SUB.: Subject-wise syllabus for the entrance examination to be held on December 4, 2016.

SCHOOL OF CONTINUING EDUCATION

**Discipline: Rural Development**

1. **Rural Development in India** – Rural society and economy, concepts & strategies of rural development, agrarian issues, rural development administration, land reforms, Panchayati Raj, cooperatives, rural credit and banking, dynamics of change in rural India.


3. **Rural Development Planning and Management** – Planning process, multi-level planning, district planning and grass roots level planning; issues in management of rural development project, project appraisal-financial feasibility, economic feasibility and technical feasibility, monitoring and evaluation of projects. Voluntary Action – voluntary efforts in rural development, voluntary agency administration, social action, formation and strengthening of voluntary organisation.


5. **Research Methods in Rural Development** – Formulation of research problem, preparing a research proposal, methods in social research, designing a research, Methods of sampling study, tools of data collection, data processing and analysis, Reporting research.

**Discipline: Food & Nutrition**

**A. Research Methods and Biostatistics** (50 Marks)

Basic Concepts; Formulation of Research Problem; 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; Measures of Variability; Measures of Relationship – Correlation, Hypothesis Testing –parametric and non-parametric tests; Proportions, Relative risk, Odds ratio;

**B. Subject Specific** (50 Marks)
Advance Nutrition
Nutrition: Basic concepts and physiological requirements; Nutritional needs during the life cycle: Dietary Reference Intake: Basic Concept, Energy Requirements, Protein and Amino Acid Requirements, Fat and Fatty Acid Requirements, Fat- Soluble Vitamins and Water- Soluble Vitamins, Minerals; Nutrition through the Life Cycle, Sports Nutrition, Nutrition during Special Conditions – Emergency, High altitude, space mission.

Clinical and Therapeutic Nutrition
Introduction to diet therapy and therapeutic nutrition; Adaptations of therapeutic diets; Nutritional management of fevers and infections; Nutrition in critical care; 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; Nutritional management of cardiovascular diseases; Nutritional management of metabolic disease; Nutritional management of gastrointestinal tract disorders; Nutritional management in pancreatic, gall bladder and liver diseases; Nutritional management of renal disease; Nutritional management of neurological disorders; Paediatric and geriatric nutrition.

Public Nutrition

Entrepreneurship and Food Service Management
History and Development of Food Service System; Planning a Food Service Unit; Setting up a Food Service Unit; Entrepreneurship and Food Service Management; Menu Planning; Food Purchasing and Storage; Quantity Food Production; Food Management: Records and Controls; Delivery and Service - Goals, Styles and Different Systems; Administrative Leadership; Staff Planning and Management; Personnel Functions: Work Productivity; Plant and Equipment Maintenance; Plant – Sanitation and Safety, HACCP, risk analysis; Issues in Worker Safety and Security; Issues in Food safety, Standards and Quality control; Food Adulteration, Additives, Contaminants.
पी.एच.डी. (हिन्दी) में नामांकन हेतु आयोजित परीक्षाएँ के लिए पाठ्यक्रम (Syllabus)

परीक्षा की अवधि : 03 घंटे
कुल अंक : 100

परीक्षा पत्र और अंकों का विभाजन:

परीक्षा खंड : शोध परिवर्तन 50 अंक
द्वितीय खंड : हिन्दी भाषा और साहित्य 50 अंक

निर्धारित पाठ्यक्रम :

परीक्षा खंड :
- अनुसंधान का स्वरूप
- अनुसंधान और आलोचना
- अनुसंधान की विभिन्न परिवर्तन
- अनुसंधान की तैयारी
- लेखन पद्धति

द्वितीय खंड :
- हिन्दी भाषा और साहित्य का इतिहास
- आधुनिक और समकालीन हिन्दी साहित्य की परमुख पर्यवर्तियों
- हिन्दी गद्य और उसकी विभिन्न विभागें
- हिन्दी कला (आदिकालीन कविता से समकालीन कविता तक)
- साहित्य निर्माता और सामाजिक
- साहित्यिक रचना/कृति पर समीक्षात्मक आलेख

नोट: सभी परीक्षा निर्बंधात्मक/विश्लेषण उत्तरीय होंगे।

Discipline: English

Research Methodology
Critical Theory
History of English Literature
British poetry, novel and drama
Aspects of Language
New Literature
Indian Writing in English
Indian Writing in English Translation
Australian Literature
American Literature
Canadian Literature
African Literature
Folk Literature

