Appendix–II

Syllabus for Entrance Test for PhD programme July 2026

1. Psychology (PHDPC)

Research Methodology (50%)

Constructs and variables, Steps in psychological research Problem and hypothesis, Type 1 and type 2 errors; Types of research: experimental, non experimental, field experiments, field studies, survey research; action research; Research designs; Paradigms of research; Methods of data collection including interview, observation, objective tests, questionnaire; test construction, reliability and validity, standardisation and norms; Areas of psychological testing, Computer based psychological testing; Applications of psychological testing; Sampling and sampling techniques; Qualitative and quantitative research; Methods of data collection and data analysis in qualitative research; Ethics in research; Statistics in psychology; levels of measurement, descriptive and inferential statistics, measures of central tendency and measures of variability; Correlation and Regression; Normal distribution and normal probability curve; Parametric and nonparametric statistics and their techniques.

Subject Specific (50%)

Eastern and Western Perspectives in Psychology; Historical development of Psychology in India; Indian Psychology; Human cognition and mental processes, Theories and assessment of Personality, Intelligence and Creativity; Motivation and Emotions, Stress and Stress Management, Coping and Coping styles and Strategies; Nature and Scope of Social Psychology, Social Cognition, Social Influence, Attitude, Prosocial behaviour and Altruism, Group dynamics, Aggression, Applied social psychology; Nature, principles and factors in human development, Theories of human development; Concepts related to disadvantage and deprivation, discrimination and marginalisation, Glass-ceiling and glass-floor effects, Theories of gender development; Conflict resolution; Factors influencing positive health, well-being and quality of life, Character strengths and virtues; Positive psychology interventions; Influence of media on human cognition and behaviour, Digital learning, Cyberbullying, Artificial intelligence.

Introduction to Industrial and Organisational Psychology; Human Resource Management and Human Resource Development; Recruitment and Selection; Training and Training Methods; Performance Appraisal; Leadership; Managing Diversity; Accidents and Industrial safety; Workplace behaviour and ethical issues; Workplace violence and harassment; Managing conflict; Work motivation; Personality and Attitude in the context of organization; Job Satisfaction; Team work and team building; Organisational Behaviour and Organisational development, Organisational Change, Organisational culture and climate; Management by Objectives; Organisational Citizenship Behaviour; Corporate Social Responsibility, Employee counselling.

Introduction to Counselling; Theories of Counselling; Career counselling and guidance; Stages of counselling and counselling relationship; Assessment in Counselling; Counselling Skills and Techniques; Counselling with regard to various developmental stages; Counselling for Special Population; Counselling in diverse settings; Multicultural counselling; Expressive Therapies; Group and Family counselling; Contemporary trends in Counselling; Ethics in Counselling.

Paradigms and perspectives of psychopathology; Classification of mental disorders (DSM 5 and ICD 10); Personality disorders; Schizophrenia; Mood disorders; Feeding and Eating Disorders; Anxiety Disorders; Obsessive Compulsive and Related Disorders, Dissociative Disorders and Somatic Symptom Disorders; Substance use disorders; Sexuality Disorders and Gender Dysphoria, Stress, Trauma and Psychopathology**;** Developmental disorders in Childhood, Emotional and Behavioural disorders in Childhood, Diagnosis and tools for diagnosis of mental disorders; Psychoanalysis, Psychotherapies, Behaviour therapy, Humanistic and Existential therapy, Person centered therapy, Gestalt therapy, Cognitive therapy, Cognitive Behaviour therapy; Rational Emotive Behaviour Therapy, Solution focused therapy, Narrative therapy; Indigenous therapies; Group and Family therapies; Ethical issues in psychotherapy.

2. Anthropology (PHDAN)

SECTION A: RESEARCH METHODOLOGY

Anthropology and Methods of Research

Introducing Anthropology:

Defining Anthropology, Meaning, Scope, History, Branches of Anthropology, Emerging Frontiers in Anthropology

Fieldwork Tradition in Anthropology:

Fieldwork and its Relevance, Ethnography, Methods and Methodology, Techniques, Genealogy and Pedigree

Research Design:

Review of Literature, Statement of Research Problem, Theory, Research Design, Sampling Methods

Data Collection Techniques:

Primary Data, Secondary Data, Qualitative and Quantitative Methods, Biological Methods, Archaeological Methods

Ethics in Anthropological Research:

Informed Consent, Confidentiality, Anonymity, Ethical Issues in Fieldwork

Statistical Analysis:

Collection and Presentation of Data, Measures of Central Tendency and Dispersion, Statistical Distribution, Using SPSS for Data Analysis

SECTION B: SUBJECT SPECIFIC

Physical Anthropology

Introduction to Physical Anthropology:

Definition and Scope, Relationship with Other Disciplines, Applied Aspects of Physical Anthropology

Human Evolution:

Principles of Evolution, Theories of Organic Evolution, Synthetic Theory, Palaeoanthropology

Primate Study:

Living Primates, Primate Behaviour

Biological Diversity:

Concept of Race, Characteristics and Criteria of Biological Diversity, Racial Classification

Human Genetics:

Human Genetics, Methods in Human Genetics, Population Genetics, Aberrations in Chromosomes

Human Growth and Development:

Principles of Growth, Methods and Influencing Factors, Human Constitution and Physique, Reproductive Biology

Ecological Anthropology:

Fundamentals of Ecology, Adaptation to Environment, Epidemiological Anthropology

Contemporary Areas:

Forensic Anthropology, Nutritional Anthropology, Molecular Anthropology

Social Anthropology

Introduction to Social Anthropology:

Nature and Scope, Philosophical and Historical Foundations of Social Anthropology, Relationship of Social Anthropology with Allied Disciplines

Society and Culture:

Concept of Society and Culture, Social Groups, Social Identity and Movements, Social Change in Indian Context

Anthropological Theories:

Classical Theories, Functionalism, Structural Functionalism and Neo-Functionalism, Social Organisation and Dynamic Theories of Structure, Culture and Personality, Marxism, Structuralism, Feminism, Postmodernism and Postcolonialism

Kinship, Marriage and Family:

Kinship, Descent and Alliance Theories, Marriage, Family, Kinship, Family and Marriage in India

Religion:

Concepts and Approaches to the Study of Religion, Rituals and Symbolism, Religious Specialists

Economic and Political Organisations:

Concepts and Definitions, State and Stateless Societies, Political Institutions, Production, Consumption and Exchange, Political Power and Distribution of Resources

Indian Society and Contemporary Concerns:

Tribe, Caste and Indian Society, Gender and Society, Applied Anthropology

Archaeological Anthropology

Introduction to Archaeological Anthropology:

Definitions and Scope, History and Development, Interdisciplinary Relations

Archaeological Field Methods:

Exploration, Excavation, Documentation, Interpretation

Tool Types and Techniques in Archaeology:
Space, Tool Families, Tool-making Technologies, Household and Decorative Objects

Geological Framework:
Time and Space, Recent Period, Human Palaeontology

Dating Methods:
Relevance of Dating, Relative and Absolute Dating

Lithic Cultures:
Palaeolithic, Mesolithic and Neolithic, Evidence of Palaeolithic Culture in India

Indus Valley Civilization:
Major Features, Urbanism, Crafts, Trade and Cultural Significance

3. Political Science (PHDPS)

Unit - 1 : Political Theory
Concepts -

- Liberty,
- Equality,
- Justice,
- Rights,
- Democracy,
- Power,
- Citizenship,

Political Traditions –

- Liberalism
- Conservatism
- Socialism
- Marxism
- Feminism
- Ecologism
- Multiculturalism
- Postmodernism

Unit - 2 : Indian Political Thought

- Dharamshastra, Kautilya, Aggannasutta, Barani, Kabir, Pandita Ramabai, Bal Gangadhar Tilak, Swami Vivekanand, Rabindranath Tagore, M.K Gandhi, Sri Aurobindo, Periyar E. V. Ramasamy, Muhammad Iqbal, M.N.Roy, V D Savarkar, Dr. B.R.Ambedkar, J L Nehru, Ram Manohar Lohia, Jaya Prakash Narayan, Deendayal Upadhyaya

Unit -3 : Comparative Political Analysis

- **Approaches:** Institutional, Political Culture, Political Economy and New Institutionalism; Comparative Methods

Colonialism and decolonization: forms of colonialism, anti-colonial struggles and decolonization

- State theory: debate over the nature of state in capitalist and socialist societies; post-colonial state; welfare state; globalization and nations-states Political regimes: democratic (Electoral, Liberal, Majoritarian and Participatory) and non-democratic

regimes (Patrimonialism, Bureaucratic authoritarianism, Military dictatorship, Totalitarianism, and fascist).

- Development: Underdevelopment, Dependency, Modernization, World Systems Theory, development and democracy.
- Actor and Processes: Electoral Systems, Political Parties and Party System, Interest groups, Social movements, new social movements, Non-Governmental Organisations (NGOs) and civil society campaigns; Revolutions.

Unit - 4 : International Relations

Approaches to the study of international relations: Idealism, Realism, Structural Marxism, Neoliberalism, Neorealism, Social Constructivism, Critical International Theory, Feminism, Postmodernism.

Concepts: State, state system and non-state actors, Power, Sovereignty, Security: traditional and non- traditional.

United Nations: Aims, Objectives, Structure and Evaluation of the Working of UN; Peace and Development perspectives; Humanitarian intervention. International law; International Criminal Court

Political Economy of IR; Globalisation; Global governance and Bretton Woods system, North-South Dialogue, WTO, G-20, BRICS.

Regional Organisations: European Union, African Union, Shanghai Cooperation Organisation, ASEAN.

Contemporary Challenges: International terrorism, Climate change and Environmental Concerns, Human Rights, Migration and Refugees; Poverty and Development; Role of Religion, Culture and Identity Politics.

Unit - 5 : India's Foreign Policy

Perspectives on India's Foreign Policy: India's Identity as postcolonial, development, rising power and as emerging political economy

Continuity and change in India's Foreign Policy: Principles and determinants; non-alignment movement: historical background and relevance of Non-Aligned Movement; India's Nuclear Policy

India's relations with major powers: USA, USSR/Russia, People's Republic of China

India's Engagement with multipolar world: India's relations with European Union, BRICS, ASEAN, Shanghai Cooperation Organisation, African Union, Southern African Development Community, Gulf Cooperation Council

India's relations with neighbourhood: SAARC, Gujral doctrine, Look East/ Act East, Look West.

Unit - 6: Political Institutions in India

Making of the Indian Constitution: Colonialism heritage and the contribution Indian National Movement to the making of the Indian Constitution

Constituent Assembly: Composition, Ideological Moorings, Constitutional Debates Philosophy of the Constitution: Preamble, Fundamental Rights, Directive Principles

Constitutionalism in India: Democracy, Social Change, National Unity, Checks and Balances, Basic Structure Debate, Constitutional Amendments Union Executive: President, Prime Minister and Council of Ministers

Union Parliament: Structure, Role and Functioning, Parliamentary Committees

Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Judicial Reform.

Executive and Legislature in the States: Governor, Chief Minister, State Legislature

Federalism in India: Strong Centre Framework, Asymmetrical Federal Provisions and

Adaption, Role of Intergovernmental Coordination Mechanisms, Inter-State Council, Emerging Trends.
Electoral Process and Election Commission of India: Conduct of Elections, Rules, Electoral Reforms.
Local Government Institutions: Functioning and reforms.
Constitutional and Statutory Bodies: Comptroller and Auditor General, National Commission for Scheduled Castes, National Commission for Scheduled Tribes, National Commission for Human Rights, National Commission for Women, National Commission for Minorities.

Unit - 7 : Political Processes in India

State, Economy and Development: Nature of Indian State, Development Planning model, New Economic Policy, Growth and Human Development.
Process of globalisation: social and economic implications.
Identity Politics: Religion, Tribe, Caste, Region, Language. Social Movements: Dalit, Tribal, Women, Farmers, labour
Civil Society Groups: Non-Party Social Formations, Non-Governmental Organisations, Social Action Groups.
Regionalisation of Indian Politics: Reorganisation of Indian States, States as Political and Economic Units, Sub-State Regions, Regional disparities, Demand for New States,
Gender and Politics in India: Issues of Equality and Representation.
Ideology and Social basis of Political Parties: National Parties, State Parties.
Electoral Politics: Participation, Contestation, Representation, Emerging trends.

4. Public Administration (PHDPA)

SECTION-I (Public Administration)

- Public Administration—Meaning, Nature and Scope, Changing Complexion of Public Administration in Globalisation era, New Public Administration, New Public Management, New Public Service, Governance, Civil Society.
- Administrative Thinkers—Kautilya, Woodrow Wilson, Luther Gullick and Lyndall Urwick, Max Weber, F.W. Taylor, Henry Fayol, M.P. Follet, Elton Mayo, Chester Barnard, Herbert Simon, D.H. Mcgregor, Abraham Maslow, Frederick Herzberg and Chirs Argyris.
- Indian Administration—Organisation of the Union Government—Central Secretariat, Ministries and Departments, Cabinet Secretariat, Prime Minister's Office, Constitutional bodies and Commissions, Regulatory Agencies, NITI Aayog.
- Organisation of the State Government—Secretariat, Role of Chief Secretary, Organisaton of Departments and Directorates.
- Personnel Administration— Bureaucracy, Classification of Services, Recruitment, Recruitment Agencies—Union Public Service Commission, State Public Service Commission, Training, Promotion, Performance Appraisal, Discipline, Morale, Staff Associations, Employer-Employee Relations, Pay Commissions.
- Financial Administration----Budget, Types of Budget, Enactment and Execution of Budget, Parliamentary Committees, Parliamentary Control over Public Expenditure, Audit, Role of Comptroller and Auditor General of India.
- Local government— Nature and Scope, 73rd and 74th Constitutional Amendments in India, Urban and Rural local bodies-Organisation and Functions, Finance, Committee System, State and Local Government Relations and Challenges of Local Self-Government.

- Disaster Management, Sustainable Development, Social Audit, Corporate Governance, Corporate Social Responsibility, and Contemporary Issues in Governance.

Section II Research Methodology

- Meaning, Objectives and Types of Research
- Research Ethics
- Research Methods versus Research Methodology
- Research Methods in Social Sciences
- Research Design
- Hypotheses
- Methods of Data Collection
- Sampling Design
- Data Processing and Analysis
- Report Writing

5. Bio-Chemistry (PHDBC)

PART A: RESEARCH METHODOLOGY Objectives of research methods versus Methodology Types of research: Descriptive vs. Analytical; Applied vs. Fundamental; Quantitative vs. Qualitative; Conceptual vs. Empirical Literature Review: Methods and Importance Research design: Need, Types and Features of research design, Formulating Research Problem Collection and analysis of Data: Importance and Methods of data collection, Data Analysis with Statistical Packages Ethical issues in Research: Copy right, Intellectual Property Rights; Plagiarism. Basic Principles and Applications of Analytical techniques.
PART-B: Subject specific paper

1) Cell biology

Physical structure of model cell membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins, other constituents; diffusion, osmosis, active transport, regulation of intracellular transport and electrical properties.
Structural organization and functions of nucleus, mitochondria, Golgi bodies, endoplasmic reticulum, lysosomes, Chloroplast, peroxisomes, vacuoles. Cytoskeletons structure and motility function.
Organization of genome, structure of chromatin and chromosomes, heterochromatin, euchromatin. Cell division and cell cycle: Mitosis and meiosis, their regulation, Cell

cycle and its regulation, apoptosis, necrosis and autophagy.
Cell transformation and cancer, oncogenes and proto-oncogenes, tumor suppressor genes, metastasis. Therapeutic interventions of uncontrolled cell growth.
Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.
Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, tight junctions, communicating junctions, extracellular matrix, integrins, neurotransmission and its regulation. Regulation of hematopoiesis, differentiation and development.

2) Biomolecules

Physical properties of water and their role in biology. Concepts of pH, ionic strength and buffers.
Laws of thermodynamics. Concepts of ΔG, ΔH and ΔS.
Structure and functions of amino acids, proteins, nucleic acids, carbohydrates and lipids.
Forces that stabilize biomolecules such as electrostatic and van der Waal's interaction, hydrogen bonding. Interactions with solvents, Hydrophobic effect. Structural characteristics of protein in α-helix, β-sheet and β-turn. Ramachandran plot. Protein domains and domain architecture. Quaternary structure of proteins. General structure of DNA and RNA, Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches
Introduction to enzymes. Types of enzymatic reaction mechanisms, Michaelis-Menten kinetics. Competitive, Non-competitive and Un-competitive inhibition. Bi-substrate reaction kinetics.
Concepts of order and molecularity of a chemical reaction. Derivation of first and second order rate equation, measurement of rate constants. Concept of activation energy.
Structure and biological significance of vitamins and minerals

3) Physiology
Photosynthesis- Light harvesting complexes; mechanisms of electron transport; photoprotective mechanism; CO_2 fixation-C_3, C_4 and CAM pathway. Nitrogen fixation: Historical background, nitrogen cycle in nature, symbiotic nitrogen fixation, nitrogenase system, nitrate reductase.
Plant nutrition, water relations, phytochromes, calmodulin, circadian rythms, plant hormones- Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.
Blood and circulation- Blood corpuscles, haematopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
Cardiovascular System- anatomy of heart structure, myogenic heart, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation.
Respiratory system – transport of gases and exchange of gases, waste elimination.
Digestive system – Digestion, absorption, energy balance, BMR.
Excretory system- Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition. Regulation of water balance, blood

volume, blood pressure, electrolyte balance, acid-base balance.
Nervous system- Neurons, action potential, central and peripheral nervous system.
Sense organs- Vision, hearing and tactile response.
Reproduction- Reproductive processes, gemetogenesis, ovulation.

4) Molecular biology and Recombinant DNA technology
Genes and chromosomes, Operon concept, DNA replication, DNA damage and repair mechanisms, homologous and site-specific recombination.
Transcription of various types of RNAs and their processing and modifications. Transcription factors and machinery including RNA polymerases, formation of initiation complex, elongation and termination of transcription. Regulation of transcription: activators (enhancers) and repressors, Locus control regions. Protein synthesis, processing and transport of proteins: Ribosome, mRNA structure, genetic code, aminoacylation of tRNA, aminoacyl tRNA synthetase. Mechanism of translation: Initiation, elongation and termination factors and translational proof-reading. Regulation of Translation- global vs mRNA-specific. Inhibitors of Translation , Posttranslational modifications of proteins. Protein trafficking and transport. Regulation of gene expression in prokaryotes and eukaryotes, role of chromatin, chromatin remodelling and gene silencing, Epigenetic regulation.

Enzymes used in Recombinant DNA technology. Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations.
Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification. Western blotting.
Generation of genomic and cDNA libraries. Plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.
Isolation and amplification of specific nucleic acid sequences, PCR, RT PCR and qRT PCR, DNA sequencing methods, strategies for genome sequencing.
Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques. Analysis of DNA polymorphism: RFLP, RAPD and AFLP techniques.

5) Microbiology and Immunology
Cell structure and components, characterization and classification of microorganisms. Cultivation of Bacteria, nutrition, physiology and growth of microbial cells, reproduction and growth, synchronous growth, continuous culture of microorganisms. Pure cultures and their characteristics. Fundamentals of control of microbial growth control by physical and biochemical agents. Production of mutants by chemical and physical agents and their characterizations.
Host microbe interactions, endotoxins, exotoxins, capsular material. Enzymatic and other factors, tissue affinity, resistance and immunity. Viruses of bacteria, plant and animal cells: Structure, classification and life cycle, mycoplasma and viriods, diseases.
Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B

and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.
Host-pathogen interaction- Recognition and entry processes of different pathogens like bacteria, viruses and protozoans into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

6) Tools and Techniques used in Biological research
Concepts of precision and accuracy in experimental measurements. Concept of signal to noise ratio.
Biostatistics: Measures of Central Tendency. Fundamental ideas of probability and probability distributions: Binomial, Poisson and Gaussian distributions. Concept of the Central Limit Theorem. Hypothesis testing: Use of Student's t and χ^2 tests. Correlation and regression. Basic concepts of design of Experiments.
Biochemical Methods: Chromatography: Ion exchange, Gel Filtration and Affinity chromatography. Electrophoresis: Native and SDS-PAGE. Isoelectric focusing. 2D-PAGE and its applications.
UV/Vis spectrophotometry. Beer-Lambert's law and its use in determination of protein/ nucleic acid concentration.
Fluorescence Spectroscopy: Basic concepts of excitation and emission. Quenching, Theory and applications of FRET and fluorescence lifetime measurements.
Fundamentals of CD, IR and Raman spectroscopy and their use in the study of biomolecular conformation.
Centrifugation: Basic concepts of centrifugation. Density gradient centrifugation. Sedimentation velocity and Sedimentation equilibrium. Separation of sub-cellular components and macromolecules using high speed and ultracentrifugation.
Microscopy: Bright field, phase contrast, fluorescence, confocal, and electron microscopy.
Fundamentals of X-ray, NMR and cryo-electron microscopy for determination of biomolecular structure.

7) Genetics and Evolution
Chromosomal inheritance: Principles of Mendelian inheritance, codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, linkage and cross-over, sex-linked inheritance, Population Genetics and Hardy-Weinberg equilibrium.
Extrachromosomal inheritance: Maternal inheritance (mitochondria and chloroplast)
Gene concept: Allele, multiple alleles, pseudoalleles.
Genetic analysis: Linkage maps, mapping with molecular markers, tetrad analysis, gene transfer in bacteria: transformation, conjugation, transduction.
Mutation: Spontaneous, induced, lethal, conditional, reversion, mutagenic suppression, germinal and somatic mutation, insertion, deletion, duplication, translocation, transposition, ploidy.
Species concept in archaea, bacteria and eukarya.
Phylogenetic analysis and evolutionary relationship among taxa, MLST.

8) Genomics and Proteomics

Introduction to Genomics: Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; Computational analysis of sequences- finding genes and regulatory regions; Gene annotation; Similarity searches; Pairwise and multiple alignments; Alignment statistics; Prediction of gene function using homology, context, structures, networks; Genetic variation, polymorphism, deleterious mutation; Phylogenetics; Tools for genome analysis– PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing; Linkage and pedigree analysis; Construction of genetic maps; Physical maps, FISH to identify chromosome landmarks.
Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map, DNA sequence; DNA sequencing and sequence assembly; Model organisms and other genome projects; Comparative genomics of relevant organisms such as pathogens and non-pathogens; Evolution of a pathogen. Taxonomic classification of organisms using molecular markers -16S rRNA typing/sequencing. DNA Microarray technology, cDNA and oligonucleotide arrays; Applications: Global gene expression analysis, Comparative transcriptomics, Differential gene expression; Genotyping/SNP detection; Detection technology; Computational analysis of microarray data.
Proteomics: Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry; ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; clinical proteomics and disease biomarkers; Prions; proteins in disease; Protein-protein interactions: Solid phase ELISA, pull-down assays (using GST-tagged protein), far western analysis, by surface plasmon resonance technique, Yeast two hybrid system, Phage display; Protein interaction maps; Protein arrays-definition, applications- diagnostics, expression profiling.

9) Metabolism
Metabolic concepts:_Introduction to metabolic concepts. Gibbs free energy, Laws of thermodynamics,__High energy compounds, Phosphoryl transferase, oxidative phosphorylation and generation of ATP, chemiosmotic theory.
Carbohydrate metabolism: Pathways involved in carbohydrate metabolism such as Glycolysis, Citric acid cycle, Gluconeogenesis, Cori cycle, HMP shunt pathway, Glycogenesis and Glycogenolysis with reference to their regulation and energetic.
Amino acid metabolism: Deamination, transamination, decarboxylation, desulphuration, Ketogenic and glucogenic amino acids.Urea cycle, Regulation of amino acid biosynthesis
Lipid metabolism: Energetics of fatty acid degradation. Fatty acid biosynthesis. Cholesterol metabolism and its regulations. Regulation of blood cholesterol, triglycerides, LDLand HDL.
Nuclei Acid Metabolism: Synthesis and degradation of purines and pyrimidines and their regulation. Integration of metabolic pathways, metabolism of Xenobiotics.

10) Clinical biochemistry
Specimen collection and analysis : Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control. Normal values. Specimen collection and Processing: Collection of blood - venipuncture, skin puncture, arterial puncture. Anticoagulants. Collection and analysis of normal and abnormal urine - timed urine specimens, preservatives. Clinical significance of sugars, proteins, ketone bodies,

bilirubin and porphyrins. CSF - collection, composition and analysis. Amniotic fluid - Origin, collection, composition.

Disorders of carbohydrate, lipid and protein metabolism : Salient features and management of disorders related to carbohydrate, lipid and protein metabolism and their diagnostics.

Disorders of carbohydrate metabolism - glucose tolerance test, Glycogen storage diseases.

Disorders of lipid metabolism - fatty liver, obesity, atherosclerosis.

Disorders of protein metabolism - Haemoglobinopathies - sickle cell anaemia, thalassemia and erythrocyte enzyme disorders. Inborn errors of metabolism- Phenylketonuria, alkaptonuria.

Serum enzyme activities in diseases - Principle and assay of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, acid phosphatase, streptokinase, asparaginase, a,-hydroxybutyrate dehydrogenase, ceruloplasmin, y -glutamyl transpeptidase, creatine kinase and lactate dehydrogenase. Enzyme and isoenzyme as diagnostic tool, method for isoenzyme analysis.

Organ and organ function tests: Normal structure and functions of liver, diseases of the liver, hepatitis types, cirrhosis, alcoholic liver disease, hepatic tumor and bilary tract diseases, liver function tests, disorders of bilirubin metabolism. Renal function tests and related disorders: Acute and chronic renal failure, urinary tract obstruction and analysis of urinary calculi.

6. Chemistry (PHDCHEM)

PART A
RESEARCH METHODOLOGY

Objectives of research
Research methods versus Methodology
Types of research: Descriptive vs. Analytical; Applied vs.
Fundamental; Quantitative vs. Qualitative; Conceptual vs.
Empirical
Literature Review: Methods and Importance
Research design: Need, Types and Features of research design,
Formulating Research Problem
Collection and analysis of Data: Importance and Methods of
data collection, Data Analysis with Statistical Packages
Ethical issues in Research: Copy right, Intellectual Property
Rights; Plagiarism

PART B
Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.

5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex ; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. 5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, 1H &13C NMR and Mass spectroscopic techniques.

7. Geography (PHDGEOG)

PART - A
RESEARCH METHODOLOGY

Objectives of research; Research methods versus Methodology
Types of research: Descriptive vs. Analytical; Applied vs. Fundamental; Quantitative vs.
Qualitative; Conceptual vs. Empirical
Literature Review: Methods and Importance
Research design: Need, Types and Features of research design, Formulating Research Problem
Sampling Techniques: Probability and Non-probability sampling
Collection and analysis of Data: Importance and Methods of data collection, Data Analysis with

Statistical Packages
Use of Cartography, Remote Sensing, GIS and GPS in Geographical Research
Ethical issues in Research: Copy right, Intellectual Property Rights; Plagiarism

PART - B

GEOGRAPHY

Unit 1: Geographical Thought

Geography during the Ancient and Medieval Period, Foundations of Modern Geography:
Contribution of German, French, British and American Schools; Conceptual and Methodological Developments during the 20th Century, Dichotomy between Systematic Vs.
Regional Geography, Physical Vs. Human Geography, and Determinism Vs. Possibilism;
Areal Differentiation and Spatial Organisation, Quantitative Revolution, Impact of Positivism,
Humanism, Radicalism and Behaviouralism in Geography.

Unit 2: Geography of India

Physiography, Climate, Natural Resources: Vegetation, Soils, Water, Coastal and Marine,
Mineral and Power; Agriculture, Agro-Climatic Regions, Irrigation, Major Industries and
Industrial Regions, Population, Settlement Patterns, Urbanisation, Transport and Communication, Major Geographical Regions of India.

Unit 3: Methods and Techniques in Geography

Cartography, Remote Sensing, GIS and GPS: Map as a Tool in Geographical Studies,
Techniques Showing Spatial Patterns of Distribution, Types of Maps: Composite, Choropleth,
Isopleth and Chorochromatic; Accessibility and Flow Maps, Cartographic Representation of
Data, Computer Applications in Cartography, Symbolisation and Generalisation; Principles of
Remote Sensing, GIS and GPS; EMR, Platforms and Sensors, Elements of Image Interpretation, Components of GIS, Data Structure, Applications of Remote Sensing, GIS and
GPS in Geography.

Statistical Methods: Data Sources and Types of Data, Statistical Diagrams, Descriptive
Statistics, Measures of Central Tendency, Measures of Dispersion, Lorenz Curve and Gini
Coefficient, Correlation and Regression, Theory of Probability, Sampling Techniques and
Tests of Significance, Scaling: Ranking Method, Normal Distribution and Z-Score.

