave shaping circuits. Multi-vibrators and flip-flops, Digital logic and gates, universal gates, combinational circuits, sequential logic circuits, Counters, registers, ADC/DAC Converters. RAM and ROMs, 80 family Micro-processor architecture, Instruction set and assembly language programming, Interfacing for memory and I/O, Applications of Micro-processors in electrical engineering.

16. Ph.D. Civil Engineering

WATER RESOURCES ENGINEERING: Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics – Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir capacity, reservoir and channel routing, surface run-off models, ground water hydrology – steady state well hydraulics and aquifers; Application of Darcy's law.

Irrigation: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage structures, outlets and escapes.

ENVIRONMENTAL ENGINEERING: Water and Waste Water: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal.

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution

17. Ph.D. Mechanical Engineering

Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses. **DESIGN:** Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, various types gears (spur, bevel, helical, worm etc) rolling and sliding contact bearings, brakes and clutches.

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. I.C. Engines: air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes.

Turbo-machinery: Pelton-wheel, Francis and Kaplan turbines – impulse and reaction principles, velocity diagrams. Mechanics of machining, single and multi-point cutting tools, tool geometry

and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, and drawing) and sheet (shearing, deep drawing, and bending) metal forming processes; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Machining and Machine Tool Operations: Different Machining Processes, Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

18. Ph.D. Computer Science and Engineering

Digital Logic Boolean algebra: Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture: Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms: Searching, sorting, hashing. Asymptotic worst-case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.

Theory of Computation: Regular expressions and finite automata. Context-free grammars and pushdown automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

Compiler Design: Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Operating System: Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Databases: ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Computer Networks: Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

19. Ph.D.Electronics & Communication Engineering

Networks, Signals and Systems: Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Electronic Devices: Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, and twin-tub CMOS process.

Analog Circuits: Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits, Power supplies: ripple removal and regulation.

Digital Circuits: Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Control Systems: Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Communications: Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications:

amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; information theory; entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Electromagnetics: Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

20. Ph.D. Information and Communication Technology

Digital Logic Boolean algebra: Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture: Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms: Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.

Theory of Computation: Regular expressions and finite automata. Context-free grammars and pushdown automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

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Computer Networks: Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

21. Ph.D. Law, Justice & Governance

Jurisprudence: Nature and sources of law, Schools of jurisprudence, Law and morality, Concept of rights and duties, Legal personality, Concepts of property, ownership and possession, Concept of liability, Law, poverty and development, Global justice, Modernism and post-modernism.

Constitutional and Administrative Law: Preamble, fundamental rights and duties, directive principles of state policy, Union and State executive and their interrelationship, Union and State legislature and distribution of legislative powers, Judiciary, Emergency provisions, Temporary, transitional and special provisions in respect of certain states, Election Commission of India, Nature, scope and importance of administrative law, Principle of natural justice, Judicial review of administrative actions Grounds.

Public International Law and IHL: International law - Definition, nature and basis, Sources of International law, Recognition of states and governments, Nationality, immigrants, refugees and internally displaced persons (IDPs), Extradition and asylum, United Nations and its organs, Settlement of international disputes, World Trade Organization (WTO), International humanitarian law (IHL) – Conventions and protocols, Implementation of IHL Challenges.

Law of Crimes: General principles of criminal liability – Actus reus and mens rea, individual and group liability and constructive liability, Stages of crime and inchoate crimes, Abetment, criminal conspiracy and attempt, General exceptions, Offences against human body, Offences against state and terrorism, Offences against property, Offences against women and children, Drug trafficking and counterfeiting, Offences against public tranquility, Theories and kinds of punishments, compensation to the victims of crime.

Law of Torts and Consumer Protection: Nature and definition of tort, General principles of tortious liability, General defenses, Specific torts - Negligence, nuisance, trespass and defamation, Remoteness of damages, Strict and absolute liability, Tortious liability of the State, The Consumer Protection Act 1986-Definitions, consumer rights and redressal mechanism, The Motor Vehicles Act, 1988-No fault liability, third party insurance and claims tribunal, The Competition Act, 2002 - Prohibition of certain agreements, abuse of dominant position and regulation of combinations.

Commercial Law: Essential elements of contract and e-contract, Breach of contract, frustration of contract, void and voidable agreements, Standard form of contract and quasi-contract, Specific contracts Bailment, pledge, indemnity, guarantee and agency, Sale of Goods Act, 1930, Partnership and limited liability partnership, Negotiable Instruments Act, 1881, Company law-Incorporation of a company, prospectus, shares and debentures, Company law - Directors and meetings, Corporate social responsibility.

Family Law: Sources and schools, Marriage and dissolution of marriage, Matrimonial remedies - Divorce and theories of divorce, Changing dimensions of institution of marriage - Live-in relationship, Recognition of foreign decrees in India on marriage and divorce, Maintenance, dower and stridhan, Adoption, guardianship and acknowledgment, Succession and inheritance, Will, gift and Wakf, Uniform Civil Code.

Environment and Human Rights Law: Meaning and concept of environment; and environmental pollution, International environmental law and UN Conferences, Constitutional and legal framework for protection of environment in India, Environmental Impact Assessment and control of hazardous waste in India, National Green Tribunal, Concept and development of human rights, Universalism and cultural relativism, International Bill of Rights, Group rights- Women, children, persons with disabilities, elderly persons, minorities and weaker sections, Protection and enforcement of human rights in India - National Human Rights Commission, National Commission for Minorities, National Commission for Women, National Commission for Scheduled Castes, National Commission for Scheduled Tribes and National Commission for Backward Classes.

Intellectual Property Rights and Information Technology Law: Concept and meaning of intellectual property, Theories of intellectual property, International conventions pertaining to intellectual properties, Copyright and neighboring rights-Subject matters, limitations and exceptions, infringement and remedies, Law of patent - Patentability, procedure for grant of patent, limitations and exceptions, infringement and remedies, Law of trademark - Registration of trademarks, kinds of trademarks, infringement and passing off, remedies, Protection of Geographical Indications, Bio-diversity and Traditional Knowledge, Information technology law - digital signature and electronic signature, electronic governance, electronic records and duties of subscribers, Cyber-crimes, penalties and adjudication.

Comparative Public Law and Systems Of Governance: Comparative Law - Relevance, methodology, problems and concerns in Comparison, Forms of governments - Presidential and parliamentary, unitary and federal, Models of federalism - USA, Canada and India, Rule of Law - Formal and substantive version's, Separation of powers - India, UK, USA and France, Independence of judiciary, judicial activism and accountability - India, UK and USA, Systems of constitutional review - India, USA, Switzerland and France, Amendment of the Constitution - India, USA and South Africa, Ombudsman - Sweden, UK and India, Open Government and Right to Information - USA, UK and India.