The pattern will be:
50% Research Methodology
50% Subject specific
Essay type questions with enough choice so that students can attempt questions related to their field of specialization in MA.
SCHOOL OF TRANSLATION STUDIES

Discipline: Translations

Syllabus of Entrance Examination for Admission of M.Phil./Ph.D. in Translation Studies

- Research Methodology
  - Definition of Research
  - Objectives of Research
  - Types of Research
  - Significance of Research
  - Preparing Research proposal on a topic relating to Translation Studies
  - Research Approaches
  - Stages of writing Dissertation/Thesis
  - Using Library resources
  - Style sheet
  - Research Ethics

- Translation Studies
  - Meaning, Nature and Scope of Translation
  - Role of Translation in Dissemination of Knowledge
  - Translation Studies in 21st Century as a Discipline
  - Future of Translation
  - Loss & Gain in Translation
  - Problem of Untranslatability
  - Translation and Indian Multilingualism
  - Translation from Hindi to English and vice-versa i.e. English to Hindi

Design of Question Paper

Maximum Marks : 100 Time Allowed : 3 hours

1. Question paper will be divided into 2 parts comprising of 50 marks each.

2. Part I will be focused on Research Methodology whereas Part II will be pertaining to Translation Studies. Candidates will be asked to attempt all the questions. Part I will consist 2 questions of 20 marks each and the 3rd question will be focused on a short note of 10 marks. All the Questions will have internal choice.

3. In Part II there shall be one question of 20 marks with an internal choice and the other one will be a short note of 10 marks with an internal choice.

4. Students will be required to translate from English to Hindi and vice-versa one passage comprising 10 marks each. Internal choice will be given for translating passages.
Discipline: Interdisciplinary and Trans-Disciplinary Studies

I
Research Design
20 Marks
Research Problem, Background of the Problem, Understanding the Literature, Capturing the Gaps, Framing the Objectives, Testing the Hypotheses Research Question, Data Sources Analytical Statistical Tools, Importance of the Research Study.

II
Research Methods, Data Sources and Statistical Tools
30 Marks
Research Methods – Qualitative and Quantitative, Understanding Interdisciplinary Research.
Secondary Data Sources, Archives, Census, NSSO, etc; Primary Data Sources- Interview/Questionnaire/Schedule/Case Study/Participatory Observation
Sampling Techniques; Random and Non-Random, Statistical tools- Trend Correlation, Regression

III
Themes of contemporary Research
50 Marks
Migration, Labour, Diaspora, Gender and Women Studies, Population and Environment, General Environment, Tribal and Folklore Studies.
SCHOOL OF TOURISM AND HOSPITALITY SERVICES MANAGEMENT

**Discipline: Tourism**

**SCHEME:**

- The written test will be of 100 marks
- The duration of the written test will be of 3 hours
- There will be two sections. Section A will be Objective type of 40 marks while Section B will be Subjective type of 60 marks.
- 50% questions will be based on Research Methodology and 50% on Tourism and Hospitality

**SYLLABUS**

The syllabus broadly covers the following areas

1. **RESEARCH APTITUDE, GENERAL AWARENESS, LOGIC & REASONING**

   The nature of filed techniques; Field techniques and tourism and hotel business; Importance; and limitations.
   Research: Meaning; Types; Trends, and challenges with special reference to tourism and hotel business. Guiding principles in selection of research problem.
   Research Methodology: Meaning; Procedural Guidelines; and Research design. Field Procedure for Data Collection and Analysis Techniques: Nature, Sources of data, Techniques of data collection.
   Frequency Distribution : Meanings, Problems and considerations in construction numerical frequency distributions.
   Measures of Central tendency and variation.
   Correlation and regressions analysis.

   **Probability and Probability Distributions :**
   Probability : Meaning; Definition; and sample points and sample space, Events, Conditional probability, Bayes theorem and probability on large sample space.
   Probability Distributions : The binomial model; The poisson model; and Normal distribution.

   **Sampling and Statistical Testing :**
   Sampling and Sample Designs : Sampling and reasons for sampling; Theoretical basis of sampling; Basic concepts of sampling and types of sampling (Random and Non-random sampling). Central limit theorem.
   Statistical Testing : Formulation and general procedure of testing of hypothesis, One-tail test and Two-tail test.
**Parametric and Non-Parametric Testing:**
Testing the Hypothesis: Comparison of two population means; Comparison of two population proportions, and Comparison of two population means and standard deviations. F-test, Student’s distribution and Chi-square test.