Unit 4: Physical and Human Geography

Geomorphology: Fundamental Concepts, Endogenic and Exogenic Forces, Geosynclines and
Mountain Building, Isostasy, Continental Drift and Plate Tectonics, Denudational Processes:
Mass Wasting, Weathering and Erosion; Cycle of Erosion and Evolution of Landscape:
Theories of Davis, Penck and King; Fluvial, Glacial, Aeolian, Karst and Coastal

Landscapes.

Climatology and Biogeography: Composition and Structure of the Atmosphere, Insolation and Heat Budget of the Earth, Temperature, Precipitation, Atmospheric Pressure and General Circulation of Winds, Monsoons and Jet Streams, Stability and Instability of the Atmosphere, Air-Masses, Fronts, Cyclones, Koeppen's and Thornthwaite's Classification of World Climates, Hydrological Cycle, Flood and Drought, Air Pollution, Global Warming, Human
Ecosystem, Bio-Diversity, Conservation and Management of Ecosystems.

Oceanography: Physical and Chemical Properties of Sea Water: Temperature and Salinity of the Oceans; Origin of Ocean Basins, Bottom Reliefs of Indian, Atlantic and Pacific Oceans, Ocean Deposits, Coral Reefs, Ocean Currents and Tides, Sea-Level Changes.

Population Geography: Distribution, Growth and Migration, Sex-Ratio, Literacy, Demographic Transition.

Settlement Geography: Site, Situation, Types, Size, Spacing and Internal Morphology of Rural and Urban Settlements, Urban Fringe, City Region, Umland, Settlement Systems, Primate City, Rank-Size Rule, Settlement Hierarchy, Christaller's Central Place Theory.

Economic Geography: Recent Approaches in Economic Geography, Location of Economic
Activities and Spatial Organisation of Economies; Classification of Economies; Sectors of
Economy: Primary, Secondary, Tertiary; Landuse and Landcover, Natural Resources: Renewable and Non-Renewable; Conservation of Resources.

Agricultural Geography: Concept and Techniques of Delimitation of Agricultural Regions; Measurement of Agricultural Productivity and Efficiency; Crop Combinations and
Diversification; Von Thunen's Model, Agricultural Regions of the World.

Industrial Geography: Classification of Industries, Weber's and Losch's Theories of Industrial Location, Resources-Based and Footloose Industries.

Geography of Transport and Trade: Models of Transportation and Transport Cost, Inter- Regional and Intra-Regional Accessibility and Connectivity; Comparative Cost Advantages.

Political Geography: Global Strategic Views (Heartland and Rimland Theories), Geopolitics, Concept of Nation, State and Nation-State, Boundaries and Frontiers, Politics of World Resources, Geography and Federalism.

Social Geography: Social Structure and Social Processes, Elements of Social Geography,
Ethnicity, Tribe and Caste, Concept of Social Well-Being, Environment and Culture, Concept of Culture: Areas and Cultural Regions, Dwelling Places as Cultural Expressions.

Regional Planning: Concept of Region, Types of Regions and Methods of Regionalisation, Regional Hierarchy, Regional Planning, Regional Planning in India, Concept of Development, Indicators of Development, Region

8. Geology (PHDGY)

Structure:

Section	Name of the Section	Sr.No.	Course Title
A	RESEARCH METHODOLOGY	1	Research Methodology in Geology
B.	DISCIPLINE SPECIFIC COURSES	2	Physical Geology and Geomorphology
		3	Structural Geology and Tectonics
		4	Stratigraphy and Palaeontology
		5	Mineralogy
		6	Petrology
		7	Georesources and Economic Geology
		8	Geochemistry
		9	Applied Geology

SECTION A. RESEARCH METHODOLOGY

1. Research Methodology in Geology: Definition, outcome and importance of geological research; theory and philosophy of research methodology in context to geology; emerging areas and interdisciplinary research in geology;
Identifying and defining research problem; techniques involved in defining research problem and identifying gaps; sources of literature; implications of literature collection and its review.
Preparation and planning for fieldwork; field kit and equipments; safety measures in field; field procedures and precautions taken during sampling; maintenance of field notebook; uses of topographical maps and satellite images; selection of traverses; recognition of geological features, rock types and stratigraphic contacts in field; use of clinometer compass, measurement of dip and strike of strata; measurements of geologic sections; uses of GPS; recording field observations in field notebook; geological mapping.
Data collection; sampling methods; data collection methods in sedimentology, palaeontology, stratigraphy, structural geology and tectonics, mineralogy, petrology, ore geology and hydrogeology; classification and presentation of data; role of statistics and computers in research; use of computer in data processing; methods of communicating and displaying analysed data; applications of Geographic Information System.
Thin section preparation; petrological and palaeontological microscopes; Ore microscopy; SEM microphotography; preparation of samples for geochemical and XRD analysis, heavy mineral separation; construction of lithologs; geophysical exploration methods, remote sensing data.
Intellectual property rights, patents, copyright and related rights; ethics-plagiarism and integrity.

SECTION B. GEOLOGY COURSES

2. Physical Geology and Geomorphology: Composition of the crust and Earth as a whole; basic concepts and significance of geomorphology; relationship between landforms and geomorphic processes- fluvial, aeolian, glacial, and marine; soils; geomorphology of India; applications of geomorphology; mountain building; volcanoes and earthquake; seismic belts of India.

3. Structural Geology and Tectonics: Classification of folds and faults; Mechanism of folding; concept of stress and strain and their geological significance; joints and unconformities. concept of plate tectonics; palaeomagnetism, polar wandering and reversal of Earth's magnetic field; sea-floor spreading, island arcs and mountain chains.

4. Stratigraphy and Palaeontology: Principles of stratigraphy, time scale and its divisions; stratigraphic classifications; stratigraphic nomenclature; stratigraphic correlation; facies concept in stratigraphy; marine transgression and regression; ice ages; broad stratigraphic subdivisions of India.
Fossil and modes of fossilization; application of fossils in age determination; evolutionary trends and geologic distribution of Brachiopoda, Pelecypoda, Gastropoda, Cephalopoda, Trilobita, Echinoids, Graptolites and Corals; elementary idea about the origin of major groups of vertebrates; evolutionary history of Horse, Elephant and Man; plant life through geologic ages.

5. Mineralogy: Physical and optical properties of minerals; classification of minerals; mineralogy of silicates, polymorphism, isomorphism and pseudomorphism; solid solution and exsolution; X-ray crystallography; concept of symmetry; crystallographic classification.

6. Petrology: Generation and evolution of magma; Bowen's reaction series; textures and classification of igneous rocks; phase equilibria: single, binary and ternary systems; silicate systems; genesis and tectonic setting of different magma types; cooling and crystallisation of magma.
Sedimentation, lithification and diagenesis; structures and textures; classification of sedimentary rocks; depositional environments; sedimentation and tectonics; heavy minerals and their applications in provenance studies.
Metamorphism and metamorphic processes; metamorphic differentiation; metamorphic facies; types of metamorphism and metamorphic rocks; metasomatism and anatexis.

7. Georesources and Economic Geology: Ore genesis; ore localisation and ore shoots; ore dressing and beneficiation; strategic, critical and essential minerals; national mineral policy; economic minerals of India; fossil fuels.

8. Geochemistry: Cosmic abundances of elements; geochemical classification and differentiation of the elements; trace element geochemistry; radiogenic and non-radiogenic isotopes; concept of geochemical and biogeochemical cycles and global climates.

9. Applied Geology:
Engineering Geology: Engineering properties of rocks; geological investigations,

seismic parameters and remedial measures related to the construction of dams, bridges, highways and tunnels; mass movements with special emphasis on landslides and causes of hill slope instability.

Mineral Exploration: Principles and methodology of geological prospecting for economic minerals and rocks; sampling methods, methods for estimating reserve and resources, grade and tonnage calculation of the deposits; pathfinder elements; geochemical and geophysical methods; mining in India.

Hydrogeology: Hydrological cycle; hydrological properties of rock; distribution of surface and groundwater in the Earth's crust; global water budget; movement of groundwater; aquifers classification and characteristics; Darcy's law; Theis equation; water table; flow nets; groundwater provinces of India; groundwater quality and pollution; groundwater prospecting; desalination; springs and its types.

Environmental Geology: Environment and energy; non-conventional energy resources; geoenvironment; environmental hazards, instrumentation and analysis; disposal of municipal, domestic, hospital, solid and nuclear wastes; oil spills; environmental impact assessment (EIA); environmental legislation: national/international standards; application of remote sensing and GIS in environmental management.

Remote Sensing and GIS: Electromagnetic radiation; aerial photographs and their geometry; elements of photo and image interpretation; satellite remote sensing; global and Indian space missions, sensor and their characteristics; digital image processing techniques; geological applications of remote sensing, GIS and GPS.

9. Life Sciences (PHDLS)

Syllabus for PhD (Life Sciences) Entrance Examination

PART-I (RESEARCH METHODOLOGY)

Research Methodology: An Introduction: Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research and Scientific Method; Importance of Knowing How Research is Done; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India.

Defining the Research Problem: What is Research Problem?; Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem; An Illustration.

Research Design: Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs Conclusion.

Issues in The Design and Conduct of Selected Research Designs: Descriptive Research – Descriptive Research: Main Steps, Correlation Studies: Basic Issues, Case Study Method; Observational Studies – Issues in the Design of Case-Control Studies, Issues in the Design of Cohort Studies; Experimental Research – Three Characteristics of Experimental Research, Steps Involved in Experimental Research, Design of experimental Study.

Sampling Design: Census and Sample Survey; Implications of a Sample Design; Steps in Sampling Design; Criteria of Selecting a Sampling Procedure; Characteristics of a Good Sample Design; Different Types of Sample Designs; How to Select a Random Sample; Random Sample from a Infinite Universe; Complex Random Sampling Designs.

Measurement and Scaling Techniques: Measurement in Research; Measurement Scales; Sources of Error in Measurement; Tests of Sound Measurement; Technique of Developing Measurement Tools; Scaling; Meaning of Scaling; Scale Classifications Bases; Important Scaling Techniques; Scale Construction Techniques.

Methods of Data Collection: Collection of Primary Data; Observation Methods; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Difference between Questionnaires and Schedules; Some Other Methods of Data Collection; Collection of Secondary Data; Selection of Appropriate Method of Data Collection; Case Study Method.

Processing and Analysis of Data: Processing Operations; Some Problems in Processing; Elements/Types of Analysis; Statistics in Research; Measures of Central Tendency; Measures of Dispersion; Measures of Asymmetry (Skewness); Measures of Relationship; Simple Regression Analysis; Multiple Correlation and Regression; Partial Correlation; Association in

Case of Attributes; Other Measures.

Sampling Fundamentals: Need of Sampling; Some Fundamental Definitions; Important Sampling Distributions; Central Limit Theorem; Sampling Theory; Sandler's *A*-test; Concept of Standard Error; Estimation; Estimating the Population Mean (μ); Estimating Population Proportion; Sample Size and its Determination; Determination of Sample Size through the Approach; Based on Precision Rate and Confidence Level; Determination of Sample Size through the Approach; Based on Bayesian Statistics.

Testing of Hypotheses-I (Parametric or Standard Tests of Hypotheses): What is a Hypothesis?; Basic Concepts Concerning Testing of Hypotheses; Procedure for Hypothesis Testing; Flow Diagram for Hypothesis Testing; Measuring the Power of a Hypothesis Test; Tests of Hypotheses; Important Parametric Tests; Hypothesis Testing of Means; Hypothesis Testing for Differences between Means; Hypothesis Testing for Comparing Two Related Samples; Hypothesis Testing of Proportions; Hypothesis Testing for Difference between Proportions; Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance; Testing the Equality of Variances of Two Normal Populations; Hypothesis Testing of Correlation Coefficients; Limitations of the Tests of Hypotheses.

Chi-square Test: Chi-square as a Test for Comparing Variance; Chi-square as a Non-parametric Test; Conditions for the Application of X^2 Test; Steps Involved in Applying Chi-square Test; Alternative Formula; Yates' Correction; Conversion of X^2 into Phi Coefficient; Conversion of X^2 into Coefficient by Contingency; Important Characteristics of X^2 Test; Caution in Using X^2 Test.

Analysis of Variance and Covariance: Analysis of Variance (ANOVE) What is ANOVA?; The Basic Principle of ANOVA; ANOVA Technique; Setting up Analysis of Variance Table; Short-cut Method for One-way ANOVA; Coding Method; Two-way ANOVA; ANOVA in Latin-Square Design; Analysis of Co-variance (ANOCOVA); ANOCOVA Technique; Assumptions in ANOCOVA.

Testing of Hypotheses-II (Nonparametric or Distribution-free Tests): Important Nonparametric or Distribution-free Test; Relationship between Spearman's *r*'s and Kendall's *W*; Characteristics of Distribution-free or Non-parametric Tests.

Multivariate Analysis Techniques: Growth of Multivariate Techniques; Characteristics and Applications; Classification of Multivariate Techniques; Variables in Multivariate Analysis; Important Multivariate Techniques; Important Methods of Factor Analysis; Rotation in Factor Analysis; *R*-type and *Q*-type Factor Analyses; Path Analysis.

Interpretation and Report Writing: Meaning of Interpretation; Why Interpretation?; Technique of Interpretation: Precaution in Interpretation; Significance of Report Writing; Different Steps in Writing Report; Layout of the Research Report; Types of Reports; Oral Presentation; Mechanics of Writing a Research Report; Precautions for Writing Research

Reports.

The Computer: Its Role in Research: Introduction; The Computer and Technology; The Computer System; Important Characteristics; The Binary Number System; Computer Applications; Computers and Researcher.

References

1. Research Methodology: Methods and Techniques – C.R. Kothari.
2. Research Methodology: Methods and Statistical techniques – Santosh Gupta.
3. Statistical Research Methods in the Life Sciences by P.V. Rao.
4. Research Methods – A tool for life by Bernared C. Beins.

PART-II (LIFE SCIENCES)

1. Cell & Molecular Biology

Cell as a unit of life? Schleiden and Schwann cell theory re-examined. Cell separation, sub-cellular fractionation. Properties of intact cells: regulation of cell shape, limitation of cell size, cellular movements, cell adhesion, cell junctions and the extracellular matrix, cell –cell adhesion and communication; cell matrix adhesion, collagen the fibrous protein of the matrix, noncollagen component of the extracellular matrix;, the cytoskeleton, the nature of cytoskeleton,intermediate filaments, microtubules, microfilaments, actin filaments, cilia and centrioles, organization of the cytoskeleton, tissue organisation.

Biological membranes, integral membrane proteins, lipoproteins, phospholipids and trafficking through membrane. Membrane structure, energetic and biosynthesis. Cell growth and division, overview of the cell cycle and its control, the molecular mechanisms for regulating mitotic events, cell cycle control in mammalian cells, checkpoints in cell cycle regulation. The Cell nucleus: Nuclear envelop, Nuclear pore complex, Nucleocytoplasmic transport, Nucleolus, chromosomes, karyotypes, Heterochromatin and euchromatin, lampbrush chromosomes and Polytene chromosomes.

Conformation of nucleic acid- DNA (A, B, Z-DNA), RNA (mRNA, tRNA, rRNA) and micro RNA. DNA replication- General features, DNA Polymerases in prokaryotes and eukaryotes, DNA replication in prokaryotes and eukaryotes. Genetic code: Properties, Wobble hypothesis. Protein Synthesis a) Transcription in prokaryotes and eukaryotes, RNA processing b) Translation: Initiation, elongation and termination of polypeptides, Modification and folding of released polypeptide, Protein translocation across membrane.

Organelles of eukaryotic cells: the lysosomes, peroxisomes, the Golgi apparatus, endoplasmic reticulum. Mitochondria and chloroplast, Structure of the mitochondria and chloroplast, oxidation of glucose and fatty acids, electron transport and oxidative phosphorylation. chloroplast and photosynthesis. Organelle biosynthesis, protein sorting: organelle biogenesis and protein secretion, synthesis and targeting, of mitochondrial chloroplast, peroxisomal proteins and translational modification in the ER. Intracellular traffic, vesicular traffic in the secretary pathway, protein sorting in the Golgi, traffic in the endocytic pathway, exocytosis.

Suggested reading:

1. Molecular Biology of the Cell-Alberts *et al* (5^{th} edn. 2007 or later Recent Edition)
2. The Cell: A molecular approach-Cooper and Hausman
3. Molecular Cell Biology Lodish *et. al*. (6^{th} edn, 2008 or later Recent Edition)
4. Genes IX. Lewin (2008 or later Recent Edition),
5. Molecular Biology of the Gene. Watson *et. al*. (6^{th} edn. 2009)
6. Cell Biology (Cell & Molecular Biology)- F Sheeler, 6^{th} Edition John Wiley & Sons.

2. Genetics & Molecular Evolution

What is gene?: Introduction and recapitulation: scope of genetics; DNA as genetic material; basic structure of DNA and RNA; DNA replication: Messelson and Stahl Experiment, Carins Experiment, Okazaki experiment, basic mechanism of DNA replication; cell division and cell cycle: mitosis, meiosis, chromosomal basis of inheritance; basic principles of Mendelian Inheritance: segregation and independent-assortment, alleles and multiple alleles, human pedigrees and inheritance. Gene Interaction: Sex determination and sex-linked inheritance, sex-determination in humans, *Drosophila* and other animals, sex-determination in plants, sex-linked genes and dosage compensation of X-linked genes, human genetics: pedigree analysis.

Linkage analysis and gene mapping in eukaryotes, coupling and repulsion phases; crossing-over and recombination. Benzer's experiment: Fine Structure of gene and gene concept. Chloroplast and Mitochondrial inheritance: yeast, *Chlamydomonas/ Neurospora* and higher plants.

Microbial Genetics: modes of genetic exchange in microbes, transformation, transduction, conjugation, evolutionary significance. Mutations, spontaneous and induced mutations, chromosomal mutation and aberrations, change in chromosome number: trisomy and polyploidy. Evolutionary history of bread wheat, aneuploids –Nullisomics and monosomics, somatic aneuploids, changes in chromosome structure, properties of chromosomes for detection of structural changes, Main type of changes– transitions, transversions and substitutions, deletions, duplications and inversions. Mechanism of chromosome mutations, genetic and cytological features of deletions, duplications, inversions, translocations, somatic vs germinal mutation.

Population genetics: application of Mendel's laws to whole population, calculation of allele frequencies, Hardy -Weinberg principle for calculating recessive gene frequency, calculating frequency of sex –linked alleles.

Genes and genome organisation. Transposons and retrotransposons. Epigenetics. Principles & applications of genetic engineering; tools and techniques; cloning vectors &expression vectors; Biosafety .

Introduction to molecular evolution: a brief history of the pre DNA era, gene structure, genetic code and mutation. Dynamics of genes in population, random genetic drift, genetic polymorphism, Neo Darwinian theory, evolution of finite and structured population, evolution of dip bit populations. Evolutionary change in nucleotide re-genesis, nucleotide substitution, divergence between DNA sequences. Molecular phylogenetics, methods and examples, molecular clocks, concerted evolution of multigene families, DNA polymorphism. Factors influencing molecular evolution, Role of mutation and selection in molecular evolution.

Genome organization and evolution, evolution of prokaryotic and eukaryotic genomes, C value paradox, tandem repetitive sequences. Cell theory. Evolution& selection, Lamarkism, Darwin's contributions .Pattern of Evolution. Process of evolution: natural & artificial. Constraints & trade offs. Genetic drift and role of chance. Gene flow. Gene flow versus drift. Natural selection versus sexual selection. Speciation, allopatry, sympatry, peripatry and parapatry.

Suggested reading:

Genetics

1. Introduction to Genetic Analysis, by Griffiths *et al,* (9th edition.2008 or later edition)
2. Concepts of Genetics, by Klug *et al* (9 th Edition, 2009, or later edition)
3. Principles of Genetics by Snustad *et a*l (2004 Ed. or later edition)

Evolution

1. Evolutionary genetics, John Maynard Smith, Oxford University Press, New York, 1998.
2. Genes and Evolution, A.P. Jha, Mc Graw Hill Publishers, New Delhi, 1993.
3. Molecular Cell Biology 5th Edition, Lodish *et al*., 2004, W.H. Freeman and Company, New York.
4. The World of the Cell Becker, Klein smith and Hardin, 5th Edition, 2004, Pearson Education Pvt. Ltd.

3. Ecology

Introduction to ecology. Interaction between environment and biota, Evolutionary ecology and molecular ecology, environmental concepts – laws and limiting factors, ecological models. Ecological concept of species: Autecological level (genecology), Synecological level (Ecosystem level). Ecads (Ecophenes), Ecotypes, Ecospecies. Concepts of Ecosystems: Types – Fresh water, marine and terrestrial – Nature and components of ecosystem – Application of laws of thermodynamics, productivity, food chain, food webs, trophic levels, energy flow through ecosystem, resilience of ecosystem, ecosystem management. The biosphere, biomes, ecological pyramids and recycling.

Plant community: Concept. Methods of study of communities–Floristic, Physiogenomic and Phytosociological methods. Classification – Raunkiaer's and Clements systems, individualistic concept of Gleason, Vegetation continuum concept of Whittaker and Curtis, Ecotone, Ecological succession on land and water. Characteristics of population, population size and exponential growth, population dynamics, life history pattern, fertility rate and age structure. Competition and coexistence, intra-specific and inter-specific interactions, scramble and contest competition model, mutualism and commensalisms, prey-predator interactions.

Phytogeography**;** Definition of static and dynamic phytogeography**,** Geological history and evolution of plant and animal life**,** Factors of distribution of plants and animals. Theories concerning present and past distribution – continental drift, glaciations, existence of land

bridges and their effect on distribution of species, Phytogeographic regions of world (Vegetational belts),Soil, climate, flora and vegetation of India.

Ecological adaptations in plants and animals: Deserts (Dry and Cold,), Tundra, Grassland, Savannah, temperate forest, tropical rain forest, mangroves, Fresh water, marine and estuaries. Environmental Stresses and their management, global climatic pattern, coping with climatic variations.

Environmental Laws and International Conventions: Environmental Impact Assessment, Forest (Conservation) Act and Wildlife (Protection) Act and their amendments, Environment (Protection) Act, Biodiversity Act, Convention on Biological Diversity and Kyoto Protocol, Montreal Protocol and Cartagena Protocol, Ramsar Convention on Wetlands. CITIES, India's Protected Area Network, Project Tiger and Ganga Action Plan, National Environmental Policy, Biodiversity Action Plant, Concept of Ecotourism and Ecocities.

Pollution : Major classes of contaminants; causes, effects and preventive measures of air, water, soil and radiation pollution; atmospheric ozone, ozone layer depletion; biotransformation, detoxification, elimination and accumulation of toxicants. Biomagnification. Pesticides and other chemicals in agriculture and industry. Impact of pollutants on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals, biosafety and climate change.

Suggested Literature:

1. Fundamental Processes in Ecology: An Earth system Approach, Wilkinson, D.M., (2007 or latest edition), Oxford University Press, UK.

2. Addision, M.J.. Ecology: An Evolutionary Approach, Wesley Publishing Co. New Delhi. (1984 or latest edition) Arora,. Fundamentals of Environmental Biology. (1995 or latest edition) Kalyani Publishers, New Delhi.

3. Chapman.. Ecology – Principles and Applications. (1999 or latest edition) Cambridge University Press. Foundation Books, New Delhi

4. Jeffrey. D.W. 1987. Soil Plant relationship – An ecological approach. Croom Helm.

5. Krishnamurti, C. R. and Viswanathan, P. (Eds.). Toxic metals in the Indian Environment. (1991 or latest edition). Tata McGraw Hill Publishing Co. Ltd. New Delhi.

6. Mackenzie, A. Ball, A.S. and Virdee S. R.Instant notes in Ecology. (1999or latest edition).Viva Books Pvt. Ltd., New Delhi.

7. Trivedi, P.R. and Gurudeep Raj.. Environmental Biology. (1995 or latest edition). Akashdeep Publishing House, New Delhi.

4. Microbiology

History and Development of Microbiology. Microbial evolution, systematics and taxonomy-evolution of earth and earliest life forms; primitive organisms, their metabolic strategies and molecular coding. Changing concepts in microbiology taxonomy, Bergey's manuals, earlier systems, molecular taxonomy and ribo typing of microorganisms, Jackard's similarities coefficients. Historical development of microbiology, general techniques in microbiology. The microbial cell: general organization of cell, prokaryotes, eukaryotes and Archaea, cell wall organization of prokaryotes, eukaryotes and Archaea, cell surface appendages-pilli, locomotion by flagella chemotactic movement, peptidoglycan synthesis - inhibitors in different steps. Bacterial plasmid and its significance.

Viruses –structure, chemical composition and replication, classification, interferons. General account of Mycoplasma. Growth, recombination, growth kinetics and regulation, effect of environmental factors on growth e.g., pH. temperature, oxygen, nutrient limitations and nutrition: batch and continuous cultures, nutritional classification of microorganisms,nutritional uptake by microorganisms (C.N.P).

Metabolic Pathways: metabolic versatility of microbes, anaerobic carbon metabolism: anaerobic respiration, sulphate respiration, reference to glycolysis, fermentation – diverse fermentation products, putrefaction, methane oxidizing and methanogenic bacteria, aerobic carbon metabolism: TCA cycle, alternative metabolic pathways. Energy Metabolism: chemo autotrophs, hydrogen bacteria, phototrophic bacteria/cyanobacteria.

Advanced Bacterial Metabolism: recent advances in unusual bacterial metabolism pathways. Microbes in extreme environment: The basis of extremophiles and their applications, thermophile and halophiles. Quorum sensing in Bacteria: gram negative bacteria: LUXI LUXR-Type: gram positive bacteria: peptide mediated quorum sensing. Microbial Diseases-disease reservoirs; epidemological terminologies; infectious disease transmission; respiratory infections caused by bacteria and viruses; tuberculosis; Sexually transmitted diseases including;disease transmitted by animals(rabies),insects and ticks (rickettsias, malaria) food and water borne diseases; public health and water quality; pathogenic fungi; Emerging and resurgent infectious diseases.

Host Parasite Relationships-Normal micro flora of skin, oral cavity, gastrointestinal tract; entry of pathogens into the host; colonization and factors predisposing to infections; types of toxins (exotoxin, endotoxin and entreotoxin) and their structure; mode of actions. Biochemical, physiological. Genetic aspects of symbionts, Physiology and Molecular Biology of symbiosis; nonspecific and specific defense mechanisms. Mechanism of pathogenesis, host factors influencing resistance to infection. vaccination

Chemotherapy and Antimicrobial agents; Sulfa drugs; Antibiotics; Pencillins and Cephalosporins; Broad-Spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics. Application of Microbiology in industrial, agriculture and waste water management: symbiotic nitrogen fixation, *Rhizobium, Azotobacter, Cyanobacteria (Anabaena, Azolla etc.), Mycorrhiza* and VAM fungi, Siderophores and other PGRs. Major industrial products from microbes, beverages, antibiotics, secondary metabolites and recombinant products. Biodegradation by microbes, sewage pollution control, control of oil spills, superbugs**.**

Suggested reading:

1. Microbiology, J.G. Cappuccino, N. Sherman, Pearson Education Publications.
2. Essential Microbiology, Stuart Hogg, John Wiley and Sons Limited.
3. Microbiology: A Human Perspective, E.W. Nester, D.G. Anderson, C.E. Roberts, N.N. Pearsall, M. T. Nester Mc Graw Hill Higher Education.
4. Manual of Environmental Microbiology, C. J. Hurst, R.L.Crawford, G.R.Knudsen, M.J. McInerney, L.D. Stetzenbach,, ASM Press.
5. Microbiology, L.M. Prescott, J. P. Harley, D.A., Klein, Mc Graw Hill International Edition.
6. General Microbiology. H.G. Schlegel, Cambridge University Press.
7. Dube RC and Maheshwari, D.K. – S. Chandpal.

5. Immunology

Introduction to Immune system – Innate and Acquired Immunity (natural and adaptive immune responses); Natural Immunity: Mechanism of barriers to entry of microbes into human body. Physical barriers (skin, mucous); chemical barrier; cellular barriers; inflammation.
In cellular barrier – Monocyte; macrophages – TLR receptors and PAMPS, signal transduction, opsonization, Eosinophils – parasitic infection and role of eosinophils; Basophils, Mast cell; Neutrophils; NK cell.
Inflation - Inflammatory reaction, migration of neutrophils to the site of infection, prostaglandins, leukotriens. Adaptive Immunity: Lymphocytes- (T. cell, B. cell). Dendritic cells; humoral and cell mediated immunity, clonal selection; lymphoid organs.

Antigens – Structure, properties, types, haptens; Antibodies – Structure, types and their biological functions. Hybridoma technology and monoclonal antibody production, application; Antibody engineering Chimeric antibody, Abzymes (catalytic antibody).