General Aptitude, Reasoning and Logic, General Knowledge, Report writing and Presentation

### II. TOURISM

**a) Tourism Concepts, terms and principles**
Tourism components, Types and typologies, Pull and Push forces in tourism, Travel motivator and barriers, Linkages and Channels of distribution in tourism. Tourist markets and Tourists profiles, Carrying capacity.

Tourism Planning: Origin, concept and approaches, Level and types of tourism planning, complex, centralized and Decentralized, Product life cycle theories and their applicability in tourism planning a, Urban and rural tourism planning, Tourism planning and policy perspective, planning at national, state and regional levels, India’s tourism policies

**b) Tourism resources and products**
Concept of resource, Attraction and product in tourism
Tourism products: Typology and unique features.
Cultural Tourism resources in India: Natural, staged and Manmade

**c) International Tourism and Trends**
Branding, Marketing, Competition, Outbound business and destinations, designing itineraries and packaging of tours, niche tourism products

**d) Emerging and Allied areas**
Sustainable/Eco/Rural/Agri/Farm/Green/Wildness/countryside/Special interest tourism, others

Strategic Marketing; Crisis Management, threats to tourism, Service characteristics of tourism, Tourism marketing mix, Measuring and forecasting tourism demand, Forecasting method, managing capacity and demand, Market segmentation and positioning, Tourist behaviour, differentiation and competitive marketing strategies, New product development, Distribution channels and strategies, Marketing of Tourism Services, Marketing Skill for tourism

Management: Concept, nature, Process and Functions, Management levels Managerial skills and roles, the external environment, Social responsibilities and ethics, POSDCORB

### III. Accommodation:
Concept, Types and Typologies, Linkages and Significance with relation to tourism.

Emerging dimensions of accommodation industry – Heritage hotels, Motels and resort properties, Time share establishments.
Hotel and Hoteliering: Origin, Growth and diversification. Classification, registration and gradation of hotels. Organisation structure, Functions and responsibilities of the various departments of a standard hotel / other catering outlets, viz, bars, restaurants, fast food centres, in flight catering.

Leading multinational hotel chains operating in India. Public sector in HRD perspective with special reference to India- Requirements, Training facilities, Constraints and Scope.

Fiscal and non-fiscal incentive available to hotel industry in India. Ethical Legal and regulatory aspects.
**SCHOOL OF SOCIAL SCIENCES**

**Discipline: History**

The question paper will have two equal parts.

i) The first part will cover Research Methodology and Historiography. This part will contain questions relating to Sources, Research methods and Writings in History.

ii) The second part will cover Indian History. This part will contain questions relating to the themes pertaining to Ancient, Medieval and Modern periods of Indian History.

Both the parts will have in built choices to provide scope to students coming from various specializations. The students would be asked to give descriptive answers. The question paper will be of 3 hours duration.

**Discipline: Economics**

The syllabus includes topics from research methods and economic theory, mostly microeconomics and macroeconomics. Research methods carry a weightage of about 50 per cent. The questions are both objective type (with negative marking) and descriptive type. The outline is given below.

**Research Methods**

Issues and Perspectives of Research

Methods and Design of Research: Conceptual foundations

Data: types and collection methods

Data analysis: Quantitative methods of analysis - correlation, regression; Qualitative methods

Inferential statistics: sampling, hypothesis, statistical tests, inferences

**Microeconomics**

Consumer Behavior: theory of Demand, Recent Developments of Demand Theory

**producer Behaviour: Theory of Production, Theory of Cost**

Price and Output Determination: Perfect Competition, Monopoly, Monopolistic Competition, Collusive and non-collusive Oligopoly, Alternative theories of Firm


General Equilibrium

Economics of Uncertainty: Choice in Uncertain Situations, Insurance Choice and Risk

Game Theory: Cooperative and non-cooperative games

**Macroeconomics**

Classical and Keynesian Approaches, Neoclassical Synthesis, Economic Growth - Solow Model, Endogenous Growth Model, Rational Expectations,

Inter-temporal decision-making - Ramsey Model, Overlapping Generations Model, Money and the Role of Monetary Policy,

Business cycles - traditional theories, Real Business Cycles
Discipline: Sociology

Section - A
1. Research Methodology
   • Logic of enquiry in social research
   • Logic of Theory Building
   • Issues of epistemology
   • Positivism and its critique
   • Comparative Method
   • Feminist Method
   • Participatory Method
2. Research Methods and Research Design
   • Types of Research
   • Methods of Research
   • Research Design
   • Techniques of Data Collections: Sampling, Interview, Case Study, Life History, Observation, Hypothesis, Correlation and regression

Section - B
• Sociological concepts: social groups, social structure, community, association, culture, identity, tradition, modernity, social processes, social Institutions- family, marriage, kinship, state, religion
• Sociological Theories: Evolutionary- Functional, Marxian, Structural-Functional, Structural, Symbolic interactionalism, Phenomenology, Post-Modernism
• Social stratification-castes, class, race, gender, ethnicity
• Types of societies: colonial, post colonial, simple, agrarian, Industrial, post industrial, knowledge society
• Social change: Theories of social change, social transformation, social movements, social development

Discipline: Political Science

Areas of concern are Political Theory and Thought, International Relations, Comparative Politics and Government and Politics of India and Research Methodology.
**Discipline: Public Administration**

**Note:** There will be one question paper consisting of Sections-I & II carrying 100 marks. The candidate has to answer ten questions, selecting five questions from each section in about 100 words each. Each question carries 10 marks.

**SECTION-I (Research Methodology)**
- Types of Research.
- Identification of Problem and Preparation of Research Design.
- Research Methods in Social Sciences.
- Hypothesis.
- Sampling—Various Sampling Procedures.
- Tools of Data Collection—Questionnaire, Interview, Content Analysis.
- Processing of Data.
- Measures of Central Tendency—Mean, Mode and Median.
- Report Writing.

**SECTION-II (Public Administration)**
- Indian Administration—Organisation of the Union Government—Central Secretariat, Ministries and Departments, Cabinet Secretariat, P.M.O.
- Organisation of the State Government—Secretariat, Role of Chief Secretary, Organisatons of Departments and Directorates.
- Personnel Administration—Classification of Services, Recruitment, Recruitment Agencies —U.P.S.C. and State Public Service Commissions, Training, Promotion, Discipline, Morale, Staff Associations, Employer-Employee Relations.
- Disaster Management, Sustainable Development and Contemporary Issues in Governance.

**Discipline: Psychology**

The syllabus will mainly be based on what is covered at Masters level in psychology. Though the outline of syllabus is given as follows:

**Research Methodology (50%)**

Introduction to research in psychology, definition, 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; Research designs; Methods of data
collection including interview, observation, objective tests, questionnaire; Test Construction; Reliability and validity; Sampling and sampling techniques; Qualitative and quantitative approach to research; Methods of data collection in qualitative research; Ethics in research; Psychological statistics, levels of measurement, descriptive and inferential statistics, measures of central tendency and measures of variability; Correlation and Regression; Parametric and nonparametric statistics and their various techniques for statistical analysis; Normal Distribution Curve.

**Specialisation (50%)**

**A: Industrial and Organisational Psychology**
Introduction to industrial and organisational psychology; Human resource management and human resource development; Recruitment and Selection; Training and training methods; Performance appraisal; Leadership; Diversity and diversity management; Accidents and Industrial safety; Workplace behaviour and ethical issues; Workplace violence and harassment; Conflict and conflict management; Motivation and theories of motivation; Personality and Attitude in the context of organization; Job Satisfaction; Team, 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; Stress and Stress management.

**B: Counselling Psychology**
Introduction to counselling, guidance and psychotherapy; Career counselling and guidance; Stages of counselling and counselling relationship; Counselling with regard to various developmental stages; Counselling for persons with HIV/ AIDS, Cancer and other terminal illnesses; Assessment in Counselling; School counselling; Multicultural counselling; Learning Disability; Behavioural problems of children; Eating Disorders; Substance abuse; Anxiety Disorder; Art, Drama and Play therapy; Psychotherapies; Family counselling; Ethics in Counselling

**C: Clinical Psychology**
Concept of Abnormality, paradigms and perspectives of psychopathology; Personality and Personality disorders; Schizophrenia; Mood disorders; Eating Disorders; Anxiety and Anxiety Disorders; Psychosomatic disorders; Substance abuse; Prevention of mental disorders; Diagnosis and tools for diagnosis including case history, Mental Status Examination, intelligence assessment, personality assessment, DSM V; Introduction to Psychotherapy, Psychoanalysis, Behaviour therapy, Humanistic and Existential therapy, Person centered therapy, Gestalt therapy, Cognitive therapy, Cognitive Behaviour therapy; Psychotherapeutic relation; Play therapy, Narrative therapy; Family therapy; Ethical issues.