Antibody – antigen interactions/techniques – Complement and lytic reaction, complement fixation test, precipitation, immuno diffustion, agglutination, RIA, ELISA immune fluorescence. MHC genes, MHC complex (organization of H_2 + HLA complex, class I and class II MHC molecules). Antigen presenting cells (APC), Antigen processing and presentation (cytosolic and endocytic pathways)

B Cell receptors, maturation, editing, activation and differentiation. T. Cell receptor (?, ?, γ, δ) thymic selection of T. Cell APC – T. Cell interaction, T. Cell activation, super antigens, role of cytokines. Cytoxictiy – T.Cell mediated cytotoxicity, NK cell mediated cytotoxicity, ADCC (antibody directed ecelluar cytotoxicity)

Transplantation Immunology. Tumor Immunology (Tumor antigen, Tumor escape). Immunological disorder – Hypersensitivity (Type I, II, III, IV) Auto Immunity, Immuno deficiencies.

Suggested reading

1. A Text book of Immunology – P. Madhavee Latha.
2. Text book of Immunology – C.A. Bona and FA Bomlla
3. Basic Immunology by Jacqueline Sharon.
4. Immunology by Ivan Roitt, Janathan Brostoff and David Male.

6. Biochemistry

An overview of Biochemistry, cellular environment and applicability of basic laws of chemistry and thermodynamics. Concept of small and macromolecules, molecular interactions and their importance in understanding cellular processes. Monosaccharides and derivatives of sugars, polysaccharides, glycosaminoglycans, proteoglycans, protein glycosylations and its significance.

Primary characterization of proteins, isolation and chromatographic purification of proteins, ultracentrifugation, sequence determination, mass spectrometry. Structure of amino acids and peptide bonds, Ramachandran Plot, alpha helical and beta pleated structures, structures of fibrous proteins like keratin, fibroin, elastin and collagen. Dynamics of protein structure, protein structure, protein stability, globular proteins and maintenance of specific confirmation, structural motifs commonly found in various proteins and their functional relevance. Basic concepts of protein folding, folding pathways, role of accessory proteins in protein folding. Fatty acids, triacylglycerols, glycerophospholipids, sphingolipids, cholesterol lipid bilayers.

Macromolecules:, proteins, polysaccharides, lipids, glycoproteins, glycolipids, lipoproteins, lipopolysaccharides, protein modifications and their functional implications. Enzyme catalysis, specificity of enzyme action, coenzymes and vitamins. Classification of enzymes, factors affecting enzymes activities, feedback and allosteric inhibition. Chemical kinetics and order of reactions, Michaelis and Menten equation, V max and Michaelis constant double reciprocal plots. Mechanisms of acid base, covalent, metal ion catalysis. Types of inhibitions, reversible (competitive, uncompetitive and non-competitive) and irreversible inhibitions, bisubstrate reaction.

Metabolism: basic concepts, central role of ATP in metabolism, carbon fuel and its oxidation, concept of energy rich compounds and intermediates, common types of reactions involved in metabolism. ATP synthesis and chemiosmotic hypothesis of ATP generation. Glycolysis and gluconeogenesis, energetics and ATP productions. Regulation of glycolysis, glycogen synthase, metabolic flux and its regulation by various metabolic intermediates. Different Metabolic Pathways: metabolic versatility of microbes, anaerobic carbon

metabolism: anaerobic respiration, sulphate respiration, reference to glycolysis, fermentation – diverse fermentation products, putrefaction, methane oxidizing and methanogenic bacteria, aerobic carbon metabolism: TCA cycle alternative metabolic pathways.

Redox reaction, mitochondrial structure and its role in energy metabolism, electron transport system and oxidative phosphorylation. Pentose phosphate pathway and its importance in biosynthetic reactions. Glycogen synthesis, breakdown and its regulation. Fatty acid biosynthesis and degradation. Amino acid metabolism, urea cycle, one carbon reaction, nonprotein amino acids, amines and their role in cell function. Nucleotide biosynthesis and degradation, salvage pathways, its regulation and diseases.

Suggested reading:

1. Biochemistry (5 th Edition) by Jeremy Berg, John Tymoczko and Lubert Stryer.

2. Biochemistry (3 rd Edition) by Donald J. Voet and Judith G. Voet.

3. Lehninger Principles of Biochemistry (4 th Edition) by David L. Nelson and Michael M. Cox.

7. Biophysics

Introduction, interaction in biological systems, feedback mechanism. Elementary quantum mechanics and its application in biological system. Biological membrane, movement of ions across cell membrane, electrochemical equilibrium; genesis of membrane potential; properties of excitable membrane; action potential and its propagation, conduction velocity. Voltage clamp, introduction to patch clamp.

Mechanism of muscle contraction, muscle energetics. Lung mechanics, diffusion of gases, surface tension, role of surfactant. Heart and circulatory system, electrical and mechanical activity of heart, mechanics of blood flow in blood vessels, cardiac work, mechanical efficiency of heart. Geometrical optics of vision, refractive defects of eye and its rectification, mechanism of hearing.

Introduction to radiation biology; non-ionising and ionising radiation, isotopes, radiation measurement; radiation hazards, radiation evaluation; control and regulatory aspects of safety. Physical measurements in biology; surface tension, viscosity, diffusion, sedimentation, electrophoresis, diffraction; microscopic techniques, electron microscopy; introduction to NMR.

Use of computers in biology, systems and application, Software, data acquisition system and analysis using software.

8. Biostatistics

Introduction to Biostatistics, Biological Data: Brief history; Population, Variables; Sampling: Representative samples, size of sample, Random & non random samples, stratified samples; Introduction to software used in Biostatistics – SPSS; INSTAT; EXCEL.

Types of Data: Primary and Secondary data; Qualitative and Quantitative; Frequency Distributions; Frequency tables; Presentation of Data: Graphical presentation, Frequency Polygon, Histogram, Bar Diagram, Pie Diagram, Pictogram, Cumulative Frequency curves.

Measures of Central Tendency and Variability: Mean: Arithmetic mean grouped and ungrouped data; Weighted mean; Mode: Grouped and ungrouped data; Median: Grouped and ungrouped data; Range, Standard deviation, variance, coefficient of variation, standard. error.

Normal Distribution: Characteristics; Areas under curve; Z – value.

Probability and Binomial Distribution: Probability: Independent events, addition and multiplication rules, conditional probability; Binomial Distribution.

Correlation and Regression: Bivariate data; Scatter plot; Pearsons correlation coefficient (r): determination and interpretation; Linear regression; Regression coefficient; Fitting regression lines.

Hypothesis Testing: Null and Alternate Hypothesis, Type I and II error; Parametric and non parametric tests; Tests of Significance, small samples (t – Test), large samples (Z – Test) degree of freedom; X^2 – Test, contingency tables; $\propto$ – levels, interpretation of test results.

ANOVA: One way; Two way; F – Test.

Application and Practice: HMM; Vital statistics.

Suggested Books for Biostatistics

1. Gould JF and Gould GF, 2001. Biostatistics Basics: A Student Hand Book. W.H. Freeman Co.
2. Campbell RC 1989 – Statistics for Biologists. Cambridge University press.
3. Sokal RR and Rohlf- An Introduction to Biostatistics W.H. Freeman and Co.
4. Bailey NTJ – Statistical Methods in Biology English University Press.
5. Mitchell K & Glover T. Introduction to Biostatistics McGraw Hill Publishing Co.
6. Zor JH – Biostatistical Analysis Prentice Hall Internal Edition.
7. Gupta SP – Statistics methods, Sultan Chand & Sons.

9. Animal Diversity (Animal Life: Form & Function)

Origin and outline classification of non-chordates and chordates (including Onychophora) along with adaptive radiations. Geological time scale and fossils. Minor phyla:- concept of significance (Mesozoa, Echiuroidea, Rotifera, Ctenophora, Rhyncocoela), organization and general characters.

Organization of the coelom:- Acoelomates, pseudocoelomates, coelomates (Protostomia and Deuterostomia); Interrelationships of Hemichordata, Urochordata and Cepahalochordata and their relations with other deuterostomes; Life histories of sessile and pelagic *Pyrosoma, Salpa, Doliolium and Oikopleura.*

Integument:- cuticle, chitin, scales, feathers, hair, dermal glands. Exoskeleton and endoskeleton:- jaw formation, gill arches, chondrocranium. Locomotion:-pseudopodia, flagella and ciliary movements in Protozoa; Hydrostatic movements in coelenterates, annelids, and echinoderms. Fins, wings quadripedal and bipedal locomotion.

Nutrition and Digestion in invertebrates and vertebrates:- patterns of feeding and digestion in lower metazoans; filter feeding in polychaetes, molluscs and echinoderms, amphioxus. Alimentary canal and its modification in vertebrates, Digestive glands.

Respiration in invertebrates and vertebrates; surface, cutaneous, gills, book lungs, trachea, lungs, air sacs, swim bladder.

Excretion Organs of excretion-coelom, nephredia, Malphigian tubules; fish to mammals-protonephridia to metanephridia, modifications of the kidney.

Circulation of body fluids invertebrates to vertebrates, open to closed circulation; evolution of heart and aortic arches; portal system.

Nervous system primitive nervous system- coelenterates and echinoderms; advanced nervous system in annelids, insects, crustaceans and cephalopods. Trends in neural evolution (basic plan to cepahlisation). Vertebrates- evolution of brain.

Reproductive system asexual to sexual in invertebrates and vertebrates; oviparous, ovoviviparous and viviparous. Larval forms of free living invertebrates, larvae of parasites, strategies and evolutionary significance of larval forms.

Suggested Reading Material for Invertebrates

1. Invertebrate Zoology Barnes, RD. W.B.Saunders Co., Philadelphia
2. A Biology of higher invertebrates, Russel-Hunter, WD. McMillan Co. Ltd., London
3. Text book of Zoology. Parker, T.J., Haswell. W.A.Macmillan Co., London.

Suggested Reading Material for Chordates

1. Text book of Zoology. Parker, T.J., Haswell. W.A.Macmillan Co., London.
2. The Biology of Hemichordata and Protochordata. Barrington, E.J.W. Olter and Boyd. Edinborough.
3. Comparative anatomy of vertebrates. Kent. C.G.
4. Chordata morphology. Malcom Jollie. East-West Press Pvt.Ltd., New Delhi.
5. The Chordates. Monielli. A.R.Cambridge University press. London.
6. Life of Vertebrates, Young. J.Z. The Oxford University Press. London.
7. Elements of Chordate Anatomy, Weichert. C.K. and Presch W. McGraw hall Book Co., New York.
8. Chordata structure and function. Waterman. A.J.Macmillan Co. New York.

10. Animal Physiology

Tissue system and their functions: Epithelial tissue, Connective tissue, muscular tissue and Nervous tissue. Principles of physiology: relationship between structure and function, Adaptation, Acclimatization, Acclimation, Homeostasis, Feed-back control systems, Conformity and Regulation. Environmental stress.

Neurophysiology:- ion transport across nerve cell membrane, electrophysiology, conduction of nerve impulse; sensing the environment- photoreceptors, mechanoreceptors, electroreceptor, chemoreceptor, thermoreceptor. Nervous system –CNS and PNS; special senses-eye, ear, smell, taste. Muscle and animal movement: biochemistry of contraction in skeletal, cardiac and visceral muscles; neuromuscular control.

Respiratory system: respiratory pigments, transport of gases in blood, regulation of body pH, respiratory response to extreme conditions like hypoxia, diving and exercise (effect on enzymes and membranes). Physiology of respiration (mammals) and neural regulation breathing.

Circulatory systems: general plan, electrical and mechanical properties of myogenic and neurogenic hearts. Cardiac cycle; regulation of heart beat and blood pressure and electrocardiogram, Haemodynamics; cardiovascular response to extreme conditions like exercise, diving and hemorrhage. Neural regulation of cardiovascular system; peripheral circulation.

Endocrine system: Glands and Hormones: Secretory mechanisms, Endocrine and Neuroendocrine systems in insects and vertebrates. Molecular mechanism of hormone action. Physiological effects of hormones.

Excretion and Osmoregulation- osmoregulators and osmo conformers, obligatory exchanges of ions and water. Osmoregulation in aquatic and terrestrial environment. Physiology of mammalian and nonmammalian kidneys.

Digestive system: Acquisition of Energy:, Digestion (motility and Secretions), Metabolism, and absorption, Physiology of gastrointestinal system (insects and mammals) including neural and hormonal regulatory mechanisms.

Energetics of metabolism expenditure: Body size and metabolic rate, Energetics of locomotion, body rhythms. Thermoregulation: Temperature dependence of metabolic rate, determinants of body heat and temperature, thermal biology of ectotherms, heterotherms and endotherms; hibernation, torpor, aestivation.

Reproductive system: Gametogenesis and its hormonal control, Fertilization, Capacitation; energetics of reproduction.

Suggested reading:

1. Text Book of Medical Physiology (latest edition) by Guyton
2. Animal Physiology: Adaptations and Environment by Knut.S Nielsen.
3. Principles of anatomy and physiology by Tortora Gabowski (10th edition or latest).
4. Physiology by Shermann.
5. Comparative Physiology by Prosser and Brown (Latest edition).

11. Animal Developmental Biology

Principle of Developmental biology: Question and Approach in developmental biology, Evaluation of developmental patterns, Principles of experimental embryology, Genomic equivalence. Identification of developmental genes, mutant screening, developmental mutations in Drosophila. **Cleavage and gastrulation:** of invertebrates and vertebrates (helminthes, insects, amphibians and mammals) axes and germ layers, cell adhesion.

Phenomenon of organizer: with special reference to amphibians: progressive determination, Regional specificity of induction, Neural tube formation, Cell migration. **General concepts of organogenesis:** Morphogenetic process in epithelia and mesenchyme in organ formation. Morphogenesis of brain, neural crest cells and their accessory organs. Insect imaginal disc – determination of wing and leg imaginal discs, organizing centre in patterning of the wing, butterfly wing development, homeotic selector genes for segmental identity. Development of compound eye, heart and kidney (Ureteric and mesenchymal tubules).

Metamorphosis: Progressive, retrogressive, cyclomorphosis (invertebrate and vertebrate)

structural and physiological changes during metamorphosis. **Embryonic Adaptations:** Evolution of cleidoic egg and its structural and physiological adaptations. Development and physiology of extra embryonic membranes in amniotes. Development, types and physiology of mammalian placenta.

Regeneration and differentiation: Types of regeneration – Epimorphic (eg. Salamander limbs), Morphallactic (eg Hydra), Compensatory (eg. Mammalian liver); Morphological and histological processes in amphibian limb regeneration. Origin of cells for regeneration and differentiation. Embryonic stem cells and their applications.

Invertebrate model organisms: *D. melanogaster, C. elegans* – Identification of developmental genes, origin of anterior/posterior and dorsal/ventral patterning, role of maternal genes, zygotic genes, segmentation genes, gap genes – the paired rule genes, homeotic selector genes. **Vertebrate model organisms:** *X. laevis*, chicken, mammals – Patterning vertebrate of limb, signaling in patterning of limb, homeobox genes in patterning.

Growth–cell proliferation, aging, and cancer genes–involved in timing of senescence.

Suggested reading

1. An introduction to Embryology by Boris Ivan Balinsky.
2. Developmental Biology by Scott F Gilbert.
3. Principles of Development by Tickle, Martinez, Arias Worpert.
4. A text book of general embryology. Kellicott and William Erskine.

12. Plant Diversity I: Phycology

Principles of classification (Fritz and Smith).Modern trends in taxonomy of Algae (Lee). Emphasis on Prochlorophyta (Prochloron). Diversity in organism and cell structure, thallus and morphological variations. Reproduction and life cycle patterns (in different group of algae). Diversity distribution and Economic importance of algae in industry, agriculture, medicine and food. Role of algae in bioremediation, and mariculture.

Mycology

Principles and modern trends in taxonomy and classification of Fungi. Structure, reproduction and phylogeny of Oomycota, Zygomycota, Ascomycota and Basidiomycota. Diversity distribution and economic importance of fungi (industry, medicine, agriculture including food). General account of Lichens.

Bryophyta

General characters and systems of classification. Contributions of Indian Bryologists. A

general account of morphological and anatomical features, reproduction, life history and phylogeny of Liverwort , Hornwort and Mosses. Origin and evolution of Bryophytes, Fossil bryophytes (Brief mention). Diversity distribution and economic importance of bryophytes.

Pteridophyta

General characters, classification (modern trends) and life cycle of Peteriophytes. Structure and evolutionary trends, stele and spore morphology. Telome concept Pteridophytes. Comparative morphology, structure, reproduction and phylogeny of the following Groups: Psilopsida, Lycopsida,Sphaenopsida,Pteropsida. Fossil Pteridophytes-*Rhynia, Lepidocarpon, Sphaenophyllum, Zygopteris.* Apospory, apogamy and parthenogenesis. Diversity, distribution and economic importance of pteridophytes.

C. Gymnosperms

General characters, distribution, phylogeny, classification and economic importance of Gymnosperms. Structural details of vegetative and reproductive parts, phylogeny and interrelationships of the following. *Cycadofilicales, Caytoniales, Bennettitales, Pentoxylales, Cycadales, Ginkgoales, Coniferales,Gnetales.* Diversity distribution and economic importance of gymnosperm.

References

Phycology

1. Bold, H.C. Wynne, M.J. 1985. Introduction to the Algae. Prentice Hall of India, New Delhi.
2. Chapman, V.J. Chapman, D.J. 1975. The Algae Macmillan India Ltd., Delhi.
3. Fritsch, F.E.1945. Structure and reproduction of Algae, Cambridge University Press.
4. Kumar, H.D. 1999. Introductory Physiology, Affiliated East West Press Pvt. Ltd. Press. New Delhi.
5. Pandey, B.P.1994. Algae. S. Chand & Company Ltd. New Delhi.
6. Round, F.E. 1984. The Ecology of Algae. Cambridge University Press.

Mycology

1. Ainsworth, G.C., Sparrow. K.E. and Sussman. The Fungi. Academic Press, New York.
2. Alexopoulos, C.J., Mims, C.W. Blackwell, M. 1996. Introductory mycology. John Wiley & Sons., New York.
3. Bilgarmi, K.S. and Verma, R.N. 1994. Physiology of Fungi. Vikas Publishing House Pvt. Ltd. New Delhi.

4. Dube, H.C. An Introduction to Fungi. Vikas Publishing House, New Delhi.

5. Hale, M.E. 1983. Biology of Lichens. Edward Arnold. – D.D. Awasthi

6. Moore, D.et al., 1986. Developmental Biology of higher Fungi

7. Sharma, O.P. Text book of Fungi. Tata McGraw Hill Publishing Co.Ltd. New Delhi.

8. Webster, J.1975. Introduction to Fungi. Cambridge University Press.

9. Agrawal – Mehrotra.

Bryophyta

1. Cavers, F. 1976. The Inter relationship of the Bryophyta. S.R. Technic (Book House), Ashok Rajpath, Patna.

2. Dyer, A.F. and Duickett, J.G. (Ed.). 1984. The experimental Biology of Bryophytes. Academic Press.

3. Parihar. N.S.1980. An Introduction to Embryophyta Vol. I. Bryophyta. Central Book Depot.

4. Prem Puri, 1981. Bryophytes: Morphology, Growth and differentiation. Atma Ram and Sons, New Delhi.

5. Vashishta, P.C. 1999. Bryophyta. S. Chand & Co. New Delhi.

Pteridophyta

1. Eames, E.J. 1983. Morphology of vascular plants. Standard University Press.

2. Rashid, A. 1999. Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.

3. Sharma, O.P. 1990. Textbook of Pteridophyta. Macmillan India Ltd. Delhi.

4. Sporne, K.R. 1986. The morphology of Pteridophytes. Hutchinson University Press.

5. Sundara Rajan, S. 1999. Introduction to Pteridophyta. New Age International Publishers, New Delhi.

Gymnosperms

1. Biswas, C. and Johri, B.M. 1999. The Gymnosperms. Narosa Publishing House, New Delhi.

2. Chamberlain, C.J. 1955. Gymnosperms. Structure and Evolution.

3. Chamberlain, C.J. 2000. Gymnosperms. C B S Publishers and Distributors, New Delhi.

4. Sporne, K.R.1986. Morphology of Gymnosperms. Hutchinson University Press. Vashishta, P.C. 1999. Gymnosperms, S. Chand & Company Ltd. New Delhi.

13. Plant Diversity-II - Taxonomy Of Angiosperms

Definition and importance of taxonomy. History of classification, evolutionary systematics and phylogenic systematics. Basic level including merits and demerits of systems of classification by Bentham and Hooker, Hutchinson and Takhtajan and APG Classification. Contents of ICBN – Author citation – Typification and different types. Publication of names – Rules of Priority-Nomina Conservanda and definitions of nomenclatural terms Autonym, Homonym, Basionym, Tautonym and Nomen. Construction of taxonomic keys (indented and bracketed) and their utilization. Floristic studies in India: Botanical garden and herbarium. Modern concepts and trends in Plant taxonomy: Elementary treatment of; (i) Cytotaxonomy (ii) Chemotaxonomy (iii) Numerical Taxonomy (Taximetries) (iv) Molecular Taxonomy (v) Cladistics. Problems in evolutionary taxonomy: the concepts of primitive and advanced, monophyly and polyphyly, parallelism and convergence, homology and analogy.

Taxonomy

1. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants.
2. Davis, P. H. and Heywood. 1963. Principles of Angiosperm Taxonomy, New York
3. Heslop – Harrison, J. 1958. new concepts in Flowering Plant Taxonomy, London.
4. Heywood, V. H. 1968. Modern methods in Plant Taxonomy.
5. Hutchinson, J. Families of Flowering Plants. Cambridge.
6. Jeffrey, C. 1968. An Introduction to Plant Taxonomy, London.
7. Naik, V.N. 1984. Taxonomy of Angiosperms. New Delhi.
8. Radford Albert, E. Fundamentals of Plant Systematics
9. Sivarajan, V.V. 1991. An Introduction to Principles of Taxonomy, London.
10. Sivarajan, V.V. 1999. Principles of Plant Taxonomy Oxford & IBH Publishing Co. Pvt Ltd. New Delhi.

14. Plant Physiology

Water relations: water transport processes (diffusion, bulk flow, osmosis, water potential, components of water potential); Mechanism of water transport through xylem; (Ascent of sap)Water loss by transpiration, Solute transport by passive and active mechanisms and membrane transport proteins (Lecithin's); Regulation of water supply. Aquaporins and facilitated water transport; Soil plant Atmosphere continuum (SPAC),

concept in stomatal physiology; Signal transduction in guard cells. **Transport processes in plants:** Active and passive transport systems, ion channels, driving forces and flow, transport of nutrients across the primary root, transport through sieve element, Regulation and transport of metabolites from the source to the sink, genetic regulation of transport systems in response to nutrients availability and growth status.

Role of micro and macro elements and assimilations of inorganic nutrients: Essential nutrients, deficiencies and plant disorders. Plant microrrhiza association,; sulfur metabolism, phosphate metabolism, calcium metabolism, assimilation of cations, chloride dynamics. **Nitrogen metabolism:** nitrogen metabolism, nitrogen fixation, assimilatory nitrate reduction, ammonia assimilation and synthesis of amino acids. Regulation of 'nif'. Plant mycorrhiza association.

Photosynthesis: Light absorption, emission, energy transfer, Z scheme of photosynthesis, electron transfer, Role of pigment in transformation of radiant energy. Light harvesting complexes, Kok curve, Kautsky curve, ETS, Photophosphorylation photo inhibition O_2 and H_2 evolution, regulation of Calvin cycle, RUBISCO activity. Photorespiration, CAM, C4 Pathway; Environment and its impact on photosynthesis, agricultural aspects. **Respiration**: Aerobic and anaerobic respiration, EMP pathway, TCA cycle, PPP, Glyoxylate cycle, Mitochondrial ETS, Cyanide resistance pathway, Gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis.

Lipid and other natural product metabolism in plants: Fatty acid biosynthesis, Alpha and Beta oxidation, membrane lipid biosynthesis, lipid desaturation, triacylglycerols, complex lipids, cell wall lipids, alkaloids, ceramides.

Plant growth regulators: Introduction and concept, types of growth regulators Auxin: the master growth hormone, distribution in plants, roles, how auxin works? Auxin mutants, auxin perception, auxin binding proteins, signal transduction, auxin responsive gene/ promoters /factors. Model for gene regulation, derepression of early auxin genes, Acid theory, polar auxin transport, A chemoosmotic model, commercial uses of auxin. **Gibberellins:** Foolish seedling disease, functions of GAs, location, and free verses conjugated Gas, signal transduction and mechanism of action of GAs taking amylase as an example, commercial applications. **Cytokinins:** location, functions and mechanism of action, commercial applications Ethylene: discovery, locations and functions, mutants, mechanism of actions, applications Abscisic acid: discovery, location, functions, mutantsVP1, ABA and ABI, mechanism of action; Introduction of other hormones- brassinosteroids, jasmonic acid and salicylic acid.

Sensory Photobiology: structure and function , photochemical and biochemical properties of phytochrome, Phytochrome induced plant responses, molecular mechanism of action of phytochrome in gene expression, Cryptochrome and its role in photomorphogenesis.

The flowering process: Photoperiodism and its significance, initiation of flower primordia, flowering stimulus Vernalization, endogenous clock and its regulation. Seed Germination; metabolic changes during seed germination, flowering initiation, maturity and fruiting, fruit ripening. **Stress Physiology:** Water deficit and its physiological consequences, drought tolerance mechanisms, salinity stress and plant responses, heat stress and

heat shock proteins, metal toxicity, biotic stress, HR and SAR mechanisms.

Plant defenses, role of secondary metabolites: terpenes, phenolic compounds, nitrogen – containing compounds. **Molecular genetics and plant physiology:** Over view, receptors and G. proteins, second messengers, two component sensor regulator systems in bacteria and plants, signal transduction and gene expression.

REFERENCE BOOKS

1. Devline and Witham, 1986. Plant Physiology. CBS Publs and Distributors, New Delhi.
2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons Inc., New York, USA.
3. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, USA.
4. Singhal *et al.* 1999. Concepts in Photobiology, Photosynthesis and Phyto-morphognesis, Narosa Pub. House, New Delhi.
5. Taiz and Zeiger, 1998. Plant Physiology Sinauer Associates Inc., Publishers, Sunderla nd
6. Salisbury and Ross, 4th Ed. Plant Physiology Cengage Learning (paperback)

15. Plant Developmental Biology

Model plants for developmental biology: Introduction of model plants used for development studies in plant system, advantages of each system with special emphasis on model plant *Arabidopsis.* **Terms and tools:** Cell division, planes, cell autonomy, cell polarity, radial a/symmetry, pattern formation, abaxial, adaxial identity, cell lineage vs. cell position, meristem, determinant vs. indeterminant meristem, cell ablation technique, temporal and spatial expression of genes*, in situ* hybridization, interacting genes and their position in respect to signaling pathway, targeted mutagenesis in plants, mutant generation and identification of the gene**.**

Reproduction: Male and female gametophyte development, pollination and fertilization. **Seed formation and germination:** Seed formation, cotyledon, endosperm and seed coat development. Seed dormancy and germination, seedling development, genetic regulation of vernalization.

Embryogenesis: Basic lay out of dicot and monocot embryos, stages of embryo development, embryonic axis, cell division and pattern formation in embryo, cell polarity in embryo. **Shoot development:** Structure and function of shoot apical meristem (SAM), initiation and maintenance of SAM, regulation of meristem size, antagonism between SAM

and lateral organs, genetic regulation, axial bud formation, shoot branching.

Leaf development: Emergence of leaf primodium from SAM, abaxial and adaxial identity of leaf cells, leaf margin, trichome, epidermis and stomata development, vascular differentiation. **Root development:** Root apical meristem structure and function, lateral root development, lateral and adventitious root development, root hair development, hormonal regulations in root development. **Flower development:** Transition from vegetative to reproductive stage, role of homeotic gene inflorescence meristem, floral whorls specification, ABC model and beyond, whorl boundary specification, asymmetric flower development, structure and development of monocot flowers.**Use of *in vitro* system for studying development**

Suggested reading:

1. The *Arabidopsis* Book, ASPB publication (available freely at www.aspb.org).
2. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.
3. Plant Physiology by Taiz and Zeiger, Sinauer Associate Inc. Publishers.
4. Plant Physiology – Hopkins.

10. Physics (PHDPH)

Ph. D. (PHYSICS) ENTRANCE EXAM SYLLABUS

I. Research Methodology

- Basic knowledge of General Science and Mathematics
- Logical reasoning, graphical analysis, analytical and numerical ability, quantitative comparisons
- Meaning and importance, Objectives, Nature and Types of Research
- General awareness of emerging areas of research in Physics and allied areas
- Literature review: methods and importance
- Formulating a research problem
- Role of computers in research; Research databases in physics and scientific softwares
- Ethical issues in Research: Copyright, Intellectual Property Rights; Plagiarism
- Statistical methods for data analysis
- Error estimation

II. Mathematical Methods of Physics

Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley-Hamilton Theorem; Eigen values and eigenvectors; Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions); Fourier series; Green's function; Partial differential equations (Laplace, wave and heat equations in two and three dimensions);Fourier and Laplace transforms; Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals; Elementary probability theory, random variables, binomial, Poisson and normal distributions; Central limit theorem; Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge- Kutta method. Finite difference methods; Tensors; Introductory group theory: SU(2), O(3).