**Discipline: Anthropology**

**Anthropology and Methods of Research**
*Introducing Anthropology:* Defining Anthropology, Meaning, Scope, history, Branches of Anthropology, Emerging Frontiers in Anthropology
*Field Work Tradition in Anthropology:* Field Work and its Relevance, Ethnography, Techniques, Methods and Methodology, Genealogy and Pedigree
Research Design: Review of Literature and Statement of Research Problem, Theory, Research Design

Data Collection Techniques: Primary Data, Secondary Data, Biological Methods, Archaeological Methods

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

**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, Characteristic, 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

**Social Anthropology**

*Introduction to Social Anthropology*: 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, Post-Modernism and Post-Colonialism

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


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

**Archaeological Anthropology**

*Introduction to Archaeological Anthropology*: Definitions and Scope, History and Development, Interdisciplinary Relations

*Tool types and techniques in Archaeology*: Space, Tool Families, Tool-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

**Discipline: Library & Information Science**
Syllabus

1. Library, Information, Communication and Society
2. Information Sources, Systems and Services
3. Information Organisation, Processing and Retrieval
4. Library and Information Centre Management
5. Research Methodology
6. ICT Applications
7. Recent Trends in LIS

Question Paper

The Question Paper for Entrance Examination will be of 100 marks and three hours duration. It will be divided into two sections namely Research Methodology and Library and Information Science. Questions will be subjective in nature.
SCHOOL OF EDUCATION

Discipline: Education

1. Philosophical Foundation 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, Philosophica inquiry of current educational issues.

2. Sociological Foundations of Education: 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; Constraints on social change in India; Education of the socially and economically disadvantaged sections of the society including students with special needs;

3. Psychological Foundation of Education: Relationship of Education and Psychology; Relationship of Education and Psychology; Growing up and childhood, Process of Growth and development, Social, emotional and cognitive development; Individual differences, Areas of individual differences including intelligence, personality, attitude, aptitude, learning styles and its implications on individual in succeeding in his/her learning; Learning and its various theories, Factors influencing learning, Neuro-psychological implications of learning; Motivation: concept, determinants and types, Implications of motivation on learning; Group dynamics and role of teacher in developing positive class room climate

4. Learning, Assessment, Evaluation and Classroom Practices: Models of the teaching/learning process; Classroom instruction; Constructionist and Cooperative approach to learning and teaching; Classroom management; Overview of Measurement and Evaluation; Nature of students assessment of learning and achievement and its relation to instruction; Continuous Comprehensive Education, Assigning Grades, Interpreting Standardized Achievement Test Scores- Criterion-referenced and Norm-referenced; Issues in Assessment and Evaluation, Curriculum Development and its use in classroom practices, School leadership, management and educational accountability

5. Educational Technology & ICT: Meaning and Scope of Educational Technology; Multimedia approach in ET; Difference between teaching and instruction, conditioning and training; Teaching at different levels-memory, understanding and reflective; Programmed Instruction (Origin, types, liner and branching, development of programmed instruction material-linear/branching model; Computer assisted instruction; Models of Teaching: Concept, different families of teaching models and Designing Instructional system; Communication Process: Concept of communication, Principles, Modes and Barriers of communication, Classroom communication (interaction verbal and non-verbal, Concept of ICT and Its role in education

6. Open and Distance Education: Concept, Different contemporary systems, viz., Correspondence, Distance and open; Student support services; Evaluation; Strategies in Distance Education: Counseling Methods in Distance Education.

7. Inclusive and Special Education: Concept and meaning of Inclusive and Special Education, Differences in educational services through Inclusive and Special education; Meeting special needs of students from difficult socio-economical, linguistic backgrounds and students with disabilities; Differentiated Instruction and Universal Design for Learning
8. **Educational Guidance and Counseling**: Concept, Principles, need and objectives of Guidance and Counseling; Guidance Services - Individual, Information, Placement & follow-up; Guidance Activities - updating Bulletin Board, Career day celebration. Information corner, career talk and conferences; Counseling process and approaches of counseling: Person centered, Cognitive Behavioral & Psycho dynamic.