III. Classical Mechanics

Newton's laws; Dynamical systems, Two body Collisions - scattering in laboratory and Centre of mass frames; Non-inertial frames and pseudo forces; Variational principle; Generalized coordinates; Lagrangian and Hamiltonian formalism and equations of motion; Phase space dynamics, stability analysis; Conservation laws and cyclic coordinates; Central force motions; Periodic motion: small oscillations, normal modes; ; Poisson brackets and canonical transformations; Symmetry, invariance and Noether's theorem; Hamilton-Jacobi theory. Rigid body dynamics-moment of inertia tensor; Special theory of relativity- Lorentz transformations, relativistic kinematics and mass—energy equivalence.

IV. Electromagnetic Theory

Electrostatics: Gauss's 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 the fields at interfaces; Scalar and vector potentials, gauge invariance; Electromagnetic waves in free space; Dielectrics and conductors; Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction; Dynamics of charged particles in static and uniform electromagnetic fields; Dispersion relations in plasma; Lorentz invariance of Maxwell's equation; Transmission lines and wave guides; Radiation- from moving charges and dipoles and retarded potentials.

V. Quantum Mechanics

Wave-particle duality; Schrodinger equation (time-dependent and time-independent); Eigen value problems (particle in a box, harmonic oscillator, etc.);Tunneling through a barrier; Wave-function in coordinate and momentum representations; Commutators and Heisenberg uncertainty principle; Dirac notation for state vectors; Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom; Stern-Gerlach experiment; Time- independent perturbation theory and applications; Variational Method; Time dependent perturbation theory and Fermi's golden rule, selection rules; Identical particles, Pauli exclusion principle, spin-statistics connection; Spin-orbit coupling, fine structure; WKB approximation; Elementary theory of scattering: phase shifts, partial waves, Born approximation; Relativistic quantum mechanics: Klein-Gordon and Dirac equations; Semi-classical theory of radiation.

VI. Thermodynamics and Statistical Physics

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell's relations, chemical potential, phase equilibria; Phase space, micro-states and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions; Free energy and its connection with thermodynamic quantities; Classical and quantum statistics; Ideal Bose and Fermi gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; First- and second-order phase transitions; Diamagnetism, paramagnetism, and ferromagnetism; Ising model; Bose-Einstein condensation; Diffusion equation; Random walk and Brownian motion; Introduction to nonequilibrium processes.

VII. Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications; Current and voltage sources; Opto-electronic devices (solar cells, photo-detectors, LEDs);Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics.

Data interpretation and analysis; Precision and accuracy; Error analysis, propagation of errors; Least squares fitting, Linear and nonlinear curve fitting; Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors); Measurement and control; Signal conditioning and recovery; Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; lock-in detector; modulation techniques. High frequency devices (including generators and detectors).

VIII. Atomic & Molecular Physics

Quantum states of an electron in an atom; Electron spin; Spectrum of helium and alkali atom; Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings; Zeeman, Paschen -Bach & Stark effects; Electron spin resonance; Nuclear magnetic resonance, chemical shift; Frank-Condon principle; Born-Oppenheimer approximation; Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules; Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

IX. 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; Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors; Superconductivity: Type-I and Type-II superconductors, Josephson junctions; Superfluidity; Defects and dislocations; Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order; Quasi crystals.

X. Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity; Binding energy, semi- empirical mass formula, liquid drop model; Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces; Deuteron problem; Evidence of shell structure, single-particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Fission and fusion; Nuclear reactions, reaction mechanism, compound nuclei and direct reactions; Energy generation; Classification of fundamental forces; Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.); Gellmann-Nishijima formula; Quark model, baryons and mesons; C, P, and T invariance. Application of symmetry arguments to particle reactions; Parity non-conservation in weak interaction; Relativistic kinematics.

11. Statistics (PHDSTAT)

Syllabus of Entrance Exam for Ph.D. Programme in Statistics

Part-A: Research Methodology

Meaning of research, Role of research in important areas, Process of research, Types of research, research approach, Significance of research, Research problem: Definition, Selection and necessity of research problem.

Primary and secondary data, Qualitative and quantitative data, Classification of measurement scales, Goodness of measurement scales, Scaling, Scale classification bases, Scaling techniques, Methods of collecting primary data, Merits and demerits of different methods of collecting primary data, Non response, Classification and tabulation of data.

Introduction to sampling, Advantages of sampling over complete enumeration, Probability and non-probability sampling, Sampling and non-sampling errors, Basic concepts of simple random sampling and design of experiments.

Measures of central tendency, Measures of dispersion, Probability distributions (Binomial, Poisson, Normal), Simple correlation and regression, Multiple and partial correlation, Testing of hypothesis (z, t, F and chi-square tests).

Part-B: Statistics

Sample space, Probability, Conditional probability, independent events, Bayes theorem, Random variables, Distribution functions (Univariate and Bi-variate), Moments and moment generating function, Independent random variables, Marginal and conditional distributions, Characteristic function, Central limit theorem (i.i.d. case).

Standard discrete (Rectangular, Geometric, Negative binomial, Hyper-geometric) and

continuous distributions (Uniform, Exponential, Beta, Gamma), Bivariate normal distribution, Sampling distributions (t, F, z, chi-square).

Properties of good estimators (unbiasedness, Consistency, Efficiency, Sufficiency, Complete and minimal Sufficient statistic), Exponential families, Methods of estimation (least square, maximum likelihood, method of moments, minimum chi-square), Mean square error, Minimum variance unbiased estimators, Rao-Blackwell theorem, Lehmann-Scheffe theorem, Cramer-Rao lower bound,

Basics of testing of hypothesis, Neyman-Pearson lemma, Most powerful and uniformly most powerful tests, Likelihood ratio tests, Unbiased test, Non-parametric tests for one or more samples problems (Sign, Wilcoxon, Mann-Whitney, Kolmogorov Smirnov, Run, Kruskal Wallies test).

Gauss-Markov theorem, Estimability of parameters in linear models, BLUE.

Markov chains with finite and countable state space, Classification of states, Limiting behavior of n-step transition probabilities, Stationary distribution, Poisson process, Birth-and-death process.

Multivariate normal and its properties, Distribution of quadratic forms, Canonical correlation, Principle components analysis, Factor analysis, Classification and discriminant analysis.

Stratified sampling, Systematic sampling, Probability proportional to size sampling, Ratio, regression and product methods of estimation, Cluster sampling, Multi Stage sampling, Two-phase sampling, Successive sampling

Analysis of variance and covariance, Completely Randomised designs, Randomised block designs, Latin-square designs, Missing plot techniques, Orthogonality, BIBD, 2^k factorial experiments, Confounding.

Linear programming problem, Simplex methods, Duality, Assignment, Transportation problems, Queuing theory, Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space. Elementary inventory models.

12. Mathematics (PHDMT)

Algebra
Prerequisites and Preliminaries: Logic, Sets and Classes, Functions, Relations and Partitions, Products, The Integers, The Axiom of Choice, Order and Zorn's Lemma. Groups: Semigroups, Monoids and Groups, Homomorphisms and Subgroups, Cyclic Groups, Cosets and Counting, Normality, Quotient Groups, and Homomorphisms, Symmetric, Alternating, and Dihedral Groups, Direct Products and Direct Sums, Free Groups, Free Products, Generators & Relations. The Structure of Groups: Free Abelian Groups, Finitely Generated Abelian Groups, The Krull-Schmidt Theorem, The Action of a Group on a Set, The Sylow Theorems, Classification of Finite Groups, Nilpotent and Solvable Groups, Normal and Subnormal Series.

Rings: Rings and Homomorphisms, Ideals, Factorization in Commutative Rings, Rings of Quotients and Localization, Rings of Polynomials and Formal Power Series, Factorization in Polynomial Rings.
Fields and Galois Theory: Field Extensions, The Fundamental Theorem, Splitting Fields, Algebraic Closure and Normality, Finite Fields.
Linear Algebra: Vector Space and Linear Transformations, Matrices and Maps, Rank and Equivalence, Determinants, The Characteristic Polynomial, Eigenvectors and Eigenvalues.

Real Analysis
Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.
Functions of several variables, linear transformations, Derivatives in an open subset of Rn, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals, Partitions of unity, Differential forms, Stoke's theorem.
Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.
Integration of Non-negative functions. The General integral. Integration of Series. Reimann and Lebesgue Integrals.

Measures and outer measures, Extension of a measure. Uniqueness of Extension. Completion of a measure. Measure spaces. Integration with respect to a measure. The Lp-spaces. Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of Lp, Convergence in Measure, Almost uniform convergence.

Topology
Countable and uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma Well-ordering theorem.
Definition and examples of topological spaces. Closed sets. Closure. Dense subsets.

Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology.
Continuous functions and homomorphism, compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-vech compactification. Compactness in metric spaces.
Equivalence of compactness, countable compactness and sequential compactness in metric spaces, Connected spaces (Connectedness only for metric space.)

Functional Analysis
Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness. Weak convergence and bounded linear transformation,

normed linear spaces of bounded linear transformations, dual spaces with examples. Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems. Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces.
Reflexive space. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces, the closed Range Theorem.
Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space.
Reflexivity of Hibert spaces. Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax- Milgram theorem.

Differential Equations
Preliminaries-initial value problem and the equivalent integral equation, mth order equation in d-dimensions as a first order system, concepts of local existence, existence in the large and uniqueness of solutions with examples.
Linear Differential Equations-Linear Systems, Variation of constants, reduction to smaller systems. Basic inequalities, constant coefficients. Adjoint systems, Higher order equations.
Dependence on initial conditions and parameters; Preliminaries. Continuity. Differentiability. Higher Order Differentiability.
Linear second order equations-Preliminaries. Basic facts. Theorems of Sturm. Sturm- Liouville Boundary Value Problems. Number of zeros. Nonoscillatory equations and principal solutions. Nonoscillation theorems.
Use of Implicit function and fixed point theorems-Periodic solutions. Linear equations. Nonlinear problems.
Second order Boundary value problems-Linear problems. Nonlinear problems. Aproribounds, Green's Function.

Partial Differential Equations
Examples of PDE. Classification.
Transport Equation-Initial value Problem. Non-homogeneous Equation. Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.
Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy methods.
Wave Equation-Solution by spherical Means, Non-homogeneous Equations, Energy Methods.

Nonlinear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton-Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform).
Representation of Solutions-Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Asymptotics (Singular Perturbations, Laplace's Method), Power Series.

Section B (50 Marks)
Research Aptitude
The processes broadly involved in undertaking math research: Ability to generalise and particularise, ability to make 'educated guesses' as conjectures, try to prove/disprove theorems.

The objectives are

A. To assess the understanding of mathematical research processes.

B. To assess the inclination and aptitude for undertaking research in mathematics.

13. Sanskrit (PHDSK)

INDIRA GANDHI NATIONAL OPEN UNIVERSITY
SCHOOL OF HUMANITIES

Date: 02.06.2026

पीएच.डी संस्कृत (Ph.D Sanskrit)

प्रवेश परीक्षा पाठ्यक्रम (Entrance Examination Syllabus)

शोध प्रविधि

1. **अनुसंधान का स्वरूप** – अर्थ, प्रयोजन एवं प्रकार
2. **अनुसंधान की पद्धतियाँ**
3. **संस्कृत शोध के उद्देश्य एवं क्षेत्र**
4. **अनुसंधान के साधन**
   - वैदिक वाङ्मय : ऋग्वेद, यजुर्वेद, सामवेद, अथर्ववेद
   - साहित्य और साहित्यशास्त्र
   - व्याकरण
   - दर्शन

संस्कृत भाषा और साहित्य

1. **वैदिक साहित्य का परिचय –**
   - संहिता, ब्राह्मण, आरण्यक उपनिषद्
   - वैदिक यज्ञमीमांसा
   - वेदांग – शिक्षा, कल्प, व्याकरण, निरुक्त, ज्योतिष् और छन्द
   - वैदिक भाष्यकार
2. **पुराण, इतिहास और स्मृति परम्परा का परिचय –**
   - रामायण और महाभारत
   - पुराण
   - स्मृतियाँ

1

3. **दर्शन और संस्कृति –**

- न्याय, वैशेषिक, सांख्य, योग, मीमांसा, वेदान्त दर्शन
- बौद्ध, जैन, वैष्णव, शैव, शाक्त का परिचय
- वैदिक संस्कृति, रामायणकालीन संस्कृति, महाभारतकालीन संस्कृति एवं पौराणिक संस्कृति

4. **लौकिक संस्कृत साहित्य –**

- प्राचीन संस्कृत साहित्य –
- गद्य – कादम्बरी महाश्वेता वृत्तान्त, दशकुमारचरितम् (विश्रुतचरितम्)
- पद्य – रघुवंश (प्रथम सर्ग), मेघदूत (पूर्वमेघ), नैषधीयचरित (प्रथम सर्ग)
- नाटक – स्वप्नवासवदत्तम्, अभिज्ञानशाकुन्तलम् (1–4), उत्तररामचरितम् (1–3)
- नीतिसाहित्य एवं कथासाहित्य का परिचय
- आधुनिक संस्कृत साहित्य – अम्बिकादत्त व्यास, पण्डिता क्षमाराव, रेवाप्रसाद द्विवेदी, राघावल्लभ त्रिपाठी, अभिराज राजेन्द्र मिश्र

5. **व्याकरण एवं भाषाविज्ञान –**

- लघुसिद्धान्तकौमुदी – सन्धिप्रकरण, समासप्रकरण
- सिद्धान्तकौमुदी – कारकप्रकरण
- भाषा परिवार एवं भाषाओं का वर्गीकरण

14. Hindi (PHDHIN)

पीएच.डी (हिंदी) की प्रवेश परीक्षा के लिए पाठ्यचर्या

1. शोध प्रविधि- शोध का उद्देश्य, शोध और आलोचना, शोध के विविध पक्ष और प्रविधियाँ
2. हिंदी साहित्य का इतिहास, परिस्थितियाँ, प्रवृत्तियाँ एवं प्रमुख साहित्यकार
3. आदिकालीन एवं मध्यकालीन कविता
4. आधुनिक हिंदी कविता (छायावाद, प्रगतिवाद, प्रयोगवाद)
5. नाटक एवं अन्य गद्य विधाएँ (स्कंदगुप्त- जयशंकर प्रसाद, आधे- अधूरे – मोहन राकेश, अतीत के चलचित्र- महादेवी वर्मा, किन्नर देश की ओर- राहुल सांकृत्यायन, अदम्य जीवन- रांगेय राघव, अशोक के फूल और अन्य निबंध- हजारी प्रसाद द्विवेदी, जूठन- ओमप्रकाश वाल्मीकि)
6. हिंदी उपन्यास (गोदान, बाणभट्ट की आत्मकथा, मैला आँचल, महाभोज), हिंदी कहानी (प्रेमचंद की कहानियाँ, मानसरोवर खंड-1)
7. भाषा विज्ञान और हिंदी भाषा
8. साहित्य सिद्धांत और समालोचना (काव्य लक्षण, काव्य प्रयोजन, काव्य हेतु, रस सिद्धांत, साधारणीकरण।

प्लेटो, अरस्तू, लांजाइनस, क्रोचे, टी.एस. इलियट, आई.ए. रिचर्ड्स, नयी समीक्षा, मनोविश्लेषणवादी आलोचना, मार्क्सवादी आलोचना, अस्तित्ववाद, आधुनिकतावाद, उत्तर आधुनिकता, दलित साहित्य और चिंतन (डॉ. आम्बेडकर, ज्योतिबा फुले), अस्मितामूलक विमर्श।

नोट : यह प्रश्न पत्र 100 अंकों का होगा।

15. English (PHDENG)

Broad areas that PhD Test may cover:

1. British literature: issues and debates, trends and movements
2. Subaltern Literary Perspectives
3. Contemporary World Literature
4. Multiculturalism
5. English Language Teaching
6. New Literatures in English
7. Diaspora Studies
8. Folklore and Culture Studies
9. American Literature
10. Australian Literature
11. Research Methodology

12. Critical Theories
13. Indian Writing in English
14. Canadian Literature

16. Computer Science (PHDCS)

PART–1(Research Methodology)

Sets, Relations, Functions, Matrices and Determinants, Probability and Statistics, Descriptiveand Inferential Statistics, Probability Distributions Numerical Methods, Finite Differences, Numerical Integration.

PART–2(Computer Science)

Computer System Architecture Digital Logic Circuits and Components: Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit.

Data Representation: Data Types, Number Systems and Conversion, Complements, Fixed Point Representation, Floating Point Representation, Error Detection Codes, Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms.

Register Transfer andMicrooperations:RegisterTransferLanguage,BusandMemoryTransfers, Arithmetic, Logic and Shift Microoperations.

Basic Computer Organization and Design: Stored Program Organization and Instruction Codes,
ComputerRegisters,ComputerInstructions,TimingandControl,InstructionCycle,Memory-Reference Instructions, Input-Output, Interrupt.

Programming the Basic Computer: Machine Language, Assembly Language, Assembler, Program Loops, Subroutines, Input-Output Programming.

Micro programmed Control: Control Memory, Address Sequencing, Design of Control Unit. CentralProcessingUnit:GeneralRegisterOrganization,StackOrganization,InstructionFormats, Addressing Modes, RISC Computer, CISC Computer.

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing, Array Processors.

Input-OutputOrganization:PeripheralDevices,Input-OutputInterface,AsynchronousDataTransfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.

MemoryHierarchy:MainMemory,Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Inter-processor Arbitration, Inter-processor Communication and Synchronization, Cache Coherence, Multi core Processors.

Discrete Structures and Optimization

MathematicalLogic:PropositionalandPredicateLogic,PropositionalEquivalences,Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference.

SetsandRelations:SetOperations,RepresentationandPropertiesofRelations, Equivalence Relations, Partially Ordering.

Counting Mathematical Induction and Discrete Probability: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion Exclusion Principle,Mathematical Induction, Probability, Bayes' Theorem.

Group Theory: Groups, Subgroups, Semi-Groups, Product and Quotients of AlgebraicStructures, Isomorphism, Homomorphism, Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory.

GraphTheory:SimpleGraph,Multigraph,WeightedGraph,PathsandCircuits,ShortestPathsin

Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.

Boolean Algebra: Boolean Functions and its Representation, Simplifications of Boolean Functions.

Optimization: Linear Programming - Mathematical Model, Graphical Solution, Simplex andDualSimplexMethod,SensitiveAnalysis;IntegerProgramming,TransportationandAssignment Models.

PERT-CPM: Diagram Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

Programming Languages and Computer Graphics

Language Design and Translation Issues: Programming Language Concepts, Paradigms and Models, Programming Environments, Virtual Computers and Binding Times, Programming Language Syntax, Stages in Translation, Formal Transition Models.

Elementary Data Types: Properties of Types and Objects; Scalar and Composite Data Types. Programming in C: Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Arguments, Preprocessors.

Object Oriented Programming: Class, Object, Instantiation, Inheritance,Encapsulation,Abstract Class, Polymorphism.

Programming in C++: Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects; Constructors and Destructors; Overloading, Inheritance, Templates, Exception and Event Handling; Streams and Files; Multifile Programs.

WebProgramming:HTML,DHTML,XML,Scripting,Java,Servlets, Applets.

Computer Graphics: Video-Display Devices, Raster-Scan and Random-Scan Systems; Graphics Monitors, Input Devices, Points and Lines; Line Drawing Algorithms, Mid- Point Circle and Ellipse Algorithms; Scan Line Polygon Fill Algorithm, Boundary-Fill and Flood-Fill.

2-D Geometrical Transforms and Viewing: Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms, Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View Port Coordinate Transformation, Viewing Functions, Line and Polygon Clipping Algorithms. 3-D Object Representation, Geometric Transformations and Viewing: Polygon Surfaces, Quadric Surfaces, Spline Representation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces; Illumination Models, Polygon Rendering Methods, Viewing Pipeline and Coordinates; General Projection Transforms and

Clipping.

Database Management Systems

DatabaseSystemConceptsandArchitecture:DataModels,Schemas,andInstances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS.

Data Modeling: Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with ConstraintViolations; RelationalAlgebraandRelationalCalculus;CoddRules.SQL:Data

Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection. Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases; DatabaseSecurityand Authorization.

Enhanced Data Models: Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems, Genome Data Management, Distributed Databases and Client- Server Architectures. Data Warehousing and Data Mining: Data Modeling for DataWarehouses, Concept Hierarchy,OLAP and OLTP; Association Rules, Classification, Clustering, Regression, Support Vector Machine, K-Nearest Neighbour, Hidden Markov Model, Summarization, Dependency Modeling, Link Analysis, Sequencing Analysis, Social Network Analysis.Big Data Systems: Big Data Characteristics, Types of Big Data, Big Data Architecture, Introduction to Map-Reduce and Hadoop; Distributed File System, HDFS. NOSQL: NOSQL and Query Optimization; Different NO SQL Products, Querying and Managing NOSQL;Indexing and OrderingDataSets;NOSQL in Cloud.

System Software and Operating System

System Software: Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers. Basics of Operating Systems: Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; SystemBoot. Process Management:Process Scheduling and Operations; Inter-process Communication, Communication in Client–Server Systems, Process Synchronization,

Critical-Section Problem, Peterson's Solution, Semaphores, Synchronization. Threads: Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues.

CPU Scheduling: Scheduling Criteria and Algorithms; Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling.

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.

Memory Management:Contiguous Memory Allocation, Swapping, Paging,Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files.

StorageManagement:Mass-StorageStructure,DiskStructure,SchedulingandManagement, RAID Structure.

File and Input/Output Systems: Access Methods, Directory and Disk Structure; File- System

Mounting, File Sharing, File-System Structure and Implementation; Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance; Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Sub-system, Transforming I/O Requests to Hardware Operations.

Security: Protection, Access Matrix, Access Control, Revocation of Access Rights, Program Threats, System and Network Threats; Cryptography as a Security Tool, User Authentication, Implementing Security Defenses.

Virtual Machines: Types of Virtual Machines and Implementations; Virtualization. Linux Operating Systems: Design Principles, Kernel Modules, Process Management, Scheduling,

Memory Management, File Systems, Input and Output; Interprocess Communication, Network Structure.

Windows Operating Systems:Design Principles, System Components, Terminal Services and Fast User Switching; File System, Networking.

Distributed Systems:Types of Network based Operating Systems, Network Structure, Communication Structure and Protocols; Robustness, Design Issues, Distributed File Systems.

9. Software Engineering

Software Process Models: Software Process, Generic Process Model–Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, ComponentBasedDevelopment,Aspect-OrientedSoftwareDevelopment,FormalMethods, Agile Process Models –Extreme Programming (XP), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering. Software Requirements: Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software RequirementandSpecification(SRS)Document.SoftwareDesign:Abstraction,Architecture,

Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Software Quality: McCall's Quality Factors, ISO9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability. Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts. Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing. Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.

10. Data Structures and Algorithms

Data Structures: Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVLTree,

BTree,B+Tree,B*Tree,DataStructureforSets,Graphs,SortingandSearchingAlgorithms;

Hashing. Performance Analysis of Algorithms and Recurrences: Time and Space Complexities; Asymptotic Notation, Recurrence Relations. Design Techniques: Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound.

Lower Bound Theory: Comparison Trees, Lower Bounds through Reductions. Graph Algorithms: Breadth- First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees. Complexity Theory: P and NP Class Problems; NP-completeness and Reducibility. Selected Topics: Number Theoretic Algorithms, Polynomial Arithmetic, Fast Fourier Transform, String Matching Algorithms. Advanced Algorithms: Parallel Algorithms for Sorting, Searching and Merging, Approximation Algorithms, Randomized Algorithms.

11. Theory of Computation and Compilers

Theory of Computation: Formal Language, Non-Computational Problems, Diagonal Argument, Russel's Paradox.

Regular Language Models: Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, Non-Regular Languages, Lexical Analysis.

Context FreeLanguage:PushdownAutomaton(PDA),Non-DeterministicPushdownAutomaton (NPDA), Context Free Grammar, Chomsky Normal Form, Greibach Normal Form, Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and Context Free Grammars; Properties of Context Free Language.

TuringMachines(TM):StandardTuringMachineanditsVariations;UniversalTuringMachines, Models of Computation and Church-Turing Thesis; Recursive and Recursively- Enumerable Languages; Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems.

Unsolvable Problems and Computational Complexity: Unsolvable Problem, Halting Problem, Post Correspondence Problem, Unsolvable Problems for Context-Free Languages, Measuring and Classifying Complexity, Tractable and Intractable Problems.

Syntax Analysis: Associativity, Precedence, Grammar Transformations, Top Down Parsing, Recursive Descent Predictive Parsing, LL(1) Parsing, Bottom up Parsing, LR Parser, LALR(1)Parser.

Semantic Analysis: Attribute Grammar, Syntax Directed Definitions, Inherited and Synthesized Attributes; Dependency Graph, Evaluation Order, S-attributed and L- attributed Definitions; Type-Checking.

Run Time System: Storage Organization, Activation Tree, Activation Record, Stack Allocation of Activation Records, Parameter Passing Mechanisms, Symbol Table.

Intermediate Code Generation: Intermediate Representations, Translation of Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls.

Code GenerationandCodeOptimization:Control-flow,Data-flowAnalysis,LocalOptimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling**.**

12. Data Communication and Computer Networks

Data Communication: Components of a Data Communication System, Simplex, Half- Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and Latency; Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing, Transmission Media, Transmission Errors, Error Handling Mechanisms.

Computer Networks: Network Topologies, Local Area Networks, Metropolitan Area Networks, Wide Area Network, Wireless Networks, Internet.

Network Models: Layered Architecture, OSI Reference Model and its Protocols; TCP/IP

Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques. Functions of OSI and TCP/IP Layers: Framing, Error Detection and Correction; Flow and Error Control; Sliding Window Protocol, HDLC, Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA, Network Devices, Backbone Networks, Virtual LANs.

IPv4StructureandAddressSpace;Classful and Classless Addressing; Datagram, Fragmentation

and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery; Routing Algorithms, TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

World Wide Web (WWW): Uniform Resource Locator(URL),Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP. Network Security: Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

Mobile Technology: GSM and CDMA; Services and Architecture of GSM and Mobile Computing; Middleware and Gateway for Mobile Computing; Mobile IP and Mobile Communication Protocol; Communication Satellites, Wireless Networks and Topologies; Cellular Topology, Mobile Adhoc Networks, Wireless Transmission and Wireless LANs; Wireless Geolocation Systems, GPRS and SMS. Cloud Computing and IoT: SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics **of IoT.**

13. Artificial Intelligence (AI)

Approaches to AI: Turing Test and Rational Agent Approaches; State Space Representation ofProblems,HeuristicSearchTechniques,GamePlaying,Min-MaxSearch,AlphaBetaCutoff Procedures.KnowledgeRepresentation:Logic,SemanticNetworks,Frames,Rules,Scripts, Conceptual Dependency and Ontologies; Expert Systems, Handling Uncertainty in Knowledge. Planning: Components of a Planning System,Linear and Non Linear Planning; Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.

Natural Language Processing: Grammar and Language; Parsing Techniques, Semantic Analysis and Prgamatics.

Multi Agent Systems: Agents and Objects; Agents and Expert Systems; Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.

Fuzzy Sets: Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy Control System and Fuzzy Rule Based Systems.

Genetic Algorithms (GA): Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle; Problem Solving using GA.

Artificial Neural Networks(ANN):Supervised, Unsupervised and Reinforcement Learning; Single Perceptron, Multi Layer Perception.