9. **Teacher Education**: Development of Teacher Education in India, NCTE Curricular Frameworks for Teacher Education; Objectives and organization of curriculum of teacher education at various levels; Agencies involved in Pre-service and In-service teacher education; Teacher education through Open and Distance Education; Quality assurance in Teacher Education programme

10. **Adult Education**: Concept of Adult Education: Different types of adult education; Adult Education and National Development; Adult illiteracy: A social problem; relationship between literacy and development; Major Policy trends in Adult Education during post-Independence period; National Literacy Mission: Objectives, strategies, achievement and areas or concern

**Research Methodology**

11. **Sources of acquiring Knowledge**
   - Nature and scope of educational research
   - Meaning and nature
   - Need and purpose
   - Scientific enquiry and theory development - some emerging trends in research
   - Fundamental-applied and action research

12. **Formulation of research problem**
   - Criteria and sources of identifying the research problem
   - Survey, review and importance of related literature
   - Selection, definition and evaluation of research problem
   - Developing assumptions and hypothesis in various types of research

13. **Collection of data**
   - Concept of population and sample
   - Various methods of sampling
   - Characteristics of a good sample

14. **Tools and techniques of data collection**
   - Characteristics of a good research tool
   - Types of research tools and techniques and their uses
   - Questionnaire-interviews-observations
   - Tests and scales, projective and sociometric techniques

15. **Major approaches to research**
   - Historical research
   - Descriptive research
   - Experimental research
   - Ex post facto research
   - Action research

16. **Analysis of data**
   - Descriptive and inferential statistics, the null hypothesis, Test of significance, Types of error
   - One tailed and two tailed tests
   - The t-test
   - The F-test
Non parametric tests
Correlation

17. Research report
   Meaning and scope
   Format of research reports
   Presentation
   Dissemination
General Instructions:

- Question Paper is comprised of two sections, namely Section A & Section B.
- Both Section A & Section B are compulsory.
- All questions in both Section A & Section B are compulsory.
- Each section i.e. Section A & Section B, carries 50 marks (Maximum marks is 100)
- Each section is of maximum 50 marks
- Use of Scientific Calculator/Calculator is allowed.

Section A
- comprised of Research Methodology based subjective (long answer typed questions).
- No Negative marking for this Section (i.e. Section A)

Section B
- comprised of subject specific (computer Science) objective type questions (multiple choice).
- Yes, there is Negative marking for this Section (i.e. Section B)
  - For each wrong answer 0.25 marks will be deducted
  - For each correct answer one marks will be awarded.
  - Only one correct answer amongst the option should be marked.

identified syllabus given below was already submitted

Syllabus

SECTION A: RESEARCH METHODOLOGY
The syllabus of this part involves following components:

Probability & Probability Distribution, Sampling & Hypothesis Testing, Descriptive & Inferential Statistics, Matrices & Determinants

SECTION B: SUBJECT SPECIFIC (COMPUTER SCIENCE)
The Syllabus of this part involves following components:

Data Structures, Design & Analysis of Algorithms, Computer Networks, Security & Cryptography, Automata Theory, Artificial Intelligence, Computer architecture, Databases, Operating system, Programming Paradigms
SCHOOL OF ENGINEERING TECHNOLOGY

**Discipline: Civil Engineering**

**SECTION A: Research Methodology (Consists of fifty Objective type Questions)**


Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Constants, Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, Merging the two approaches.

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


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


**SECTION B: Civil Engineering (Consists of 50 MCQ)**

**STRUCTURAL ENGINEERING**

**Structural Analysis:** Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/ energy methods, analysis by displacement methods (slope deflection and moment
distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

**Concrete Structures:** Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

**Steel Structures:** Analysis and design of tension and compression members, beams and beam-columns, column bases. Connections- simple and eccentric, beam–column connections, plate girders and trusses. Plastic analysis of beams and frames.

**GEOTECHNICAL ENGINEERING**

**Soil Mechanics:** Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability & seepage, effective stress principle, consolidation, compaction, shear strength.


**TRANSPORTATION ENGINEERING**

**Highway Planning:** Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

**Traffic Engineering:** Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

**ENVIRONMENTAL ENGINEERING**

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

**Air Pollution:** Types of pollutants (including greenhouse gases), their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

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

**WATER RESOURCES ENGINEERING**

**Hydrology:** Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

**Irrigation:** Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on
permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

CONSTRUCTION MANAGEMENT

Discipline: Mechanical Engineering

SECTION A: Research Methodology (Consists of fifty Objective type Questions)


Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Constants, Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, Merging the two approaches.

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


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


SECTION B: Mechanical Engineering (Consists of 50 MCQ)

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

**Strength of Materials:** Stress and strain, stress-strain relationship and elastic constants, Mohr’s circle for plane stress and plane strain, thin and thick Spherical shell, cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler’s theory of columns; strain energy methods; thermal stresses.