17. Education (PHDES)

(A) Methodology of Educational Research

Sources of acquiring Knowledge, Meaning and Scope of Educational Research, Meaning and steps of Scientific Method, Characteristics of Scientific Method (Replicability, Precision, Falsifiability andParsimony), Types of Scientific Method (Exploratory, Explanatory and Descriptive), Aims of research as a scientific activity: Problem-solving, Theory Building and Prediction, Types ofresearch(Fundamental,AppliedandActionresearch),Ethicalconsiderations in Research

Criteria and sources of identifying the research problem, Survey, review and importance of related literature, Selection, definition and evaluation of research problem, WritingObjectives

Hypotheses-Concept, Sources, Types(Research, Directional, Non directional, Null),Formulating Hypothesis, Characteristics of a good hypothesis, Concept of Universe and Sample, Characteristics of a good Sample, Techniques of Sampling (Probability and Non-probability Sampling), Tools of Research - Validity, Reliability and Standardisationof a Tool, Types of Tools (Rating scale,Attitude scale, Questionnaire, Aptitude test and Achievement Test, Inventory), Techniques of Research (Observation, Interview and Projective Techniques)

Variables:MeaningofConcepts,Constructsand Variables, Types of Variables (Independent, Dependent, Extraneous, Intervening and Moderator)
Toolsandtechniquesofdatacollection-CharacteristicsofagoodresearchtoolTypesofresearch tools and techniques and their use
MajorApproachestoEducationalResearch-QuantitativeResearch,QualitativeResearch and Mixed Methods Research

MethodsofEducationalResearch-
Historicalresearch,Descriptiveresearch,Experimentalresearch, Expost facto research

Statistical Analysis of Data:Types of Measurement Scale (Nominal,Ordinal,Interval and Ratio),Quantitative Data Analysis - Descriptive data analysis (Measures of central tendency, variability, fiduciary limits and graphical presentation of data), Testing of Hypothesis (Type I and Type II Errors), Levels of Significance, Power of a statistical test and effect size,ParametricTechniques,Non-ParametricTechniques, Inferential data analysis, Use and Interpretationofstatisticaltechniques:Correlation,t-test,z-test,ANOVA,ANCOVA, Chi-square (Equal Probability and Normal Probability Hypothesis). Qualitative Data Analysis- Data Reduction and Classification, Analytical Induction and Constant Comparison, Concept of Triangulation
WritingResearchReport-Meaningandscope,Formatofresearchreports,Presentation Dissemination

(A) Subject Specific Areas:

(i) Philosophical and Sociological Foundations of Education

Relationship of Education and Philosophy, Indian and Western Schools of Philosophy and

their educational implications; Contributions of Vivekananda,Tagore,Gandhi and Aurobindo to Indian Education; National values as enshrined in the Indian Constitution, and their educational implications; Philosophical Inquiry in Education, Nature and Scope, Steps, Philosophical inquiry of current educational issues.

Education as a social sub-system-specific characteristics: Education and its relationship with modernization and democracy; Education and its relationship with the home, community; Socialization of the child; Meaning and nature of social change: Education as related to social equity and equality of educational opportunities;ConstraintsonsocialchangeinIndia;Education of the socially and economically disadvantaged sections of the society including students with special needs. Social mobility.

(ii) Learner, Learning Process and Assessment

Growth and Development: Concept and principles, Social, emotional and cognitive development. Individual differences. Personality - Definitions and theories (Freud, Carl Rogers, GordonAllport, Max Wertheimer, Kurt Koffka), learning styles and their implications on individual in succeeding in his/her learning; Motivation - concept; determinants and types, implications of motivation on learning; Group dynamics and role of teacher in developing positive class room climate. Mental health and mental hygiene.

Approaches to Intelligence from Unitary to Multiple: Concepts of Social intelligence, multiple intelligence, emotionalintelligenceTheoriesofIntelligencebySternberg,Gardner,Assessmentof Intelligence, Concepts of Problem Solving, Critical thinking, Meta cognition and Creativity.

Principles and Theories of learning: Behaviouristic, Cognitive and Constructivist theories of learning, Factors affecting learning, learning environment, Concept of social cognition, understanding social relationship and socialization goals.

Assessment–
Meaning,nature,perspectives(assessmentforLearning,assessmentoflearningandAssess ment as Learning) - Types of Assessment - Placement, diagnostic, formative, summative, Criterion-referenced and Norm-referenced. Relation between objectives and outcomes, Assessment of Cognitive(Anderson and Krathwohl), Affective (Krathwohl) and Psychomotor domains (R.H. Dave) of learning.; Issues in Assessment and Evaluation.

Assessment in pedagogy of education – feedback devices, meaning, types, and criteria. Assessment of Portfolios, Reflective Journal, Field Engagement using Rubrics, Competency Based Evaluation, Assessment of Teacher Prepared ICT Resources, performance-based assessment, issues in assessment and evaluation.

(iii) Curriculum Studies

ConceptandPrinciplesofCurriculum,StrategiesofCurriculumDevelopment,Stagesinthe Process of Curriculum development, Foundations of Curriculum Planning-Philosophical Bases (National, democratic), Sociological basis (socio cultural reconstruction), Psychological Bases (learner's needs and interests), Bench marking and Role of National level Statutory Bodies - UGC, NCTE and University in Curriculum Development

ModelsofCurriculumDesign:TraditionalandContemporaryModels(Academic/Discipline Based Model, Competency Based Model, Social Functions/Activities Model (social reconstruction), Individual Needs and Interests Model, Outcome Based Integrative Model, Intervention Model, Context, Input, Process, Product Model(CIPP Model).
Instructional System, Instructional Media, Instructional Techniques and Material in enhancing curriculum Transaction, Approaches to Evaluation of Curriculum: Approaches to Curriculum and Instruction (Academic and Competency Based Approaches), Models of Curriculum Evaluation:Tyler'sModel,Stakes'Model,Scriven'sModel,Kirkpatrick'sModel
Meaning and types of Curriculum change, Factor saffectingcurriculumchange, Approaches tocurriculumchange,Roleofstudents,teachersandeducationaladministratorsincurriculum
change and improvement, Scope of curriculum research and Types of Research in Curriculum Studies.

(iv) Educational Management, Administration and Leadership

Educational Management and Administration – Meaning, Principles, Functions and importance, Institutional building, POSDCORB, CPM, PERT, Management as a system, SWOT analysis, Taylorism, Administration as a process, Administration as a bureaucracy, Human relations approach to Administration, Organisational compliance, Organisational development, Organisational climate
Leadership inEducationalAdministration:MeaningandNature,Approachestoleadership: Trait, Transformational, Transactional, Value based, Cultural, Psychodynamic and Charismatic, Models of Leadership (Blake and Mouton's Managerial Grid, Fiedler's ContingencyModel,Tri-dimensionalModel,HerseyandBlanchard'sModel, Leader-Member Exchange Theory.

Concept of Quality and Quality in Education: Indian and International perspective, Evolution of Quality: Inspection, Quality Control, Quality Assurance, Total Quality Management (TQM), Six sigma, Quality Gurus: Walter Shewart, Edward Deming, C.KPralhad

Change Management: Meaning, Need for Planned change, Three-Step Model of Change (Unfreezing, Moving, Refreezing), The Japanese Models of Change: Just-in-Time, Poka yoke, Cost of Quality: Appraisal Costs, Failure costs and Preven table costs, Cost Benefit Analysis, Cost Effective Analysis, Indian and International Quality Assurance Agencies: Objectives, Functions, Roles and Initiatives (National Assessment and AccreditationCouncil [NAAC], Performance Indicators, Quality Council of India (QCI), International Network for Quality Assurance Agencies in Higher Education(INQAAHE).

(v) Educational Technology and ICT

Concept of Educational Technology (ET)as a Discipline:(Information Technology, Communication Technology, Information and Communication Technology (ICT) and Instructional Technology, Application of Educational Technology in formal, non-formal (Open and Distance Learning), informal and inclusive education systems, Overview of Behaviourist, Cognitive and Constructivist Theories and their implications to Instructional Design (Skinner, Piaget, Ausubel, Bruner, Vygotsky), Relationship between Learning Theories and Instructional Strategies (for large and small groups, formal and nonformal groups)
Systems Approach to Instructional Design, Models of Development of Instructional Design

(ADDIE,ASSURE,DickandCareyModelMason's),Gagne'sNineEventsofInstructionand Five E'sof Constructivism, Nine Elements of Constructivist Instructional Design, Application of Computers in Education: CAI, CAL,CBT, CML, Concept, Process of preparing ODLM, Concept of elearning, Approaches toe-learning (Offline, Online, Synchronous, Asynchronous, Blended learning, mobile learning)

EmergingTrendsine-learning:Sociallearning(concept,useofweb2.0toolsforlearning,socialnetworking sites, blogs, chats, video conferencing, discussion forum),Open Education Resources (Creative Common, Massive Open Online Courses; Concept and application), e-Inclusion - Conceptofe-Inclusion,ApplicationofAssistivetechnologyinElearning,Qualityofe-Learning – Measuring quality of system: Information, System, Service, User Satisfaction andNetBenefits(D&MISSuccessModel,2003),EthicalIssuesfore-Learnerand e-Teacher-Teaching, Learning and Research.
Use of ICT in Evaluation, Administration and Research: Eportfolios, ICT for Research-Online Repositories and Online Libraries, Online and Offline assessment tools (Online survey tool sortest generators) –Concept and Development.

(vi) Inclusive Education
Inclusive Education: Concept, Principles, Scope and Target Groups (Diverse learners; Including MarginalizedgroupandLearnerswithDisabilities),EvolutionofthePhilosophyof Inclusive Education: Special, Integrated, Inclusive Education, Legal Provisions: Policiesand Legislations (National Policy of Education (1986), Programme of Action of Action (1992), Persons with Disabilities Act (1995), National Policy of Disabilities (2006), National Curriculum Framework (2005), Concession and Facilities to Diverse Learners (Academicand Financial), Rehabilitation Council of India Act (1992), Inclusive Education underSarva Shiksha Abhiyan (SSA), Features of UNCRPD(UnitedNationsConventionontheRightsof Persons with Disabilities) and its Implication

ConceptofImpairment,DisabilityandHandicap,ClassificationofDisabilitiesbasedonICFModel,Readiness of School and Models of Inclusion, Prevalence, Types, Characteristics and Educational Needs of Diverse learners' Intellectual, Physical and Multiple Disabilities, Causesandpreventionofdisabilities,IdentificationofDiverseLearnersforInclusion,

Educational Evaluation Methods, Techniques and Tools

Planning and Management of Inclusive Classrooms: Infrastructure, Human Resource and Instructional Practices, Curriculum and Curricular Adaptations for Diverse Learners, Assistive and Adaptive Technology or Diverse learners: Product (Aids and Appliances) and Process (Individualized Education Plan, Remedial Teaching), Parent- Professional Partnership: Role of Parents, Peers, Professionals, Teachers, School

Barriers and Facilitators in Inclusive Education: Attitude, Social and Educational, Current Status and Ethical Issues of inclusive education in India, Research Trends of Inclusive Education in India

(vii) Educational Guidance and Counselling
Understanding Guidance - Meaning and Definitions, Misconceptions about guidance, Need

for guidance, Purpose of guidance:self-understanding,self-discovery,self-reliance, self-direction,self-actualization,Scope ofguidanceprogramme,PlanningGuidanceProgrmmes

Types of Guidance and Group Guidance: Types of Guidance-Educational, Vocational/Career and Personal, Individual guidance and group guidance; advantages of group guidance, Group guidance techniques-class talk, career talk, orientation talk, group discussion, career conference, career corner, bulletin board, role play.

Understanding Counselling - Meaning and nature of counselling, Misconceptions about Counselling, Scope of counselling, Goals of counselling:resolutionofproblems,modification of behaviour, promotion ofmental health. Relationship between guidance and counselling: place of counselling in the total guidance programme

Counselling Process and Counselling Relationship-Stages of the counseling process, Counselling Techniques - personcentred and groupcentred, cognitive interventions, behavioural interventions, and systematic interventions strategies. Theories of Counselling, Skills and qualities of an effective counsellor, Professional ethics

Types and Areas of Counselling - Uses of group process in counselling, Process of group counselling, Areas of counselling: family counselling, parental counselling,adolescent counselling, counseling of girls, counselling of children belonging to special groups, Peer counselling: Its concept and the relevance to the Indian situation, Steps and skills in group counseling process.

(viii) Teacher Education

DevelopmentofTeacherEducationinIndia,NCTECurricularFrameworksforTeacherEducation;O b jectives and organization of curriculum of teacher education at various levels; Agencies involved in Pre-service and In-service teachereducation;TeachereducationthroughOpenand DistanceEducation;QualityassuranceinTeacherEducationProgramme.Meaning,Nature

and Scope of Teacher Education; Types of Teacher Education Programmes, The Structure of Teacher Education Curriculum and itsVisioninCurriculumDocumentsofNCERTandNCTE at Elementary,Secondary and Higher Secondary Levels,OrganizationofComponentsof Pre-service Teacher Education Transactional Approaches (for foundation courses) Expository, Collaborative and Experiential learning.

Understanding Knowledge base of Teacher Education from theviewpointof Schulman,Deng and Luke and Habermas, Meaning of Reflective Teaching and Strategies for Promoting Reflective Teaching, Models ofTeacherEducation-Behaviouristic,Competency-basedandInquiryOrientedTeacherEducationM odels

Concept, Need, Purpose and Scope of In-service Teacher Education, Organization and Modes ofIn-service Teacher Education, Agencies andInstitutions of In-service Teacher Educationat District, State and National Levels (SSA, RMSA, SCERT, NCERT, NCTE and UGC), Preliminary Consideration in Planning in-service teacher education programme (Purpose, Duration, Resources and Budget)

Concept of Profession and Professionalism, Teaching as a Profession, Professional Ethics of Teachers, Personal and Contextual factors affecting Teacher Development, ICT Integration, Quality Enhancement for Professionalization of Teacher Education, Innovation in Teacher Education.

(ix) Adult Education

AdultEducation–Basicconceptsandmeaning.AdultandContinuingEducation—Preand PostIndepe ndent India, Extension Education and Services in India -- Phases and Movements, Adult Education Perspectives: Asian, Latin American, European and American perspectives Need, concept , types and characteristicsofLifelong Learningprogrammes in India, Opportunitiesfor Lifelong Learning and Extension, Agencies in Lifelong Learning in and outside India, Comparative Studies in Adult Education: Parameters, Trends and Analysis Theoretical and Functional bases of Adult Education -- Liberal, Behaviouristic, Progressive, Humanistic, Radical and Analytical approaches of Adult Education, Social and educational perspectives of Tagore,Gandhi,Vivekananda,Radhakrishnan,AmbedkarandotherIndianthinkers

Androgogy and Pedagogy—Issues of marginalization and pedagogy of women, tribals, minorities, transgender, aged and persons with disability, Attributes anddistinctivefeaturesof adult learninganddevelopment,IndividualVs.GrouplearningapproachesinAdultEducation, Experiences and learning from agriculture, home science, community health and technology, Learning needs of diverse group of adult learners, Recognition of prior learning – Resolvingthedilemmas of institutional and non-institutional learning, Theories of adult learning, Professionalization of adult education

Policy Planning and Implementation of Adult Education in India–Five Year Plans, Implementing Agencies – Role of Government Departments,Role of Universities, Collegesand Students, Role of NGOs, Role of Local Bodies, Community and individuals, Understanding

Networking in AdultLearning,NationalLiteracyMission;Objectives,strategies,TotalLiteracy Campaigns, Post- Literacy Campaigns and Continuing Education programmes, Operationalization of the concept of vocational education in adult, continuing education and Lifelong Learning through state supported structures like JanShikshanSansthan(JSS)andnon state supported structures of Industrial and Bussiness houses, Population Education: Concept and paradigm shift Development and its indicators, Millennium Development Goals (MDGs), Sustainable Development Goals(SDGs),Building learning communities—Towards a learning society.

18. Distance Education (PHDDE)

SECTIONA– Research Methodology Conceptual

Framework of Research:

Meaning of research; Sources of acquiring Knowledge; what is research problem.

Types and characteristics of distance education research; areas of distance education research; technique involved in defining a problem; selecting the problem; necessity of defining the problem; steps and formulation of research problems;operational definition.

Identify key theories, concepts and ideas around the topic; distinguish between what is known and what is unknown; the significant controversies around the topic; theoretical emphasis of epistemological and ontological ground on which problem has been selected.

Objectives of research; research design in selecting a topic for research study; researchquestions; hypothesis; research approaches (scientific, historical, descriptive, comparative).

Major steps preparing involved in a research design; factors affecting research design; aims of research as a scientific activity:problem-solving; theory building and prediction; types ofresearch (fundamental,applied and action research);

Research ethics and ethical considerations in researchcriteria; and, sources of identifying the research problem.

ResearchReview:

Meaning and definition of reviewofliterature; importance of relatedliterature; criteria of review selection; purpose of the review;

Types of reviews (Narrative Review, Realistic Review, Meta Review, Qualitative Review, Systematic Review, Transparent Review);

Sources of information for review selection (Primary source, secondary source, tertiarysource); and, process of selecting and reading journals.

Research Method sand Data Analysis:

Researchdesign;toolsofresearch-validity,reliabilityandstandardizationofatool.

Types of tools (rating scale, attitude scale, questionnaire,aptitude test and achievement test, inventory); techniques of research (observation, interview, projective techniques).

Variables- meaning of concepts, constructs and variables; types of variables(independent, dependent,extraneous, intervening and moderator).

Methods of educational research - qualitative, quantitative and mixed methods of research;types of research.
Sampling,characteristicsofagoodsample;techniquesofsampling(probabilityandnon-probability sampling); sampling (types of sampling, sampling error).

Methods of data collection.
Data processing and analysis strategies - data analysis with statistical packagesand sample.

Report Writing:

Significanceofreport writing; different steps in writing report; types of research reports; format of research report writing; referencing techniques.

Precautions for writing research reports; methods to avoidplagiarism; and, using software for plagiarism detection.

Evaluation of research report.

SECTION B– Distance Education Policy, Growth and

Development of Distance Education:

Scenario of higher education in India; basic issues of open and distanceeducation;philosophical foundation of open and distance education; genesis, growth of distance education in Indiaand global spheres; its socio-economic relevance;theories of distance education and their implications; issues concerning distance education; nature, scope and characteristics of distance education;distance education as a system as well as a discipline of study, structure and governance of distance education/ODL institutions in ODL; policies, regulations, national education policies and reform; quality assurance and accreditation mechanism.

Pedagogy of Distance Education:

Concept of learning and instruction; theories of learning - Behaviouristic School of Thought (Pavlov;Skinner,Guthrie,Watson,Thorndike, Gagne,Social learning theory);Cognitivist School of Thought (Piaget, Bruner, Ausubel, humanistic perspective, Maslow, Carl Roger;Constructivist School of Thought(discovery learning, Vygotsky's zone of proximal development, scaffolding, cognitive apprenticeship coaching, contractual learning, problem based learning);Implications and application of learning theories in instructional design for distance education. Instructional design theories (Component display theory, elaboration theory, cognitive load theory, theory of multiple intelligence); instructional design models (ADDIE, ASSURE); educational implications on designing and developing course materialsthrough print, multimedia and other technology in distance education.

Design and Development of Course Material for Distance Education:

Design and Development of Curriculum and Course Materials – (Basic concepts, Nature, types, Characteristics, Approaches, Planning, ImplementationStrategies,IssuesandTrendsin DistanceEducation); Development of Self Learning Materials – (Concept Mapping, Access devices, WritingLearning Objectives/Learning Outcomes, Developing Content, Incorporation of Assessment Tools,Referencing Styles); Editing ofCurriculumandCourseMaterials–(Language, Content, Format, Proofreading, Copy write and Plagiarism Issues); Production,

Distribution and Revision of Course Materials –
(Printing, Dispatching, Maintenance, Procedures, Framework and Strategies for Revision);Design andDevelopment of e-Resources- (OER, MOOCs, Integration of Multiple Media, Universal Design Principlesand Accessibility Issues)

Learner Supportin ODL:

Some Basic Issues (Nature, Significance, Need, Types, LSS at various Stages,Components of LSS, Evolution, Factors, Institutional Arrangements and Models, Relationshipbetween LSS and other Components of ODL System, Self-directed Learning);Development of Skills (Cognitive Skills; Study Skills; Reading Skills; Writing Skills and Problem SolvingSkills);Counseling and Tutoring Services (Importance, Nature, Forms of Counseling, Qualities and Skills, Roleand Attributes of Idol Tutor, Media and Technology);Assessment and Evaluation Support(Assessment in ODL, Types, Marking, Grading, Reliability, Validity of Assessment, Tutor Comments, Tutoring Through Correspondence and Supplemental Interaction);Management of Learner Support (Learners Expectations, Learners' Satisfaction, Monitoring Learner); Progress, Data Management, Quality Assurance in Learner Support, Learners' Attrition (types, factorsand measures to reduce attrition), Library and Information Services.

19. Environmental Science (PHDEV)

RESEARCH METHODOLOGY: Meaning of Research in Environmental Sciences, Characteristics and Types of Research, Hypotheses, Methods of Research, Major emerging areas in environmental sector and interdisciplinary research, problems encountered by researchers in India in the field of Environmental Science. Basic concepts of Techniques of defining research problem; literature review, types of data collection. Basic concepts in analytical techniques of chromatography & spectroscopic methods. Ethical, legal, social and scientific issues in Environmental Science Research. Basic concepts in writing research papers, reports and research proposals. Role of IPR in Research and Development.

Subject areas: Environmental Chemistry, Environmental Biotechnology, Environmental Geomicrobiology, Environmental management, Natural resource management, Climate change, Sustainability science

20. Fine Arts (PHDPVA)

Research Methodology in Fine Arts

1. Research and its meaning
2. Objectives of Research
3. Motivation in Research
4. Types of Research
5. Research and its approaches
6. Significance of Research

7. Research Methods Vs Methodology
8. Research and Scientific Methods

a. Research Process: Research Problem, Review of the literature, Hypothesis, research design, Data collection, Analysis, Interpretation, Report.

9. Tools and Techniques
10. Field Methods
11. Qualities of good research
12. Problems and issues in research
13. Research Ethics

Indian Art History

Sculpture:

Formal and stylistic aspects of sculpture in Indus Valley, Mauryan, Sunga, Satvahana, Kushana (Mathura and Gandhara), Gupta (Buddhist, Brahamancical and Jain), Chalukya, Gurjara Pratihara, Pallava, Chola, Rashrakuta, Hoysala, Kakatiya, Pala-Sena, Orissan, Solanki and Paramara periods.

Architecture:

Formal and stylistic aspects of architecture in Indus Valley of stupas (Bharhut, Sanchi, Amaravati, Sarnath) of cave temples, (Bhaja, Karle, Ajanta, Nasik, Lomas Rishi, Kanheri, etc.), Gupta (Udaygiri, Deogarh, nachna, etc.) Chalukya (Badami, Aihole, Pattadakal, etc.), Pallava (Mahabalipuram, Kanchipuram, etc.) Rashtrakuta (Ellora), Gurjara Pratihara, Saindhava – Maitraka, Chandela (Khajuraho), Orissa (Bhubaneshwar, Konaraka), Chola (Tanjore and Gangaikonda Cholapuram, Darasuram, etc.), Hoysala (Belur, Halibid, etc.) Paramara, Nayuka and Vijayanagar (Hampi Lepakshi). Islamic architecture; Sultanate and Mughal; Mandu, Delhi, Agra, Fatehpur Sikri.

Painting:

Formal and stylistic aspects of pre-historic, Ajanta, Bagh and later mural tradition. Manuscript painting (Eastern Indian and Western Indian), Sultanate (Mandu) Chourapanchaskika style and other pre-Mughal schools, Mughal (Akbar to Shahjahan), Rajasthani (Mewar, Bundi, Kotah, Bikaneer, Jaipur, Kishangarh, etc.) Malwa, Pahari (Basholi, Guler, Kangra) and Decacani (Ahmednagar, Bijapur and Golkonda) schools.

Modern Indian Art:

Company School, Bazar Painting, British Art Schools, Kalighat Painting, Raja Ravi Verma and followers. Neo-Bengal School ('Revivalism' and earlymodernists): Abanindranath Tagore and disciples, Nandalal Bose, Benode Behari Mukherjee, Ramkinkar Baij, Rabindranath Tagore, Gaganendranath Tagore, Jamini Roy and others. Role of Santiniketan in art education.

Academic/Professional sculptors and painters; Mahatre, Talim, D.P. Roy Choudhuri, Dhurandar. Heman Majumdar, Thakur Singh, etc. Early modernists: Amrita Shergil, Karmarkar. Geroge Keyt. Art in 1940's and 50's : Bengal famine and artists (Somnath Hore, Chittaprasad, Zainul Abedin, Gobardhan Ash. Sudhir Khastgir), Progressive art movements in Calcutta, Madras, Bombay and Delhi. International Modernism and artists : F.N. Souza, Pradosh Dasgupta, K.C.S. Panikkar, B.C. Sanyal, Dinkar Kaushik, Nirode Majumdar, Paritosh Sen, M.F. Hussain, Akbar Padamsee, Ramkumar and others. Independent Artists : N.S. Bendre, K. K. Hebbar, Shankho Choudhuri, Krishan Reddy, Dhanraj Bhagat, Y. K. Shukla, Piloo Poochkhanwala, V.S. Gaitonde, Santhanraj, Davierwala and other.

Art in 1960's and 70's Indigenist trends in painting, sculpture, mural and print-making; K. G.

Subramanyam, K.C.S. Panikkar (Cholamandal artists village), Reddappa Naidu, S.B. Palsikar, Janaki Ram, Meera Mukherjee, Jyoti Bhatt, J. Swaminathan, Neo- Tantric art, etc.
Figurative-Narrative trend since 1960's Bikash Bhattacharjee, Ganesh Pyne. A. Ramachandran, R.B. Bhaskaran, Lakshma Goud, Jogan Choudhuri, Bhupen Khakhar, Anjole Ela Menon, Arpita Singh, Gogi Saroj Pal, Arpana Kaur, Vivan Sundaram and others.
Trend of Abstraction since 1960's : raghav Kaneria, Jairam Patel, P. Barwe, Ram kumar, L. Munnuswamy, P.V. Kolte, Jagmohan Chopra, Balbir Singh Katt, Nagji Patel.
Development of Installation, Multimedia, Performative, Happening Art : nalini Malani, Ved Nayar, Vivan Sundaram and others.
Tribal, Folk and Popular Art (Including Design and Functional Art)
African, Oceanic, North-West Coast American, Mexican, Indian, South- East Asian Art.

Aesthetics and Art Critical History:
General principles of Indian art, art and beauty, principlies of image making (iconometry and other canons), six limbs of Indian painting (shadanga) and six Chinese canons of paintings, theories of Rasa, Dhvani, Aankara, Auchitya and Riti, and their relevance in understanding art making and viewing. Interrelationship of visual and performing art. Classification of painting in Chitrasutra. Concepts of Kshyavridhi. Guna-dosha, Sadrishya, Vartana, Nimnonata, etc. Visible and invisible aspects of art (Drishyam/Adrishyam), Rekha (Line) and Linear rhythm (Chanda) compositional aspects of art, perspective, form and content. Textual sources (Vishnudharmottara, Brihatasmhita and otherSilpasastra texts. Kashmiri aestheticians.
Distinctions and overlap between the scope of Art History, Art Criticism, and Aesthetic theories. Interrrelationship between Art History, Anthroplogy, Arhaelogy, Cultural History and Philology, Development of Art History as a discipline. Connoiseurship and catalogue raissone. Development of formalism (Wolffin, Reigl, Roger Fry, Greenberg), Iconology (Gombrich and Panofsky), Visual perception (Rudolf Arnheim) and New Art History (Bryson, Hal Foster). Ananda coomaraswamy and Stella Kramrisch and their relevance in the India Art Historical Studies.
Western approaches to art and aesthetcs : Plato, Aristotle, Alberti, Vasari, Bellori, Reynolds, Diderot, Wincklemann, Croce, Tolstoy, etc. Writing by artists and manifestors of modern art movements. Theory of Avant-Garde. Implicaiton of theories of Semiotics, Structuralism, Post-strcuturalism, Post-modernism and Feminism on Art thinking and writing.

Fundamental and Principles of Painting:
Knowledge of principal elements, perspective values, fundamentals of paintings. Visual principles, Form, space, illusion, image. Chronology of the development of ideas. Visual reality, conceptual reality. Tradition and the gradual development of the art of combining the elements of ideas of different visual arts specialization.
Media and material and their use, sketching and drawing. Application of materials, oil painting- Alla Prima and old master process, glazing and scumbling, priming of canvas, different types of oil, brushing etc. Tempera and Gocache and their uses in painting in both traditional and non-traditional art. Wash method on paper and silk, Acrylic, pastel, mixed media, water colour mural and mural techniques- Fresco secco and Buono fresco, Ajanta and different modern media relief and mixed media in mural.
Collage, Encaustic Wax
Supports in Painting (Canvas, paper, wood, silk, etc.)
Types of paintings, open air paintings, portrait paintings, study of head and full length figures, male and female. Landscape paintings, patronized art, paintings under different art movements,

still life, thematic, abstract , etc.
Principles of compositions, reflection of artists personal views, development of concept. Process of creative paintings. Expression of ideas under some aesthetical and philosophical views. Artistic expression during different social and structural changes. Art and Changes.
Application of techniques, colours and colour theory and the application of colour theory in art activities. Colour harmony, traditional application of colour and the application of colour with reasoning.
Colour preparation, tecture, technical aspect of pigment.

Sculpture:
Detail knowledge of Principle element of Sculpture including Historical backgrounds, developments and the modern approach about all Sculpture methods.
- Stone Carving
- wood Carving
- Metal Casting
- Terracotta (Low relief/ High relief)
- Other- Clay Making Process, Plaster of Paris, Metal Fabrication like Welding, Metal Scrap, waste Material, Installation.
- History of Sculpture– Indian and Western: Manifestation and invention of different Sculpture technique Artist and their Contributions.

Graphics (Printmaking):
Detail knowledge of Principle element of Printmaking including Historical backgrounds, developments and the modern approach about all Printmaking methods.
- Relief method
- Intaglio Method
- Planography Method
- Serigraphy Method
- Other- Computer Graphics, Paper making, Dimensional Print like Blind print, Embossing, colography, Unique Print / Mono prints.
- Concept Study of Tools, Techniques, Processing and developing Block preparation & Printing
- History of Printmaking – Asia and Europe: Manifestation and invention of different PrintmakingMethods Artist and their Contributions.
- History of Indian Printmaking – Manifestation, invention and development of different Printmaking Methods Artist and their Contributions.

Applied Arts:
- Introduction to Advertising, History of Advertising, truth and fundamentals of Advertising, ethics in Advertising. Media of Advertising.
- Technical terms of Advertising.
- Principles of Design. Elements of design, its role and effect in Advertising layouts.
- Typography and its basic rules. Calligraphy and its History.
- Illustration, History and famous Illustrator.
- Printing: its history and development , introduction of main printing processes such as Letterpress, Lithography, Gravure, Offset, Silk-screen, latest techniques of printings.
- Trends and developments of Modern Advertising, Types of Advertising, Justification of Advertising for expenditure and growth.

- Advertising for Nation-Building and Social welfare. Concept Planning and Creative Research.
- Advertising Agency, its structure and different departments. Function of different departments. Role of art studio in the Agency. Famous Ad. Agency and Ad, gurus.
- Different Media of Advertising – Print Media, Indoor, outdoor, Direct mail, POP, Social Media, TV, Radio, Internet, electronic media, new media of advertising etc.
- Campaign Planning, appeal : Use of appeal in campaign planning, objectives, continuity. Different kinds of Campaigns : Social, Product, Movie, Event, Educational, Political etc.
- Corporate Image, and Corporate Identity.
- Types of copy and Design approach of campaigning.
- Communication and its type. Barriers in good communication.
- Different functions of Advertising Business. Research and Motivational Research – present and future action.
- Future of Advertising – Career options in Internet Advertising, web designing and Animation.
- Introduction to marketing. 4P's of marketing.
- Market Research & Analysis.
- Importance of Marketing and Consumer Behaviour in Advertising.
- Advertising Effectiveness.
- Testing of Advertising.

21. Theatre Arts (PHDPVA)

Research Methodology

1. Research and its meaning
2. Objectives of Research
3. Motivation in Research
4. Types of Research
5. Research and its approaches
6. Significance of Research
7. Research Methods Vs Methodology
8. Research and Scientific Methods
9. Research Process: Research Problem, Review of the literature, Hypothesis, research design, Data collection, Analysis, Interpretation, Report.
10. Tools and Techniques
11. Field Methods
12. Qualities of good research
13. Problems and issues in research
14. Research Ethics

Theatre Arts

1. History and origins of Western and Indian Theatre /drama

2. Elements of Theatre and Drama (Western and Indian)

3. Bharata's Natyasastra and Aristotle Poetics.

4. Origin and development of Traditional Theatre and Folk theatrical Forms of India

5. History and Development of Modern Western Drama and Theatre

6. History and development of Modern Indian Drama and Theatre

7. History and development of Orient/Asian/South Asian Theatre and Drama

8. Makers of Modern Theatre (Indian and Western)

9. Major acting theories

10. Technical Aspects of Theatre (design, direction, set design, costume design, lighting, stage craft, theatre music, Play production Process)

11. Theatre Aesthetics(Western and Indian)

12. Indigenous Theatre Practices (Indian context)

13. Theatre- in- education, Children theatre, creative drama, applied theatre, political theatre, street theatre.

14. Theatre management and Theatre festivals.

15. Post modern theories of theatre(Theatre Semiotics, Feminist Theatre, Intercultural Theatre, Phenomenology, Historiography, Post-Dramatic theories etc)

16. Theatre Pedagogies and Theatre Education (Universities and Institutions)

22. Music (PHDPVA)

Syllabus for Entrance exam for "Research Methodology in Music"

Topics for entrance exam in - **"Research Methodology in Music"**

1. Importance of Literature Survey in research
2. Importance of content analysis in research
3. Qualitative and quantitative research in music
4. Methods to be applied in historical research in Music
5. Sources for collection of Data for research in Music
6. Various approaches for research in Music
7. Ethical issue in research
8. Principles of Research Ethics
9. Process of Data analysis in research
10. Presentation of Research findings

1. Technical-Terminology.

Nada, Shruti, Swara, Grama-Moorchana, Jati, Thata (Mela), Raga, Tana, Gamak, Gandharva,Gaan, Margi-Deshi, Giti, Nibaddha, Anibaddha, Varna, Alankar, Melody, Harmony, SwarSanwad, Musical Scales, Musical Intervals, Western and South Indian terminology and their explanation,Alpatva-Bahutva,Avirbhav-Tirobhav,Laya,Tala,Matra,Avartan,Vibhag, Theka, Kriti, Kirtana,Ragmalika, Tillana, Javeli, Maseetkhani and Rajakhani Gat.

2. Applied theory.

DetailedandcriticalstudyofRagas,classificationofRagas,i.e.GramaRagavargikaran, MelaRagaVargikaran, Raga-RaginiVargikaran, Thata Raga Vargikaran, and Raganga Vargikaran, Time-theory of Ragas, Application of melody and harmony in Indian Music, Placement of Shuddhaand Vikrit Swarason Shruties in ancient, medieval and modern period.

DetailedknowledgeofprevalenttalasofHindustanimusic,knowledgeoftalaDashpranas and Margi and Deshitalas of ancient period.

3. Compositional forms and their Evolution.

Prabandha, Dhrupad, Dhamar, Sadra, Khyal, Thumri, Tappa, Tarana, Chaturang, Trivat, Vrindagana, VrindaVadan.

4. Gharanasand Gayaki.

Origin, development and contribution of Gharanas in preserving and promoting Hindustani classical music (Vocal-Instrumental).

5. Contribution of Scholars to Indian Music and the study of Important Granthas (treatises).

Natya-Shastra, Brihaddeshi, Dattilam, Sangeet-Makarand, Geet-Govinda, SangeetRatnakar, Rag-Tarangini, Swara-Mela-Kalanidhi, Sadraga-Chandrodaya, Sangeet Raj, Sangeet-Parijat, HridyaPrakash,ChaturdandiPrakashika,Rag-Tatva-Vivodh,Raga-Darpan,Nagmat-e-Asaphi, Bhatkhande SangeetShastra (Vol. 1-4), Rag-Vigyan, Sangeetanjali, SangeetChintamani etc.

6. Historical Perspective of Music.

Astudyofthehistoricaldevelopment of Hindustani music (Vocal,Instrumental). Contribution of Western Scholars to Indian Music.

7. Aesthetics.

Itsorigin,expressionandappreciation:PrincipleofaestheticsandIts,relationtoIndianMusic. Rasa theory and its application to Indian Music.
RelationshipofMusicalaestheticsandRasatoHindustaniMusic(Vocal,Instrumental).

Inter-relationship of FineArts with special reference to Rag-Ragini Paintings; Dhyan of Ragas and others.

8. Instruments.

Origin,development,materialusedandstructureofvariousinstrumentsandtheirwell-known exponents of Hindustani Music (Vocal, Instrumental).

ClassificationofInstrumentsofHindustaniMusic.

9. Folk Music.

GeneralstudyofthefolkmusicofvariousregionsofIndialikeUttarPradesh,Rajasthan, Haryana,Punjab, Maharashtra, Bengal and South India.

10. Music Teaching and Research Methodology.

The methodologies of music research, preparing synopsis, data collection, field work, writing project reports, finding bibliography, Footnotes, reference material etc. with reference to Hindustani music.

23. Dance (PHDPVA)

PhD Performing Arts- Dance

The entrance test shall consist of two papers with subjective questions: 1. Research Methodology 2. Dance. The syllabus for entrance test for **PhD Performing Arts- Dance** is as follows

1. **Paper- 1: Research Methodology**
2. Introduction to Research- Its definition, role of research in dance, process, types, significance
3. Research approaches
4. Formulation of research problem
5. Research design
6. Sources of Data
7. Data collection- primary and secondary data, methods of collection and techniques
8. Literature review
9. Analysis and Interpretation
10. Quantitative and Qualitative research methods
11. Interdisciplinary research areas in Dance
12. Applied areas of research in Dance- eg: Dance education, Dance therapy etc.

Paper- 2: Dance

Unit 1.. Dance in Sanskrit Literature and Treatises

1. A brief study of references to dance in the works of Kalidasa, Bhasa, Sudraka and others
2. General understanding of the concepts relating to dance from texts of ancient and medieval period- *Natyasastra*, *Abhinaya Darpana*, *Sangeeta Ratnakara*, *Nritta Ratnavali* and *Nartana Nirnaya*. Concepts include *Natya*, *Nritta*, *Nritya*, *Lasya*, *Tandava*, *Marga*, *Desi*, *Baddha*, *Anibaddha*, *Nartaki lakshana*, *Sabha lakshana* and the like. Also specific study of

the *padas*, *hastas*, *caris*, *mandalas* and *karanas*, and *anga*, *upanga* and *pratyanga* movements
3. Detailed study of *Abhinaya Darpana* along with introduction to other region/form specific texts like *Hasta Lakshana Deepika*, *Balarama Bharatam*, *Abhinaya Chandrika*, *Srihasta Muktavali* and others
4. The various categories and typologies of *Nayakas* and *Nayikas* and their *avasthas* according to Bharata's *Natyasastra*, Saradatanaya's *Bhavaprakasana*, Bhanudatta's *Rasamanjari* and Akbar Shah's *Sringaramanjari*

Unit 2. India Classical Dance
1. Origin and history of Indian classical dance
2. Evolution, technique, costumes, music, Gurus and pioneers of Bharatanatyam, Kathak, Kathakali, Kuchipudi, Manipuri, Mohiniattam, Odissi and Sattriya
3. General understanding of major Talas of Carnatic music traditions
4. A brief study of Composers/*Vaggeyakaras* and their works including Jayadeva, Narayanateertha, Surdas, Meera Bai, Tulasidas, Vanamalidas, Kshetrayya .
5. Study of the role of Rabindranath Tagore, Rukmini Devi Arundale, Vallathole Narayana Menon, Madame Menaka and others in the revival and reconstruction of classical dance

Unit. 3 Indian Classical Dance in Independent India
1. An overview of major Gurus, performers, their works and important institutions in Independent India
2. Institutionalization of dance and its effect on form, pedagogy, repertoire etc.
3. The new wave in Indian dance - Its development through the works of Uday Shanker and Ram Gopal and the later major contemporary artists and their works. (eg. Shantibardhan, Narendra Sharma, Sachin Shanker, Mrinalini Sarabhai, Maya Rao, Kumudini Lakhia, Manjusri Chaki Sarkar, Chandralekha, Astad Deboo and others)
4. Indian classical dances in diaspora
5. Patronage to Dance- the role of government and private bodies
6. Awareness of important dance festivals, awardees and current happenings in dance

Unit 4. Dance Education, Pedagogy and Research
1. Dance as part of curriculum in school education and Universities
2. Movement Analysis based on kinesthetics and Laban system
3. Eminent scholars and their works, who contributed significantly to the knowledge of Indian dance
4. Key inroads in dance training and research in India from the 1930's to the present like applied areas of dance, therapy, cross- cultural training etc.

Unit 5. International dance and interactions
1. Study of the history and development of classical ballet in Europe, Russia and America
2. Emergence of Modern Dance in the west and major personalities involved
3. Influence of the West on Indian dance in terms of production design

Unit 6. Cultural History of India
1. Cultures of India from pre-historic to CE 1200
2. Evolution of Art in pre-historic and historic periods, as evidenced in cave paintings, sculptures and other visual representations

3. Evolution of dance and drama (*Natya*), (a) the divine origin theory according to *Natyasastra*, and, (b) art as a product of society, its rituals and belief systems
4. The *Vedas*, major epics and *puranas* (Ramayana, Mahabharata, *Cilappadikaram* and *Bhagavatapurana*) in terms of their content, character and relevance to dance and theatre
5. Bhakti and various religious movements and their influence on different representative aspects of culture with focus on dance and theatre

Unit 7. Folk dance Forms of India
1. Understanding and defining the terms Tribal, Folk, Traditional and Classical in the context of Indian dance and their interrelation
2. Introduction to the different tribal, folk and traditional dance and theatre forms spread over various regions of India
3. Introduction to regional theatrical practices of *Kudiattam*, *Yakshagana, Bhagavatamela, , Rasalila, Chhau, Laiharaoba, Therukoothu, Theyyam, Ankia-nat, etc*
4. Awareness of various musical instruments, costumes and make-up used in these forms

Unit 8. The Natyasastra
1. Knowledge of *Natyasastra* and the concept of *Natya* and *Nritta*
2. Study of chapters relating to the eleven aspects (*ekadash sangraha*) such as, *Abhinayas*, *Dharmis*, *Vrittis*, *Pravrittis* and *Aatodyas*. *Samanya* and *Chitrabhinayas* and their classification
3. *Dasarupakas*
4. *Natyagruha* (Playhouse) and *Ranga* – Construction, types and different elements
5. *Poorvarangavidhi* and Stage conventions viz. *Kakshya vibhag* etc.

Unit 9. Art and Aesthetics
1. '*Rasasutra'* of Bharata
2. Elaboration of the theory of *Rasa* by commentators like Bhattalollata, Sri Sankuka, Bhattanayaka and Abhinavagupta.
3. Rasa and its constituent elements, viz., *Sthayi*, *Sanchari* and *Sattvika bhavas* and their corresponding *Vibhavas* and *Anubhavas*
4. Definition, purpose and elements of Art
5. A brief introduction to Performance studies and significant western theories on Art : 'Art as Imitation/Catharsis' , 'as Imagination', 'as Beauty', 'as Communication' and 'as Utility' put forth by various Philosophers

Unit 10. Dance and Theatre forms of East and South Asian Countries
1. An overview of dance and theatre forms of East Asian (China, Japan and Korea), South Asian (Bangladesh, Pakistan and Sri Lanka) and South- East Asian (Indonesia, Thailand, Vietnam, Cambodia, Myanmar, Philippines and Laos) countries
2. History and presentation techniques of various popular theatre and dance forms of the above countries

24. Social Work (PHDSW)

Syllabus for Entrance Examination

- History, Philosophy and Ideological Foundations of Social Work
- Professional Social Work: Indian and Global Perspectives
- Basic Social Science Concepts and Human Behaviour
- Social Work and Social Development
- Social Work Practicum, Field Work and Supervision
- Social Work Research and Statistics
- Case Work and Counseling: Working with Individuals and families
- Social Group Work: Working with Groups
- Community Organization and Community Development
- Social Welfare administration, Social Policy and Social Action
- Areas of Social Work Practice
- Current Issues and Contemporary Concerns
- Indian Social Problems and Social Legislation

25. Management (PHDMGMT)

The question paper will have the following two parts:

a. Research Methodology
b. Management(Financial Management, Human Resource Management, Marketing Management, Operations Management and General Management)
Part1-Research Methodology

1. Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method–Understanding the language of research–Concept, Construct, Definition, Variable.

Research Process

2. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis–Null Hypothesis & Alternative Hypothesis. Hypothesis Testing–Logic & Importance

3. Research Design: Concept andImportanceinResearch–Featuresofagoodresearchdesign – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables

4. Qualitative and QuantitativeResearch: Qualitative research – Quantitative research–Concept of measurement, causality, generalization, replication. Merging the two approaches.

5. Measurement: Concept of measurement–what is measured? Problems in measurement in research– Validity and Reliability. Levels of measurement–Nominal, Ordinal, Interval, Ratio.

6. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error,

Sample Size, Non Response. Characteristicsofagoodsample.ProbabilitySample–Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

7. Data Analysis: Data Preparation–Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bi-variate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

8. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

9. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

10. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/ Mendeley, Software for paper formatting like LaTeX/ MSOffice, Software for detection of Plagiarism

Part 2
Management (Financial Management, Human Resource Management, Marketing Management, Operations Management and General Management)

I Managerial Economics – Demand Analysis Production Function Cost–Output Relations Market Structures Pricing Theories Advertising Macro – Economics National Income Concepts Infrastructure – Management and Policy Business Environment Capital Budgeting

II The concept and significance of organizational behaviour – Skills and Roles in an organisation –Classical,Neo–ClassicalandModernTheoriesofOrganisationalStructure– Organisational Design – Understanding and Managing individual behavior personality – Perception – Values – Attitudes – Learning – Motivation.UnderstandingandManagingGroupBehaviour,Processes–Inter– personal and group dynamics – Communication – Leadership – Managing change–Managing conflicts. Organisational Development.

III Concepts and perspectives in HRM;HRM inchanging environment.Human Resource Plarming– Objectives, Process andTechniques.
Job analysis – Job Description. Selecting Human Resources. Induction, Training and Development. Exit policy and Implications. Performance Appraisal and Evaluation. Potential Assessment. Job Evaluation. Wage Determination. Industrial Relations and Trade Unions. Dispute Resolution and Grievance Management. Labour Welfare and Social Security Measures.

IV Financial Management – Nature and Scope. Valuation Concepts and Valuation of Securities. Capital Budgeting Decisions – Risk Analysis. Capital Structure and Cost of Capital. Dividend Policy–Determinants. Long– Term and Short–Term Financing Instruments. Mergers and Acquisitions.

V Marketing Environment and Environment Scanning; Marketing Information Systems

and Marketing Research; Understanding Consumer and Industrial Markets; Demand Measurement and Forecasting; Market Segmentation– Targeting and Positioning;
Product Decisions, Product mix, Product Life Cycle; New Product Development; Branding and Packaging; Pricing Methods and Strategies.
Promotion Decisions– Promotionmix; Advertising; Personal Selling; Channel Management; Vertical Marketing Systems; Evaluation and Control of Marketing Effort; Marketing of Services; Customer Relation Management; Uses of Internet as a Marketing Medium– Otherrelatedissueslike branding, market development, Advertising and retailing on the net. New issues in Marketing.

VI Role and Scope of Production Management; Facility Location; Layout Planning and Analysis; Production Planning and Control – Production Process Analysis; Demand Forecasting for Operations; Determinants of Productmix; Production Scheduling; Work measurement; Time and Motion Study; Statistical Quality Control. Supply Chain Management and Materials Management
Role and Scope of Operations Research; Linear Programming; Sensitivity Analysis; Duality; Transportation Model; Inventory Control; Queueing Theory; Decision Theory; Markov Analysis; PERT/CPM.

VIIProbabilityTheory;Probabilitydistributions–Binomial,Poisson,NormalandExponential;
Correlation and Regression analysis; Sampling theory; Sampling distributions; Tests of Hypothesis; Large and small samples; tz, F, Chi–square tests.
Use of Computers in Managerial applications; Technology issues and Data processing in organizations; Information systems; MIS and Decision making; System analysis and design; Trends in Information Technology; Internet and Internet–based applications.

VIII Concept of Corporate Strategy; Components of Strategy Formulation; Ansoffs Growth Vector; BCG Model; Porter's Generic Strategies; Competitor Analysis; Strategic Dimensions and Group Mapping; Industry Analysis; Strategies in Industry Evolution, Fragmentation, Maturity, and decline.
Competitive strategy and Corporate Strategy; Transnationalization of World Economy; Managing Cultural Diversity; Global Entry Strategies; Globalisation of Financial System and Services; Managing International Business; Competitive Advantage of Nations; RTP and WTO.

IX Concepts–Types,Characteristics;Motivation;Competenciesanditsdevelopment;Innovation and Entrepreneurship; Small business–Concepts Government policy for promotion of small and tiny enterprises; Process of Business Opportunity Identification; Detailed business plan preparation; Managing small enterprises; Planning for growth; Sickness in Small Enterprises; Rehabilitation of Sick Enterprises; Intrapreneurship (Organisational Entrepreneurship).

X EthicsandManagementSystem;EthicalissuesandAnalysisinManagement;Valuebased organisations; Personal framework for ethical choices; Ethical pressure on individual in organisations; Gender issues; Ecological consciousness; Environmental ethics; Social responsibilities of business; Corporate governance and ethics.

26. Commerce (PHDCOM)

Course1:Research

Methodology

Theory of Research :Meaning and Definition of Research, Types of Research, Research Approached(Scientific, Historical, Descriptive, Comparative, Institutional), Criteria of Good Research, Research and Business Decisions, Research Applications in Functional Areas of Business.

1. **Research Process :** Problem Selection and Research Design-Selecting a Topic for Research Study ,Formulation of Hypothesis, Research Design (Concepts relating to Research Design, Major stops preparing a Research Design, Factors affecting Research Design.)

   Technique of Collecting Qualitative Data (PRA-ParticipatoryRuralAppraisal,RRA-Rapid Rural Appraisal Case Study), Tools of Collecting Qualitative Data (Social Mapping Resource Mapping, Wealth Ranking of the Households, Preference Ranking, FocusGroup Discussion etc.),Formatting and Processing of Qualitative Data Sampling Techniques and Sample Design (Methods, Selectionof Appropriate Methods and Sampling Criteria),SamplingTests(Ztest,Ttest,Ftest).Editing,Coding,ClassificationandTabulation Diagrammatic and Graphic Presentation

2. **Analysis of Data (Statistical Application in Research)**

   Statistics and Business Research Probability Theory Probability DistributionsPercentages and Ratios Measures of Central Tendency Measures of Variability Correlation and Regression Measurement of Trend Association of Attributes Construction of Indices Hypothesis Testing Scaling Technique

RCO – 002: SPECIALIZATION COURSE (In the selected area of research interest) FOR Ph.D

Area–1:Accounting&TaxationACCOUNTING

Contents

1. **Accounting: Information for Decision Making**

   Accounting Information: A Means to an End User's Perspective-Types of Accounting Information

   Accounting Information Forms:-Determining Information Needs-The Cost of Producing Accounting Information, Users of Accounting Information - Objectives of External Financial Reporting – CharacteristicofExternallyReportedInformation-Characteristicsand Objectives of Management Accounting Information

   IntegrityofAccountingInformation:InstitutionalFeatures-ProfessionalOrganizations-Competence, Judgment, and Ethical Behavior

Accounting Systems: Basic Functions of an Accounting System-Designing andInstallation Accounting Systems.

Careers in Accounting: Public Accounting- Management Accounting-Governmental Accounting -Education

2. Presentation and Reporting of Accounting Information

Reporting the Results of Operations: Developing Predictive Information - Reporting IrregularItemsContinuingOperations– DiscontinuedOperations,Extraordinary Items-Changes in Accounting Principles -Earnings per Share (EPS)-Basis and Diluted Earnings per Share

3. Statement of Cash Flows

Statement of Cash Flows: Purpose of the statement -Example of a Statement of Cash Flows-Classification of Cash Flows-The Approach to Preparing a Statement of Cash Flows

Managing Cash Flows: Budgeting (The Primary Cash Management Tool-What Priority Should Managers give to Increasing Net Cash Flows? –Some Strategies for Permanent Improvements in Cash Flow

4. Financial Statement Analysis

Techniques of financial statement Analysis: Common Size Financial Statements-Financial Statement Analysis Using Common Ratios- Profitability Ratios, Efficiency Ratios, and Solvency Ratios

ToolsofAnalysis:TrendPercentages,ComponentPercentages,Ratios,Standardsof Comparison, Quality of Earnings, Quality of Assets, and the Relative Amount of Debt

Measures of Liquidity and Credit Risk: A classified Balance Sheet - Working Capital – Current Ratio, Quick Ratio, Debt Ratio-Evaluating Financial Ratios– Liquidity, Credit Risk, and the Law

5. Accounting Standards

Introduction – Accounting Standards in India – Importance of the Accounting Standards– Disclosure of Accounting Policies – Regulations for Valuation of Inventories – Rules for Cash Flow Statement – Norms for Events after Balance Sheet Date – Rules for Provisions and Contingencies – Norms for Net Income and Changesin Accounting Policies–Regulations fo rDepreciation Accounting–Norms for Reven ue Recognition – Accounting for Fixed Assets – Accounting for Taxes on Income – Accounting for Intangible Assets – Norms for Consolidated Financial Statements – Need forNotestoAccounts–OtherAccountingStandards–ComputerizationofAccounts–

Indian Companies Providing their Accounts as per US GAAP and IFRS

6. **Global Business and Accounting**
   Environmental Forces Shaping Globalization- Political and Legal Systems, Economic Systems, Culture, Technology and Infrastructure Harmonization of Financial Reporting Standards

   Foreign Currencies and Exchange Rates: Exchange Rates - Accounting forTransactions with Foreign Companies - Currency Fluctuations – Who Wins and Who Loses? - Consolidated Financial Statements That Include Foreign Subsidiaries

7. **Management Accounting**
   An overview –Concept sanduses-Management Accounting Decision Making Authority– Management Accounting's Role in Decision Making - Management Accounting's Role in Performance Evaluation and Rewards

8. **Costing System and Analysis**
   Activity Based Costing System: Introduction -Traditional manufacturing Costing System- Activity Based Costing (ABC) and Activity Based Management (ABM) System - Cost of Resource Capacity - ABC for Marketing, Selling and Distribution Expenses-ABC for Service Companies

   Cost variance Analysis: Introduction – Material Variances–LabourVariances– Overhead Variances –Standard Cost Accounting

   Revenue and Profit Variance Analysis*:* Introduction - Sales Variances – Profit Variances- Actual Profit and Budgeted: Reconciliation –Variance Reporting- Disposition of Variances

9. **Responsibility Accounting**
   Introduction–Meaning and Objectives–Types of Responsibility Centres

Reference text books:

1. Williams, Haka, Bettner (2005) Financial & Manageria lAccounting, the basis for business decisions, Tata McGraw- Hill, New Delhi.
2. M.Y.Khan,P.K.Jain(2007)ManagementAccounting,Text,ProblemsandCases,TheMc Graw-Hi ll, New Delhi.
3. Asish K .Bhattacharyya(2006) Financial Accounting for Business Managers, Printice-Hall of India Pvt. Ltd., New Delhi.
4. Robert N Anthony, David F. Hawkins, Kenneth A Merchant (2007) Accounting Text and Cases, Tata McGraw-Hill, New Delhi.
5. N.Ramachandran,RamKumarKakani(2008),FinancialAccountingforManagement,Tat aMcG raw-Hill, NewDelhi.
6. ShashiK.Gupta(2002),ContemporaryIssuesinAccounting,KalyaniPublishers,NewDelhi.

7. Aggarwal,M.P.(1981),AnalysisofFinancialStatements,NationalPublishingHouse,New Delhi.
8. S.N.Maheshwari (2004),Management Accounting and Financial Control, Sultan Chandand Sons, New Delhi.
9. S.N.Maheshwari, S.K.Maheshwari (2006),Corporate Accounting, Vikas Publishing House Pvt. Ltd. New Delhi.

Taxation

Direct Taxation–Law and Practice

1. ***General Frame work of Direct Taxation in India:*** Different direct tax laws and their inter-relationship; Importance of Income Tax Act and Annual Finance Bill Relevant Constitutional provisions; harmonization of tax regime.
2. ***Tax Planning:*** Concept of tax planning; Tax planning with reference to setting upanew business; locational aspects; nature of business; tax holiday, etc. - Tax planning with regard to specific management decisions such as mergers and takeovers; location of undertaking; introduction of voluntaryretirement;taxplanningwithreferencetofinancial management decisions such as borrowing or investment decision; reorganization or restructuring of capital decisions - Tax planning with respect tocorporatereorganization; tax planning with reference to employees' remuneration - Tax Planning vis-à-vis important provisions of wealth-tax including court rulings and legislative amendments.
3. ***Tax Management:*** Return and procedure for assessment; special procedure forassessment of search cases, e-commerce transactions, liability in specialcases;collection and recovery of tax; refunds, appeals and revisions ;penalties imposable ,offences and prosecution.

Indirect Taxation–Lawand Practice

4. ***Indirect Taxes:*** Special features of indirect taxlevies–allpervasivenature, contribution to Government revenues; constitutional provisions authorizing the levy and collection of duties of central excise, customs, service tax, central sales tax and VAT.
5. ***Central Excise:*** Basis of chargeability of duties of central excise –goods, manufacture, classification and valuation of excisable goods, assessment procedure, exemption, payment, recovery and refunds of duties. Clearance of excisable goods; Central Excise Bonds; maintenance of accounts and records and filing of returns. CENVAT; Duties payable by small scale units. Set-off of duties –concept, meaning and scheme; Central Excise Concessions on exports; search, seizure and investigation; offences and penalty.
6. ***Custom:*** Levy of and exemption from, customs duties – specific issues and casestudies; assessment and payment duties; recovery and refund of customs duties; drawback of duties; Confiscation of goods and conveyances and imposition of penalties; search,seizure and arrest, offence and prosecution provisions -Adjudication, Appeal and Revision; Settlement of Cases.
7. ***Service Tax:*** Introduction; Genesis of service tax in India; Constitutional

Provisions; Definition of service; Education Cess and Secondary and Higher Education Cess

8. ***Tax Planning and Management:*** Tax Planning, Tax Management, Tax Avoidance and Tax Evasion

Reference text books:

1. Dr.VinodKumarSinghania&Dr.MonicaSinghania,(2014),DirectTaxesPlannin gand Management,Taxmann,NewDelhi
2. Dr.VinodKumarSinghania&Dr.MonicaSinghania,(2014), Income Tax including Central Sales Tax,Taxmann, NewDelhi
3. R.K.Jain,(2014),IncomeTaxPlanning&Management,SahityaBhawan,Agra
4. Dr.P.K.Jain&R.KTyagi,(2014),IncomeTaxlaw&accounts,SanjaySahityaBhawan,Agra
5. R.K.Jain (2014) Excise Customs and Service Tax CaseReferences,JainBookDepot,New Delhi.