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

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

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

**Thermodynamics:** Thermodynamic properties, Heat and work. Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle, irreversibility and availability; behavior of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion. Refrigeration and Air conditioning

**Metal Casting:** Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations. Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding. Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures, Non-conventional machining.

**Industrial Engineering:** Introduction to Industrial Engineering, Time and Motion Study, Production Planning and Control, Forecasting models, aggregate production planning, scheduling, materials requirement planning. Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems. Operations Research: Linear programming, simplex and graphical
method, transportation model, assignment model, network flow models, simple queuing models, PERT and CPM. Supply Chain Management.

Discipline: Electrical Engineering

SECTION A: Research Methodology (Consists of fifty Objective type Questions)


Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Constants, Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, Merging the two approaches.

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


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

Interpretation of Data. Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Elementary operations on matrices. Echelon matrix. Rank of a matrix. Determination of rank of a matrix (relevant results are to be state only). Normal forms. Elementary matrices. Singularity of Matrix. Statements and application of results on elementary matrices


SECTION B: Electrical Engineering (Consists of 50 MCQ)

PRINCIPLES OF ELECTRICAL ENGINEERING

Power Circuit Components; Electrical Theorems; DC & AC Circuit Analysis; Power Single & Three Phase Circuits; Step Response & Transients; Magnetic Circuits; Principles of Electrical Measurement and Instrumentation; Electro Mechanical Energy conversion; Energy Conservation Devices; Transformers & Principles of Rotating Machines; Sources of Energy: Conventional and Renewable; Diodes, Rectifiers, Operational Amplifiers; Electrical & Electronic Materials.

POWER SYSTEM
Power Generation, Transmission, Distribution; Transmission line parameters; Per Unit representation; 3-Φ system; Short Circuit Studies; Sequence Networks; Load-flow Studies; Automatic Generation Control; Load-Frequency Control; Automatic Voltage Regulator; Power System Stability – Equal area criteria; Swing Equation; Optimal Load dispatch in Power System. Protection Schemes for Transformer, Generators and Transmission Lines. Renewable Power Generation.

**ELECTRICAL MACHINE**
Linear transformation in Machine, DC Motors and DC Generators, Single phase and three phase conventional Transformer, Single Phase and 3-Phase Autotransformer, Poly phase Synchronous Machines, Poly phase Induction machines, Single phase induction Motors, AC commutator machine. Brushless DC motors, Stepper Motors and variable reluctance motor.

**CONTROL SYSTEM**
Mathematical models of physical systems, Transfer functions, Signal flow graph, Feedback characteristics of control system, Time domain analysis, Steady state errors and error constants, Stability of control system, Root locus technique, Frequency response analysis, Stability in frequency domain, Design of digital control system, State variable analysis and design. Analysis of non linear system.

**POWER ELECTRONICS AND DRIVES**
Characteristics and specification of different thyristor family devices, Different firing and commutation methods, Protection circuit, Series and parallel connection of SCRs and their rating, Phase Controlled Converters (Single and three phase) with different types of load i.e R, R-L, R-L-E, Single phase and three phase Inverters (CSI and VSI), DC-DC converters i.e. Choppers, Cycloconverters, AC voltage controllers (single phase and three phase). Characteristics and principle of AC and DC machines, Methods of conventional controls and application of static controls and microprocessor based controls for AC and DC machines.
SCHOOL OF HEALTH SCIENCE

Discipline: Nursing

School of Health Sciences IGNOU has the following syllabus for the entrance examination for Ph.D in Nursing.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Syllabus</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>Research Methodology &amp; Statistics</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Nursing Administration &amp; Management</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Nursing Education</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Clinical Speciality</td>
<td>10</td>
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<tr>
<td></td>
<td>Total Marks</td>
<td>100</td>
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</tbody>
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Note: The Minimum Qualifying marks in entrance examination is 50%. The entrance examination is based on M.Sc Nursing Syllabus. The question paper comprises of Essay type questions including long answer and short answer questions.
SCHOOL OF MANAGEMENT STUDIES

Discipline: Management

Research Methodology
4. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
7. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
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/MS Office, Software for detection of Plagiarism

Management ( including Business Administration Management / Marketing / Marketing Management / Industrial Relations and Personnel Management/Operations Management., etc ).

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
- Organisational Development.