Area 2–International Business

1. **BasicsofInternationalBusinessEnvironment**–Social,Cultural,Economic, Political, Demographic, Ecological and Legal Environment.

2. **Balance of Payments** – Concept, Balance of Payments Accounting, DeficitandSurplus, Factors affecting Balance of Payments andEquilibriumandDisequilibriumofBalanceof Payments. India's Balance of Payments.

3. **GovernmentInfluenceonTrade**–Rationalefor government intervention, Tariff and Non tariff barriers.Impact of tariff and non tariff barriers on international trade.

4. **CrossCulturalManagement**–HofstedeandotherstudiesrelatedtoCrossCultural Management

5. **Introduction to Globalization**–Concept, Major forces, Effects of Globalization on the world economy and developing countries, Globalization strategies of Indian Companies, Cross border Mergers and Acquisitions
6. **International Investment**– Concept, Types of International Investment, FDI and Developing Countries, Determinants of FDI, Recent Trends in FDI flows, Trade Related Investment Measures, Multilateral Investment Agreements.

7. **Transnational Corporations**–Features of Transnational Corporations, RecentTrends in Transnational Corporations, Issues And Controversies Of Transnational Corporations. TNCs and Developing Countries.

8. **Technology Transfer** – Rationale of Transfer of Technology, Recent Trends and Current Issues, Non Equity Forms of Technology Transfer, Intellectual Property Rights, Indiaand Transfer of Technology –strategies and challenges.

9. **World Trade**–Recent Trends –composition and direction, Problems of Developing Countries.
10. **International Trade in Services**–Role of Trade in Services in Economic Development, Composition and Direction of International Trade in Services,ChallengesofInternational Trade in Services.

11. **Multilateral Trading System** – Functions and Structure of WTO, Multilateral Trade Agreement and Plurilataral Trade Agreement, India and WTO. Recent issues related to Multilateral Agreements. Impact of Multilateral Trading System on World Trade.

12. **Regional Economic Groupings**–Forms of Regional Groupings, Rationale and Impact of Regional Economic Groupings, Major Regional Economic Groupings - European Union (EU), North American Free Trade Agreement(NAFTA), Association of South etc. East Asian Nations (ASEAN), South Asian Association for Regional Corporation(SAARC)

13. **International Product Planning** – Product Decision, International Product Life Cycle, New Product Development. Product diffusion.

14. **InternationalBrandingandPackaging**–
ObjectivesandAdvantages,BrandFamiliarity Levels, Branding Strategies , Local Brand VsGlobalBrand,ImpactofBrandsonBuying Behaviour, Scope for Indian Brands, Functions and Importance of Packaging, Factors Influencing Packaging Decision, Special Considerations in International Marketing.

15. **International Pricing** – Objectives and factors affecting Pricing Decisions, Pricing Methods and Practices in International Marketing, Transfer Pricing, Counter Trade and Pricing Issues.

16. **International Distribution**–International Channel System, Types of Intermediaries, Factors affecting Channel Choice, Selecting Overseas Agents.

17. **International Marketing Communication** – Promotion Mix, Objectives and Role of International Marketing Communication, Key Issues in International Marketing Communication, Major Marketing Promotion Tools.

18. **International Advertising** – Rationale for International Advertising, Adaptation Vs Standardization, Advertising Appeals and Product Characteristics, Impact of Advertising on buying decisions, Global Media Decisions, Selecting Advertising Agencies, Advertising Regulations, Sales Promotion Tools.

19. **International Retailing** – International Store Operations andSupplyChainManagement ofLeading International Retailers. International Retail Formats, International Retail Marketing Strategy.

20. **Emerging Trends and Issues in International Marketing** – E-Marketing, Green Marketing, Digital Marketing, Multi level Marketing (MLM),Web-based Marketing, and Network Marketing etc.

Further Readings

-WTOReport
-UNCTADReport
-WorldInvestmentReport
-WorldEconomicSurvey,etc.

Area3–BankingandFinance

1. **Commercial Banks:** Overview of Commercial Banking in India; Role and Functions of Commercial Banks; Indian Banking in Pre, Nationalization and Post, nationalization Phases.
2. **Banking Sectoral Reforms:** Banking Sector Reforms and their Implications on Indian Banking Sector; Changing Role of Indian Banks; Reforms and Restructuring of Banks; Management of Private Sector Banks and Public Sector Banks; ManagementofBanksin Rural Areas.
3. **Basic Banking Services:** Opening of accounts for companies, trusts, societies, government and public bodies; Importance of AML.
4. **Credit concepts:** Principles of lending; Various credit Products/ Facilities - working capital and term loans; Credit Appraisal Techniques; Approaches to lending; Credit Management, credit monitoring ,NPA Management; Credit Risk Analysis Framework.
5. **Documentation:** Different types of documents; Documentation Procedures; Stamping of documents Securities; Types of collaterals and their characteristics; Priority Sector Lending - Sectors, Targets and Issues/Problems.
6. **RecentDevelopments:**Agriculture/SMEs/SHGs/SSI/TinySector;FinancingNewProducts& Services:Factoring,Securitization,bancassurance,MutualFunds,MerchantBanking,HirePurchase,Securitization,VentureCapital,LeasingandDepository,CreditCards/HomeLoans/Pers onalLoans/ConsumerLoans;ITApplicationinBanking.
7. **Credit Rating in India:**Conceptandreasonsofcreditrating;Creditratinginstitutionsin India, Limitation of Credit Rating.
8. **Reforms in Banking and Finance:** Reports of the committees; Chakravarty committee, Narsimham Committee I&II :FDI In Banking Sector.
9. **International Banking:** An Overview; Rationale and Scope of International Banking Regulation; Capital Adequacy, loan loss provisioning and other Regulatory Controls.
10. **International Financial System:** An overview; Foreign Exchange Markets; Exchange rate determination; International party theory and Fisher effect; Foreign Exchange Risk Management.
11. **Financial Institutions:** Role of FDI, NBFCs and other International Financial Institutions
12. **FinancialMarkets:**Structure;InstitutionsandOperationMechanism;MoneyMarketinIndia;I mportance; Feature and Instruments; Capital Market in India, New Issues Market and Secondary Market(Stock Exchanges);salient features and operation, changing scenarioof Indian Stock Market.

13. **Valuation of Securities:** Equity shares and Bonds valuation models; CAPM, Arbitrary pricing theory.
14. **Corporate Valuation:** Approaches to Corporate Valuation; Restructuring; merger, acquisition and disinvestment leveraged buy-outs.

References

Chandra, Prasanna, Financial Management Theory and Practice, Tata McGraw-Hill Publishing CompanyLtd.,New Delhi,2007

- Shapiro AlanC., Multinational Financial Management,PrenticeHall of India Ltd.,NewDelhi
- Khan,M.Y.andJain,P.K.,FinancialManagementText,CasesandProblems,Tata McGraw-Hill Publishing CompanyLtd.,NewDelhi,2007
- Kishore,RaviM.:FinancialManagement,Tax,Delhi.
- VanHorne,JamesC.,FinancialManagementandPolicy,PrenticeHallofIndiaLtd.,New Delhi Damodaran onValuation:Security Analysis for Investment and Corporate Finance (WileyFinance)
- NeelamCGulati(2011)BankingandInsurance:Principles&Practices,3rdedition,Excel Books, DaryaganjNewDelhi
- Gomez Clifford (2011) Banking and Finance: Theory, Law and Practice, 3rdedition, PHI, Daryaganj NewDelhi
- IndianInstituteofBanking&Finance(2012):PrinciplesandPracticesofBanking, 2ndedition, McMillan, Daryaganj, NewDelhi.
- Indian Institute of Banking & Finance (2012):Legal and Regulatory Aspect of Banking 2nd edition, McMillan, Daryaganj NewDelhi.
- NK Sinha (2009): Money Banking and Finance 5thedition,BscPublisherco,Daryaganj, New Delhi.

Area4: MARKETING MANAGEMNT

1. **Defining Marketing for the 21stcentury Thenew marketing realities:**
Marketingin21stcentury,Markerts:ConsumerandOrganisationalmarkets,Strategicplanning&themarketingenvironment,Currentissuesinmarketing,Marketingresearch,Buyerbehaviour,
Segmentation,targetingandpositioning,Valuecapture,Valuecreation,Valuedelivery, Value communication, Major Societal Forces, New Consumer Capabilities, New Company Capabilities, Integrated Marketing, Internal Marketing,

Performance Marketing, Connecting with Customers, Shaping the Market Offerings.

The Demographic Environment and its implication in marketing management: Economic Environment, Social- Cultural Environment, Natural Environment, Technological Environment, Political-Legal Environment.

CreatingCustomerValue: SatisfactionandLoyalty,CustomerPerceivedValue(CPV), Total Customer Satisfaction, Monitoring Satisfaction, Maximizing Customer Lifetime Value (CLV), Cultivating Customer Relationships.

Analyzing Consumer Markets: What Influences Consumer Behaviour? Cultural Factors Social Factors, Personal Factors, Key Psychological Processes.

Analyzing Business Markets: Organizational Buying, The Business Market Versus the Consumer Market, Delivering Superior Customer Value, Managing Business-to-Business Customer Relationships, Business Relationships: Risks and Opportunism, Segment Marketing, Niche Marketing, Local Marketing, Balancing Customer and Competitor Orientations. Creating Brand Equity, Building brand equity, Measuring brand equity, Devising a branding strategy, crafting brand positioning.

2. Marketing Decisions

ProductDecisions: SettingProductStrategy,Differentiation,Productandbrandrelationship, The Product Hierarchy, Product Systems and Mixes, Product-Line Analysis Product-Line Length, Packaging, Labeling,Warranties, and Guarantees.

Designing and Managing Services: The Nature of Services, Categore is of ServiceMix Distinctive Characteristics of Services, Service Experience , Service Innovation, Service Delivery, Service Quality, service recovery and its implications on business. Managing Service Brands, Developing Brand Strategies for Services, Developing Service Offers for Rural Areas, Manageing Product-Support Services, Identifying and Satisfying Customer Needs, Post sale Service Strategy.

Pricing Decisions: Developing Pricing Strategies and Programs, Consumer Psychology and Pricing**,** Setting the Price, Adapting the Price, Geographical Pricing (Cash, Countertrade, Barter),Price Discounts and Allowances, Promotional Pricing,Differentiated Pricing, Pricing for Rural Markets, Initiating and Responding to Price Changes, Responding to Comptitiors's Price Changes

Distribution Decisions(logistics decisions): Designing and Managing Integrated Marketing Channel, Marketing Channels and Value Networks, Channel Integration and Systems,VerticalMarketingSystems,The Importance of Channel Stewards, Horizontal Marketing Systems, Integrating Multichannel Marketing Systems, Conflict, Cooperation, and Competition, Channel Conflict andCompetition,ManagingChannelConflict,Dilution and Cannibalization, Legal and Ethical Issues in Channel Relations, Managing Retailing, Wholesaling, and

Logistics.

Promotion Decisions:Communicating Value, Designing and Managing Integrated Marketing Communications, The Changing Marketing Communication Environment, Marketing Communications, Brand Equity, and Sales, The Communications Process Models, Developing Effective Communications, Celebrity Endorsements as a Strategy, Selecting the Communications Channels, Establishing the Total Marketing Communications Budget,Deciding on theMarketing Communications Mix, Managing the Integrated Marketing Communications Process, Implementing IMC, Managing Mass Communications: Advertising, Sales Promotions, Events and Experiences, and Public Relations, Developing and Managing anAdvertising Program, Communicating to the Rural Audience, Deciding on Media and Measuring Effectiveness, Sales Promotion in Indian market, Events and Experiences, Public Relations, Managing Personal Communications: Direct and Interactive Marketing, Word of Mouth, and PersonalSelling, Direct Marketing, Public and Ethical Issues in Direct Marketing, Interactive Marketing, Placing Ads and Promotions Online, Word of Mouth, Buzz andViralMarketing,Creating successful long term growth.

3. **Marketing research**
   Introduction to Marketing Research, Qualitative and quantitative research methods, Sampling methods, Questionnaire design, reliability and validity. Online survey method, Data preparation and data presentation (graphing), AnalysisofVariance (ANOVA)and Analysis of Covariance(ANCOVA),Cluster Analysis, Factor analysis, Presenting research information

4. **EmergingTrendsinmarketing:**RuralMarketing,Greenmarketing,Experientialmarketing,DigitalMarketing,ebusiness,Onlinemarketing,Onlineretailing,Neuroscienceandconsumer,Spor tsMarketing ,Media marketing and advertising, Brand Management, Innovation and marketing

Reference Books

- Marketing Management by Arum Kumar and N Meenakshi
- The Rural Marketing Book by Kashyap Raut
- MarketingManagementasouthAsianPerspectivebyPhilipKotler,KevinLanekeler,Abrahamko shiandMithileshwarJha,PearsonPrenticeHall,2009
- ResearchMethodology,ConceptsandcasesbyDeepakChawlaandNeenaSondhi,VikasPublishi nghouseprivatelimited
- MarketingmanagementRanjanSaxena,TataMcGrawHillPublishingCompany limited
- Marketingmanagement,CasesandConcepts,NikihileshDholakia,RakeshKhurana, Labdhi Bhandari, AbhinandanKjain, MacmilanIndia

Area5:EntrepreneurshipandSmallBusinessManagement

1. **Entrepreneurshipandeconomicdevelopment**

Entrepreneurship theory and literature: Entrepreneurship in India and abroad, Entrepreneurial motivation(socio-economic factorsinentrepreneurship development, basic skills in entrepreneurship),Entrepreneurial environment, Entrepreneurship development Programmes, Entrepreneurial functions, Analysis of barriers in entrepreneurship development, Analysis of success factors of entrepreneurship development.

Entrepreneurship'sImportance:Economicimpactofentrepreneurialfirms,Entrepreneurial Firms' impact on society, Entrepreneurial Firms' impact on larger firms, Entrepreneurial Firms' impact on overall economic development of a nation Entrepreneurship development.

2. **CreativityandInnovationinbusiness**
   Encouraging creativity at the firm level, protecting ideas from being lost or stolen, IPR, Creation of effective innovation, Market dynamics and new technology, Diffusion and adoption of innovations, Marketing and sales of technology based product sand services.

3. **Enterprise creation**
   Screening of ideas, opportunity identification and selection, moving from an idea to an entrepreneurial firm, New enterprise creation: Conceptual and analytical tools to understand, analyze and manage critical aspects of new enterprise, Buisness plan preparation and Analysis, feasibility analysis of business (product/ service feasibility, industry/market feasibility,organizationalfeasibilityandFinancialfeasibilityanalysis,Industry and competitoranalysis),Businesscrisis,Familybusinessmanagement,Smallandmedium enterprises(threats and opportunities),
   Developing an effective Business models: The importance of business models, How buisness models emerge, potential fatal flaws of business models.
4. **Enterprise Management Small and medium enterprise (managing and growing entrepreneurial firm): Essentials of management principles, its application on enterprise management, planning, importance and application of planning in an organisation, strategic planning and its application.**
   Human resource Management: recruitment, selection and induction of key employees, training and development, performance appraisals, application of exit interviews etc.,Board of directors, Professional advisers, lenders and investors, other professionals.
   OrganisationBehaviour: Motivationandbehavior,designingMotivatingjobs,perception,
   personality,Stressandbehavior,Groupbehavior,Intergrouprelations,conflictanditsimpactonor
   ganization,Leadershipinorganisation,followership,transactionanalysis,analysisandapplication of leadership styles, Organisation structure and design, Organisational change and development, organizational culture and climate.
   Controlling (PERT, CPM and other emerging methods to establish control in an

organization. Managinghuman resources and organization development and dynamics, Personnel and Industrial relations, Sources of capital and capitalization process, Venture capitals, Angel investors etc, Intrapreneurship.

5. **Microbusiness development**
   What are micro businesses, Role of Government in micro business development, Importance of micro businesses in an economy, Microfinance, Self help groups, Direct funding from financial institutions.
6. **New Age entrepreneurship**
   Agri-entrepreneurship,Edu-preneurship(education/academicentrepreneurship),Techno-preneurs (nanotechonology, biotechnology)
7. **Social Entrepreneurship**
   Socialentrepreneurship,socialentrepreneursaschangeagents,financialsustainability Social entrepreneurship in India and abroad
8. **Women Entrepreneurship**
   StateofwomenEntrepreneurshipinIndia.BarrierstowomenEntrepreneurship development.
9. **Business ethics**
   Corporate Social responsibility Corporate governance
10. **Succession Planning**
    BusinessgrowthandneedofsuccessionPlanninginIndia.Itsroleandimportancein expansion management.

Reference Books:

- SmallBusiness Management and Entrepreneurship by DavidStokes, NicholasWilson
- Think and Grow Rich by Napoleon Hillane -book
- Entrepreneurship and small business management by Norman MSc or borough
- EntrepreneurialDevelopmentByVasantDesai
- Entrepreneruship and entrepreneurial Development by M. Gangadhar Rao
- OrganisationalBehaviourByJitSChandan,VikaspublishinghousePrivateLimited

27. Nutritional Sciences (PHDFN)

C. ELECTIVE COURSES

Course: Advance Nutrition (RFNE004 - 8 Credits)

The course would cover the following concepts/topics:

- Nutrition: Basic concepts and physiological requirements,
- Recommended Dietary Allowances, Estimated Average Requirements, Tolerable upper limit, AMDR: Basic Concepts
- Nutrient Requirements for Indians: Energy Requirements, Protein and Amino Acid Requirement, Fat and Fatty Acid Requirements, Fat- Soluble Vitamins and Water- Soluble Vitamins, Mineral requirements etc.
- Nutritional needs during the life cycle: Pregnancy/lactation, Infancy, Preschool, School

Age, Adolescent, Adulthood and Old Age

- Diet planning during the life cycle
- Nutrition needs for sports person,
- Nutrition during Special Conditions – Emergency, High altitude, Space Mission etc..

Course: Clinical and Therapeutic Nutrition (RFNE003 -8 Credits)

The course would cover the following concepts/topics:

- Introduction to Diet therapy, Therapeutic Nutrition,
- Adaptations of Therapeutic Diets,
- Nutritional management of Fevers (Typhoid, Tuberculosis etc.) and infections (HIV/AIDS),
- Nutritional management of patient with Burns, Trauma, Sepsis and Surgery,
- Nutritional management of Food Allergies and Food Intolerance,
- Nutrition, Diet and Cancer,
- Nutrition care for Weight Management (Underweight, Overweight, Obesity),
- Nutritional management of Cardiovascular Diseases (Dysipidemia, Hypertension etc.),
- Nutritional management of Metabolic Diseases – Diabetes, Gout etc.
- Nutritional management of Gastrointestinal Tract Disorders (Peptic Ulcer, Ulcerative colitis, Dyspepsia, Malabsorption Syndrome etc.)
- Nutritional management in Pancreatic, Gall bladder and Liver Diseases,
- Nutritional management of Renal Disease,
- Nutritional management of Neurological Disorders (Ketogenic Diet etc.),
- Paediatric and Geriatric Nutrition.

Course: Public Health Nutrition (RFNE002 - 8 Credits)

The course would cover the following concepts/topics:

- Concept of Public Health Nutrition, Public Nutrition: Multidisciplinary Concept,
- Nutritional Problems of Public Health Importance – VAD, PEM, Anaemia, Iodine Deficiency Disorders, Zinc deficiency and Vitamin D deficiency,
  - Basic Concept, Etiology, Consequences
  - Strategies to Combating Public Nutrition Problems,
  - National programmes/policies related to prevention of deficiency disorders
  - Programme Management and Evaluation
- Health Economics and Economics of Malnutrition,
- Food and Nutrition Security,
- Assessment of Nutritional Status in Community Settings: Methods and Techniques,
- Nutrition Monitoring and Surveillance,
- National Nutrition Policy and Nutrition Programmes (Operational details):

- Supplementary feeding programmes,
- Nutrient Deficiency Control programmes,
- Food Security programmes etc.
- Programme Management and Administration,
- Infrastructure Systems for delivery of the nutrition and health services in India
- Conceptualization and the Process of Nutrition Education, Behaviour Change communication (BCC);
- Nutrition Education Programmes – Formulation, Implementation, Evaluation.

Course: Food Service Management (RFNE005 - 8 Credits)

The course would cover the following concepts/topics:

- History and Development of Food Service System;
- Planning/Setting Up a Food Service Unit;
- Entrepreneurship and Food Service Management;
- Menu Planning
- Food Management: Menu Planning, Purchase and Storage, Food Production, Delivery and Service: Goals, Styles and Different Systems; Records and Controls;
- Personnel management
- Leadership
- Staff Planning and Management (Approaches, Issues, employment process, staff recruitment and selection
- Staff Training (Need, Training process, Evaluation and Appraisal etc.)
- Work Productivity;
- Plant and Equipment Maintenance, Sanitation and Safety,
- Issues in Worker Safety and Security (Personal Hygiene and Sanitary Practices);
- Food hazards, Food borne diseases and their prevention
- Factors influencing growth of microorganisms
- Food Laws, Food Regulations, Standards and Quality control;
- Food Adulteration, Additives, Contaminants.

D. COMPULSORY COURSE

Course: Research Methods and Biostatistics (RFN001 - 8 Credits)

The course would cover the following concepts/topics:

- Basic Concepts; Formulation of Research Problem and Objectives;
- Designing research proposal and study
- Design Strategies in Research – Descriptive Studies, Analytic Studies, Experimental studies, Intervention trials etc.,
- Methods of Sampling,
- Data Collection Tools and Techniques,
- Presentation and Summarization of Data,
- Graphical presentation of quantitative data,

- Measures of Disease Frequency and Association,
- Reference Values,
- Health Indicators and Validity of Diagnostic Tests,
- Measures of Central Tendency: mean, medium, mode,
- Measures of Variability: Standard Deviation, Variance,
- Measures of Relationship – Correlation,
- Hypothesis Testing –parametric and non-parametric tests,
- Proportions, Relative risk, Odds ratio.
- Ethics and Scientific Writing for Research
- Computer Applications

28. Child Development (PHDCD)

The Entrance examination will be based on what is covered in the syllabus of the M.Sc. Home Science specialization 'Child Development' as well as the relevant components in the UGC-NET syllabus pertaining to the component 'Research Methodology' and the specialization component 'Child Development'. (The specialization 'Child Development' could be referred to by different names in various universities such as Human Development/Human Development and Childhood Studies/Human Development and Family Studies).

The outline of the syllabus is as follows:

Paper 1: Research Methodology (50%)

1. Purpose and characteristics of research.
2. Research approaches: quantitative, qualitative and mixed.
3. Positivism and post-positivistic approach to research; nomothetic and idiographic approaches.
4. Steps of research-the research cycle.
5. Research design, sampling and methods of data collection in quantitative, qualitative and mixed methods research.
6. Reliability and validity.
7. Values, Social Responsibility and Ethics in Research.
8. Sources, acquisition, and classification of data.
9. Basic principles and concepts in statistics; Descriptive Statistics; Probability and normal distribution.
10. Statistical tests-parametric and non-parametric tests of association and difference, regression; interpretation of tests
11. Data analysis and interpretation-quantitative and qualitative data.

12. Graphical representation (bar-chart, histograms, pie-chart, table-chart, and line-chart) and mapping of data.

13. Application of ICT in research.

Paper2: Subject specific : Child Development (50%)

1. Principles of growth and development.
2. Pregnancy and child birth.
3. Development through the lifespan in various domains (including physical-motor; cognitive, language, socio-emotional development).
4. Theories of child/human development and behaviour; cultural context of human development.
5. Early childhood care and education–curriculum, pedagogy and materials; activities to promote holistic development.
6. Influence of family, peers, school, community and culture on development.
7. Children and persons with disabilities-care and support, early intervention, special education, prevention of disabilities, rehabilitation.
8. Children at risk-child labour, street children, orphaned, abandoned and destitute children, child abuse and trafficking.
9. Adolescence and youth: developmental changes and challenges; Programme to promote optimal development.
10. Adulthood-characteristics, changing roles and responsibilities in early and middle adulthood.
11. Aging-physical and psychological changes; care, health and psychological needs.
12. Diversity, Disadvantage, Rights and Equity : Policies, Legislation, Strategies and Programme for Intervention and Inclusion
13. Parenting and Society; Counselling for optimal child development.
14. Research Methods in Child Development.

29. Home Science (PHDHC)

Community Resource Management and Extension Communication for Development (C4D) ICTforDevelopmentGenderandDevelopment Corporate Social Responsibility Capacity Building – Training, Advocacy and Development Entrepreneurship and Innovations Programme Management and Development Consumer Studies Sustainable Development – Policies and Programmes Resource Management Extension Education Ergonomics and Design Learningoutcomes:

· Building systematic, methodological and comprehensive gain in knowledge inthefield of Community Resource Management and Extension. · Enhancing research skills in the areas of: participatory and innovation communication strategies, resource management, product development; extension management and sustainable development of communities. · Preparing a cadre of professionals for planning and implementing various programmes in the development sector

Fabric and Apparel Science (8 Credits)

1. **Recent Advancements in Textiles and Apparel**

- Types of Novelty yarns,
- New generation of fibres (Specialty rayons (high wet modulus rayon, polynosics, etc); high tenacity polyester; microdenier polyester; aromatic polyester/co-polyester; speciality nylons and nylon-6 T; poly-aramid fibres (Nomex and Kevlar). Bicomponent / Multicomponent / Conjugate Fibres: Nanofibres; hollow fibres; microfibres; glass, ceramic and other inorganic fibres. Poly-blend fibres, elastomeric fibres and biodegradable synthetic fibres. Super absorbent fibres etc).

2. **Fabric Construction**

- Advance woven fabric such as welt and piques, bed ford cord, backed cloths, double cloth, gauze and leno fabrics, Turkish toweling, plied fabric, lapped and swivel fabric.
- Advancement in knitted and nonwoven fabrics, introduction of advance looms and weaving techniques

3. **Technical Textiles**

- Agrotech (Agro-textiles),
- Geotech (Geo-textiles) ,
- Meditech/Medtex (Medical textiles),
- Mobiltech (Textiles used in transport, Oeko tex,
- Smart textiles.

(Production of Technical Textiles: Coating, lamination, manufacturing polymer /resin based fibre reinforced composite products, functional finishing, and uses of smart polymers for manufacture of specialty products of different technical textiles.)

4. **Sustainable Textile**

- Eco friendly textiles, banned dyes and eco parameters.
- Environmental impact of Textile Industries, Pollution control and treatment of effluents, advanced Textile Production,
- Sustainability and Renewable Products, Circular Economy/ Certificates
- Eco Labels, Eco mark
- Sustainable textiles finishes
- Green Practices in textiles processing (dyeing, printing, finishing)

5. **Quality Assurance in textiles and Apparel industry**

- Concept of Quality, Inspection and its significance in textiles and Apparel industry.
- Introduction of defects: fabric, yarn, weaving, dyeing, printing and finishing**.** Textile testing, Standards follow in textiles industry.
- Apparel Testing: strength, dimensional changes in apparel due to laundering, dry cleaning, steaming pressing and color fastness, drapability & crease recovery,
- Standards: Benefits of standards, Levels of standards, Sources of standards, ISO 9000 Series Standards. Introduction to AATCC, ASTM, ISO, BIS, INDA
- Consumer Behaviors towards quality of products

6. **Functional Clothing**

- Clothing for special need
- Protective and functional clothing

- Medical function clothing
- Sports Clothing
- Cross function clothing

7. **CAD – Textiles and Apparel**

- Identification of recent software's used for textiles and apparel design
- Benefits of software's at textiles and apparel industry

8. **Visual merchandising**

- Recent advancement in Visual Merchandising
- Inage building and Brand portfolio

9. Entrepreneurship in textiles and apparel field

- Business opportunities in the field of textiles and Apparel
- Government policies for new business
- Strategies to plan new enterprises

.

B. Compulsory Course: Research Methodology (8 Credits) Introduction to Research Ethics in Research Research Methods and Approaches Conceptualization and Research Theory building Research Design – Qualitative and Quantitative Designing Research Proposal Methods of Sampling, Techniques of Data Collection Tool Construction – Reliability, Validity and Standardisation Statistical Methods (including Hypothesis Testing – parametric and non-parametric tests) Data Analysis, Interpretation and Report Writing Scientific Writing and Publishing Learning outcomes: · Developing research competencies in the field of Home Science. · Enhancing analytical abilities and strengthening research through research on community mobilization, participatory development, development communication extension and resource management. · Raising standards of the profession of Home Science through quality research andatthe same time promoting responsible citizenship

30. Vocational Education (PHDVE)

SYLLABUS FOR ENTRANCE EXAMINATION

Scheme:

- The written test will be of 100 marks.
- The duration of the written test will be of 3 hours.
- 50% questions will be based on Research Methodology and 50% on Vocational Education and Training.

A:RESEARCH METHODOLOGY

(a) Research Aptitude

- Understanding of research, **importance of research in vocational education and training**, process of research, research approach and significance of research, **knowledge generation**, research problem: definition, selection and necessity of research problem (quantitative v/s qualitative) and **area of research in vocational education and training.**

(b) Understanding of Research Methods

- **Quantitative, Qualitative, Historical/Descriptive and Mixed Research Methods.**

(c) Understanding of Research Design

- Experiential, Correlation, Survey, Case Study and Action Research.
- Data Collection Techniques: Designing a questionnaire, pretesting a questionnaire, editing of primary data, technique of interview, collection of secondary data, scrutiny of secondary data, scale of measurements.
- Sampling Techniques: Introduction to sampling, advantage of sampling over census, probability and non-probability sampling and non-sampling methods, basics of simple random sampling.
- Presentation of Data: Classification and tabulation of data diagrammatic and graphical presentation of data.
- Statistical Methods: Measure of Central tendency, measures of dispersion, simple correlation and regression, testing of hypothesis.

(d) Data Analysis and Report Writing

- **Application of ICT in research like Excel and SPSS software and ICT tools for data collection and analysis like Google Forms etc.**

(c) Report Writing: Format of Report and presentation **and ethical consideration in VET Research.**

Suggesting Readings/References/ Web pages

Khan, J.V. and Best, J.W. (2016) Research in Education, 10th Edition, Pearson (Kindle Edition).
Koul, L. (2020). Methodology of Educational Research, 5th Edition, New Delhi: Vikas Publication
Creswell, J. W. (2014). Research design: qualitative, quantitative, and mixed methods approaches. Sage publications.
IGNOU (2009) Educational Research, MES-016 (http://egyankosh.ac.in).
IGNOU (2018) Research for Distance Education, MDE-415 https://egyankosh.ac.in/handle/123456789/42619
Elements of Research Methodology and Types of Data Used in Social Research: http://egyankosh.ac.in/bitstream/123456789/26098/1/Unit-13.pdf
Types of Research: http://egyankosh.ac.in/bitstream/123456789/26100/1/Unit-12.pdf
Elements of Research Methodology and Types of Data Used in Social Research: http://egyankosh.ac.in/bitstream/123456789/26098/1/Unit-13.pdf
Types of Research: http://egyankosh.ac.in/bitstream/123456789/26100/1/Unit-12.pdf
Research Design: http://egyankosh.ac.in/bitstream/123456789/26096/1/Unit-14.pdf

Sampling Methods and Estimation of Sample Size: http://egyankosh.ac.in/bitstream/123456789/26109/1/Unit-15.pdf
Measures of Central Tendency: http://egyankosh.ac.in/bitstream/123456789/26108/1/Unit-16.pdf
Variance and Standard Deviation: http://egyankosh.ac.in/bitstream/123456789/26106/1/Unit-17.pdf
Tests of Significance: http://egyankosh.ac.in/bitstream/123456789/26104/1/Unit-18.pdf
Correlation and Regression: http://egyankosh.ac.in/bitstream/123456789/26101/1/Unit-19.pdf
Survey Methods and Design: http://egyankosh.ac.in/bitstream/123456789/67343/1/Block-6.pdf
Data Analysis and Research Findings: http://egyankosh.ac.in/bitstream/123456789/67345/1/Block-8.pdf

B: VOCATIONAL EDUCATION AND TRAINING

A. Vocational Education & Training

- **Vocational Education, Growth and Development, Vocational Education for Sustainable Development Goals (SDGs), VET and National and e Global Perspectives, Recent Trends in Vocational Education, Futuristic Approach[2].**
- **Issues in VET-**Social Acceptability, Access, Terminal Nature of Courses, Employability, Multi-Skilling, Managing a Small Enterprise, Remunerative Structure (wages and earnings) of vocationally trained person; Trend and Issues in Technical and Vocational Education.

B. Pedagogy of Vocational Education and Training

- **Pedagogy of Work, Curriculum Development for VET, Use of Instructional Media and Materials[3]. Assessment and Evaluation of VET.**

C. The Changing World of Work

- **Skill Forecasts, Skill Development Initiatives in India, VET and ICT, Quality Assurance in VET[4] and Green Skills.**

D. Policy, Planning and Management of VET

- VET system in India. NEP-2020 Policy, Planning and Administration: Policy and Vision, Education Sector (School and Tertiary Education)/ NCVET, MSME, Sector Skill Councils and Entrepreneurship and Government Schemes in different sectors of skill developments. Issues and Challenges of VET in Higher Education.

Suggesting Readings/References/ Web pages

[1]**Hyland, T, Winch, C 2007, *Guide to vocational education and training*, Continuum International Publishing, New York.**
[1]**Naidu, R., Stanwick, J. and Frazer, K. (2020). Glossary of VET, National Centre for Vocational Education and Research (NCVER) (https://www.voced.edu.au/vet-knowledge-bank-glossary-vet).**
[2]**IGNOU (2009) Vocational Education, MESE-062, SOE, IGNOU (https://egyankosh.ac.in/handle/123456789/848)**
[3]**Pedagogy of Vocational Education and Training, SOVET, IGNOU**
[4]**McGrath, S., Mulder, M. and Paper, J. (2019): Handbook of Vocational Education and Training.** Developments in the Changing World of Work.
UNESCO (1985), Studies in technical and vocational education policy, planning and administration, Paris.
Finch, C.R. (1979), Curriculum development in vocational and technical education, Boston Allyn and Bacon.

i. https://unevoc.unesco.org/up/India_Country_Paper.pdf
ii. https://unevoc.unesco.org/home/TVETipedia+Glossary/filt=all/id=545
iii. https://www.aicte-india.org/education/vocational-education
iv. https://msde.gov.in/en/schemes-initiatives/apprenticeship-training/naps
v. https://msde.gov.in/en/schemes-initiatives/schemes-initiatives-through-nsdc/udaan
vi. https://msde.gov.in/en/organisations/ncvet
vii. http://psscive.ac.in/about/psscive
viii. http://moef.gov.in/en/environment/pollution/
ix. https://nios.ac.in/departmentsunits/vocational-education.aspx

31. Development Studies (PHDDV)

COURSE1: DEVELOPMENT STUDIES:ANOVERVIEW(8CREDITS) BLOCK 1: DEVELOPMENT: AN OVERVIEW

Unit 1: Introduction to Development: Why Development? Objectives and Scope of Development; development and growth; Development Ethics: Gandhi, Lebret,Myrdal and other ethical concepts

Unit2: Dimensions of Development: Economic, Political, Social, Human, Cultural, Genderand Ethical Dimensions

Unit 3: Development Paradigm: Inclusive Development, Sustainable Development, Good Governance, International Relationship, Women Empowerment and Participatory Development Paradigms

Unit 4: Actors of Development: Markets, State and other Heterogeneous Actors such as international organization, and CVOs

BLOCK 2: DEVELOPMENT THEORIES

Unit 1: Classical and Neo-Classical Theories and Marxian theory

Unit2:DevelopmentalistTheories:BalancedandUnbalancedGrowththeories,Rostow's Stages of Economic Growth, Gunnar Myrdal theory

Unit 3: Heterogeneous Theories: Modernization theory, Human Capital Theory, Neo- Liberal Theory and Dependency Theories

BLOCK 3: EDIFICES OF DEVELOPMENT

Unit 1: Development Governance: meaning and scope of development governance; functions and components; features of good governance; attributes and challenges of good development governance

Unit 2: Development Administration: concept and meaning of development administration, scope of development administration, features of good development administration, and challenges of development administration

Unit 4: Development Management: meaning and concept of development management, aim and scope of development management; development management cycle and requisites of effective development management

BLOCK4:DEVELOPMENTALISSUESANDCHALLENGES-I

Unit 1:Economic Challenges:Poverty, Inequality, InflationandUnemployment, Population and Development

Unit2:SocialChallenges:ConflictandDevelopment,DisplacementandDevelopment,Marginalization, Social Disparities and Inclusion, Education and Health

Unit3:EmergingChallenges:Globalization,Climatechange,SocialClustering,Regional Development

BLOCK 5: DEVELOPMENT ISSUES AND CHALLENGES-II

Unit1:AgricultureandDevelopment:Roleofagriculture,IssuesandChallengesof agriculture, Measures to improve agriculture

Unit 2: Industry and Development: Role of industry in development, Issues and Challenges of

industrial Development, Industrial Development measures

Unit3:ServiceSectorandDevelopment:Roleof Service Sector in Development, Issues and challenges of service sector, measures to strengthen service sector.

Unit 4: Informal Sector and Development: role of informal sector in development, measures to formalize the informal sector and challenges of informal sector

BLOCK 6: INDIAN DEVELOPMENT

Unit 1: Urban Development in India: Urbanization, Issues and Challenges of Urbanization, Smart Cities

Unit 2: Rural Development in India: Components of Rural Development, Models of Rural Development, Issues and Challenges of Rural Development,Smart Village, Rural Development measures

Unit 3: Planning and Development in India: Impact of planning before and after liberalization and NITI Ayyog

Unit5:GlobalizationandDevelopmentinIndia:Globalizationanditsimpactonthe development in India

REFERENCES

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(ed.), Approaches to Development: Politics, Administration and Charge, MacGraw- Hill, New York, pp59-65.

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Pattanaik B K (2016): Introduction to Development Studies, Sage, New Delhi. PattanaikBK(2017):IssuesandChallengesofDevelopment,Sage,NewDelhi.

Preet R andHartrick,E(2009):TheoriesofDevelopmentContents,Arguments,Alternatives,The Guilford Press, New York.

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Tadaro,MP(1977):EconomicsforaDevelopingWorld,Longman,London.

Tadaro, M P and Smith S C (2012): Economic Development Third Edition, Dorling Kindersley(India) Private Ltd., New Delhi.

UNCTAD(2009): The Least Developed Countries Report 2009, New York and Geneva, United Nations Publication.

United Nations (1975): Developemnt Adminstrtion:Current Approaches and Trends in Public Adninistration for National Developemnt, Kew York, United Nationa, p189.

United Nations Development Programme(2001): Human Development Report, Oxford University Press, Oxford.

World Bank(2000):, New Paths to Social Development, Community and Global Net Work in Action, World Bank, Washington.

Zafarulla, H and Huque, A S (2006): "Understanding development governance: Concept, institution and process" in Haque A.S. and Zafarulla, H (ed.) International Development Governance, Taylor and Francis, PP 13-50.

COURSE 2: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES(8

CREDITS)

BLOCKS	UNITS
Block-1	Fundamentalsof Social Science Research 1.Social Science Research-An Overview 2.Component of Social Science Research 3.Research Designs 4.Research Project Formulation
Block-2	Development Research 1.Basic of Development Research 2.Methods of Development Research 3.Development Research Applications
Block-3 Measurement and Sampling	1. Measurement 2. Scales and Tests 3. Reliability and Validity 4. Sampling
Block-4	Data Collection andAnalysis-1 1.Quantitative Data Collection Methods and Devises 2.Qualitative Data Collection Methods and Devises 3.Overview of Statistical Tools
Block -5	Data Collection andAnalysis-2 1.Data Sources-Uses and Limitations 2.Data Processing and Analysis Report Writing 3.Report Writing 4.Use of Computer in Data Analysis

32. Gender and Development Studies (PHDGDS)

Course I (8 credits) Concepts and Theories for PhD in Gender and Development Studies
1. Concepts and Theories
Goals and Praxis of Gender and Development, History of Feminists Movement and Formation of Patriarchy, Emergence of Gender and Development Studies in India, Gender Sensitive Planning and Policy Making, Gender Mainstreaming, Gender Analysis, Gender Auditing and Gender Budgeting, Gender and Democracy, Gender Justice, Gender Equality and Equity.
2. The Development Debate
Changing Notions of Development, Development and Post Development Theories, Critique of Development theories from a Gender Perspective, Development and Underdevelopment

(Dependency Theory and its Critiques); WAD/WID/GAD, Power and Decision Making, Gender and Empowerment, Gender and Poverty, HDI, GDI, GEM -Approaches and Indicators.

3. Gender and Livelihoods

Issues in Gender and Environment, Climate Change, Sustainable Environment, Green Politics, Food Security; Land Rights, Right to Forest Resources, Gender, Water and Sanitation, Security of land tenure, Sustainable Development, Ecological Security.

4. Gender and Work

Theories of Feminist Economics; Debates on Women's Labour, Gender Based Division of Labour in Pre-Industrial and Industrial Society, Gender Segregation in the Labour Force, Labour Force Participation of Women in National Economy, Productive and Unproductive Work, Domestic Labour, Female Headed Households, Women and issues of Poverty, Visibility of Women in Statistics and Indicators, Gender Concerns in Formal and Informal Sectors, Social Security and Decent Work, Women's Contribution to National Wealth.

5. Demographic, Nutrition and Health Dimensions

Demographic Characteristics (Sex ratio, Population distribution, Census Enumeration and the debates on Indian Census), Gender Based Violence, Migration, Gender and Health (Nutritional Needs, Occupational Health) Poverty and Food Security, Basic Needs and Development Goals

6. Gender and Culture

Debates in Gender and Culture, Construction of Gender, Formation of Patriarchy, Nature of Indian Patriarchy, Variations in the Theories of Femininity and Masculinity: Cross- Cultural Perspectives, Gender Roles, Gender Ideology, Issues of Ethnicity and Multiculturalism;

Communitarianism, Recent debates in Gender and Literature: Post-structuralism; Post-colonialism; Post-feminism; Feminist Futures; Eco Feminisn and Environmental Humanisms,

Communication, Media and Gender Debates, Changing Gender Roles and Identities: Sexualities and Queer issues; Recent debates on Gender, Education and Social Development, Social Equity and Distributional Aspects of Development in Education and Health.

7. Case Studies and Selected Readings

Course II

Research Methodology in Gender and Development Studies (8 credits)

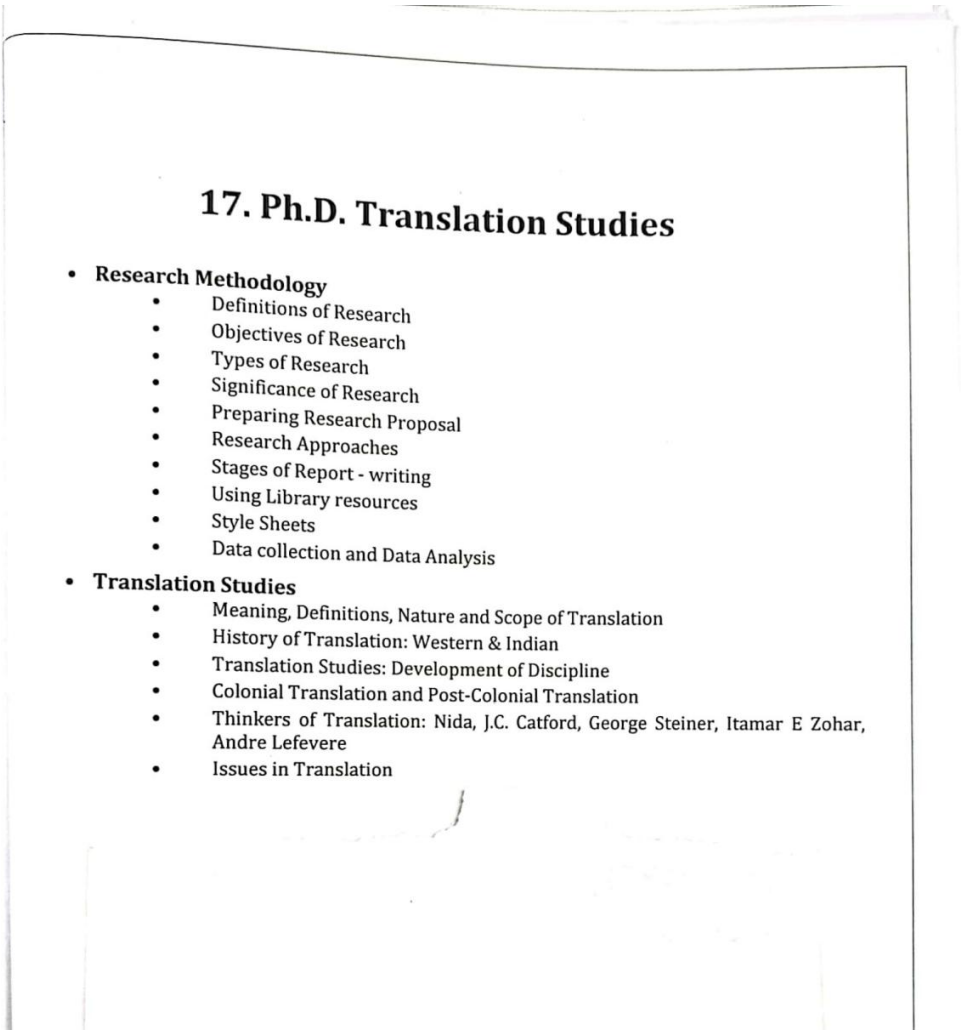
1. Researching Gender- I

Debates in the difference between Social and Natural Science, Positivism, Empiricism, Rationalism, Realism, Post Empiricism, Feminist Critique of Positivism, Feminist Epistemology, Stand Point Theory; Gendered Ontology and Changing terms of Societal Inquiry: Liberalism, Marxism, Hermeneutics, Feminism, Post- Modernism, Post- Colonialism and Post-structuralism,
Gender and Ethnographic Cultural Studies, Life Histories and Narratology, Gender and Discourse Analysis

2. Researching Gender- II
Quantitative and Qualitative Research, Feminist Paradigms, Feminist Research Methods and Ethics, Situating Differences, Interdisciplinary Methods in Feminist Research.
Processes of Gendering and the Institutionalizing Gender and Gender Relations, Building Alternative Knowledge Base and Feminist World View (Weltanchauung): State, Society, Industry and Market.
3. Research Design, Types and Strategies
Research Design, Exploratory Studies, Surveys, Historical, Experimental, Ethnographic and Case Studies; Types of Research- Fundamental, Applied Research, Action Research, Experimental, Ex-Post Facto Research, Descriptive, Correlational Research, Participatory

Research, Special Approaches for Studying Gender- Sensitive Problem- Centred, Policy Relevant and Action Oriented Research, Linking Policy and Research as Strategies for Advocacy
4. Sampling
Definition of Population, Sample, Merits and Demerits of Sampling; Probability Sampling: Random Sampling, Multi-stage Sampling, Cluster Sampling, Non- Probability Sampling, Purposive Sampling, Convenience Sampling, Quota Sampling; Sampling Designs for Various Types of Research; Critical Review of Sampling Design of Different Research Studies.
5. Tools and Techniques of Research
Questionnaire, Interview (Media and Internet), Scaling, Measurement, Focus Group Discussions,
Observation, Narration, Gender Analysis Matrix and Impact Flow Chart
6. Selected Studies in Gender and Development\
Factors Determining and Influencing Gender and Development; Gender Division of Labour, Time use Survey and Management; Women's Status and Challenges; Household allocation of Resources; Access to Natural Resources; Time Scale for Rural Households; Value Added Analysis for Households: Production/Goods/Resources, Household Decision Making.
7. Data Analysis
Quantitative Data Analysis; Parametric Tests used for Quantitative Data Analysis; Qualitative Data Analysis, Non-Parametric Tests used for Analysis of Qualitative Data; Presentation of Data
(Tables, Graphs etc.); Interpretation of Data.
8. Preparing and Presenting Research Reports
Evaluation Research; Report Writing/Paper Presentation, Bibliography/References/Citations; Research Ethics; Research Proposals Seeking Grants; Research Funding Sources

33. Translation Studies (PHDTT)



17. Ph.D. Translation Studies

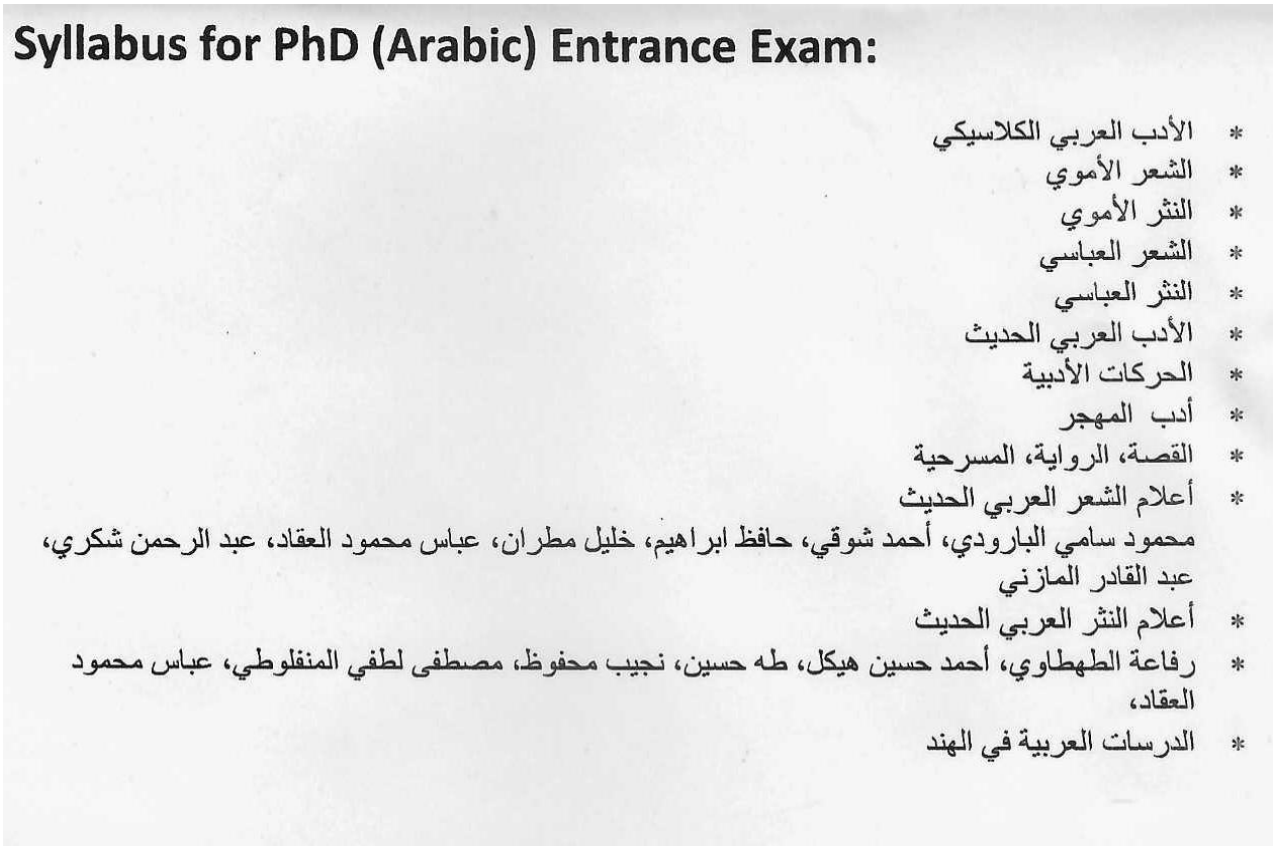
- **Research Methodology**
  - Definitions of Research
  - Objectives of Research
  - Types of Research
  - Significance of Research
  - Preparing Research Proposal
  - Research Approaches
  - Stages of Report - writing
  - Using Library resources
  - Style Sheets
  - Data collection and Data Analysis
- **Translation Studies**
  - Meaning, Definitions, Nature and Scope of Translation
  - History of Translation: Western & Indian
  - Translation Studies: Development of Discipline
  - Colonial Translation and Post-Colonial Translation
  - Thinkers of Translation: Nida, J.C. Catford, George Steiner, Itamar E Zohar, Andre Lefevere
  - Issues in Translation

34. French (PHDFL)

A. **Research methodology: Approaches and categories/types of research; selection of subject; research design; sampling techniques; data gathering, fieldwork, primary & secondary sources, questionnaires and data collection tools , data analysis, quantitative and qualitative analysis, referencing and annotation: research ethics.**

B. **French and francophone Literature (17th-20th century); Linguistics ; Theories of Translation & Interpretation; Didactics of foreign languages with emphasis on FLE: Trends and Theories; History, Culture & Civilization of France (17th-20th century), Current contexts in socio political trends in France; Francophonie : history, culture and literary trends; Introduction to Open and Distance learning – FOAD., Digital Tools & Technology in Language Studies; Popular culture in France : art, cinema & theatre; India and the French Connection—Polity, Culture and History.**

35. Arabic (PHDAL)



Syllabus for PhD (Arabic) Entrance Exam:

* الأدب العربي الكلاسيكي
* الشعر الأموي
* النثر الأموي
* الشعر العباسي
* النثر العباسي
* الأدب العربي الحديث
* الحركات الأدبية
* أدب المهجر
* القصة، الرواية، المسرحية
* أعلام الشعر العربي الحديث

محمود سامي البارودي، أحمد شوقي، حافظ ابراهيم، خليل مطران، عباس محمود العقاد، عبد الرحمن شكري، عبد القادر المازني

* أعلام النثر العربي الحديث
* رفاعة الطهطاوي، أحمد حسين هيكل، طه حسين، نجيب محفوظ، مصطفى لطفي المنفلوطي، عباس محمود العقاد،
* الدرسات العربية في الهند

36. Journalism and Mass Communication (PHDJMC)

1. Media and Society - functions, role, access and interaction. Contemporary developments in the media as an institution.

2. Concepts and models of various communication settings : Communication: Concept & Process; Models of Communication; Theories of Mass Communication

3. Different Schools of thoughts - related communication discipline : Media Content: Information, Education & Entertainment; Functions of Media; Impact of Media; and Media Economics and Finance.

4. Mass Audience; Access to Media; Mass Media Policies. Health & Education; Gender and Media; Media and Environment; Media & Human Rights.

5. Mass Communication and Culture; New Media, Networked Society – New Theory; Media Economics, Ownership, Control and Governance; The Production of Media Content; Media Content: Issues, Concepts and Method of Analysis;

6. Media and Information Literacy; MIL Competencies; Theoretical approaches of MIL, Interplay between MIL and Sustainable Development Goals.

7. The Behaviorist and Cognitive Orientations: The Learning Theories. The Yale Communication Research Studies. Persuasion and Attitude. Social Judgement Theory (Sherif et al.) Theory of Reasoned Action (Fishbein & Ajzen). The Cognitive Theories: The Balance, Dissonance, Congruity and Consistency theories and their applications to communication research.

8. Media and communication role in Open Learning

9. Critical Orientations: The Feminist Theories – The Culture Studies Theories.

10. Children and Media Violence: Social learning Theory/Social Cognition (Bandura); Disinhibition and Cue Theory (Berkowtiz); and Arousal Theory / Excitation Transfer (Tannenbaum and Zillman).

11. "Middle Range" Theories (Selections): Uses and Gratifications; Agenda Setting by the Media; Cultivation of Perceptions of Reality (George Gerber); Limited and Selective Influences Theory.

12. Overview of communication research paradigms: philosophical assumptions of positivism, interpretivism, critical paradigms. What is scientific? Logic of scientific reasoning: Terms, propositions, arguments; deductive and inductive reasoning in research

13. Research design: Quantitative Variables: Types of variables; unit of analysis; exploratory, explanatory and predictive research, Measurement: conceptual and operational definitions; levels of measurement: nominal, ordinal, interval, ratio; basic understanding of reliability and validity. Sampling: why sample? Samples and population of interest; sampling design: probability and non-probability sampling; factors affecting choice of sampling design; sample size and determining sample size; stages of quantitative research

14. Data collection methods: Quantitative Experimentation: Logic of experimentation: testing causal relationships; random assignment; internal and external validity; sampling in experiments; experimental designs; field experiments. Survey research: General features of survey design; strengths and limitations; survey research designs: cross-sectional and

longitudinal. Questionnaire construction: Steps leading to construction of questionnaire; content and format; leading and loaded questions; pre-testing questionnaires; tabulating data.

15. Data analysis: Quantitative. Introduction to statistics, Measures of central tendency: Mean, median , mode; when to use them. Measures of dispersion: range, semi-quartile range, standard deviation. z-scores: location of scores and standardized distributions. Introduction to probability; Probability and samples: The distribution of sample means; Hypothesis testing procedure.

***