III
- Concepts and perspectives in HRM; HRM in changing environment.
- 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.

IV
- Valuation Concepts and Valuation of Securities.
- Capital Budgeting Decisions – Risk Analysis.
- Capital Structure and Cost of Capital.
- Dividend Policy – Determinants.
- 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 – Promotion mix; 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 – Other related issues like 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 Product mix; 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.

VII

- Probability Theory; Probability distributions – Binomial, Poisson, Normal and Exponential; Correlation and Regression analysis; Sampling theory; Sampling distributions; Tests of Hypothesis; Large and small samples; t z, 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; Ansoff’s 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; Competencies and its development; 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

- Ethics and Management System; Ethical issues and Analysis in Management; Value based 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.
Discipline: Commerce

The entrance examination for admission to Ph.D and M.Phil programmes in Commerce discipline comprises of 100 multiple choice questions of three hours duration.

In this paper, the weightage of subjects covered is as under:

a) 50% of the questions cover Research Methodology and Statistical Analysis
b) Remaining 50% of the questions cover the following subject areas:
   - Organisation Theory And Behaviour
   - Business Environment
   - Accounting For Managerial Decisions
   - Marketing Management
   - Financial Management

RESEARCH METHODOLOGY AND STATISTICAL ANALYSIS

RESEARCH AND DATA COLLECTION
Introduction to Business Research
Research Plan
Collection of Data
Sampling
Measurement and Scaling Techniques

PROCESSING AND PRESENTATION OF DATA
Processing of Data
Diagrammatic and Graphic Presentation
Statistical Derivatives and Measures of Central Tendency
Measures of Variation and Skewness

RELATIONAL AND TREND ANALYSIS
Correlation and Simple Regression
Time Series Analysis
Index Numbers

PROBABILITY AND HYPOTHESIS TESTING
Probability and Probability Rules
Probability Distribution
Tests of Hypothesis
Chi-Square Test

INTERPRETATION AND REPORTING
Interpretation of Statistical Data
Report Writing

ORGANISATION THEORY AND BEHAVIOUR
ORGANISATION THEORY
Introduction to Organisation
Organisation Theory
Organisation Structure and Effectiveness

ORGANISATIONAL BEHAVIOUR AND INDIVIDUAL PERSPECTIVE-I
Overview of OB
Industrial Behaviour and learning
Perception
Attitudes and Values

ORGANISATIONAL BEHAVIOUR AND INDIVIDUAL PERSPECTIVE-II
Personality and Emotions
Stress Management
Motivation
Job Design and Job Satisfaction

Group Behaviour
Group Formation and Structure
Communication
Conflict Management
Team Building and Leadership
Power and Politics

ORGANISATION THEORY AND BEHAVIOUR

ORGANISATION THEORY
Introduction to Organisation
Organisation Theory
Organisation Structure and Effectiveness

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Stress Management
Motivation
Job Design and Job Satisfaction

Group Behaviour
Group Formation and Structure
Communication
Conflict Management
Team Building and Leadership
Power and Politics

ORGANISATIONAL CULTURE AND DEVELOPMENT
Organisational Culture and Climate
Organisational Change
Organisational Development
Emerging Trends in OB

BUSINESS ENVIRONMENT

SOCIO-POLITICAL ENVIRONMENT
Dimension of Business Environment
Socio-Cultural Environment
Social-Responsibilities of Business
Political Environment

LEGAL ENVIRONMENT
Regulatory Policies and Framework
Corporate Laws
Labour Legislation

REGULATIONS OF FINANCIAL MARKETS
Financial Markets
Capital Markets
Regulation of Capital Market
Investors’ Protection and Corporate Governance

ECONOMIC ENVIRONMENT
Structure of Indian Economy
Economic Planning
Economic Policies
Small Scale Industries
Economic Reforms

INTERNATIONAL AND TECHNOLOGICAL ENVIRONMENT
Balance of Payment and Exim Policy
Globalisation and WTO
Foreign Investment and Collaboration
Technological Environment

ACCOUNTING FOR MANAGERIAL DECISIONS

FUNDAMENTALS OF ACCOUNTING
Accounting: An Overview
Basic Cost Concepts
Financial Statements
Understanding Financial Statements

ANALYSIS OF FINANCIAL STATEMENTS
Techniques of Financial Analysis
Statements of Changes in Financial Position
Cash Flow Analysis

BUDGETING AND BUDGETARY CONTROL
Basic Concepts of Budgeting
Preparation and Review of Budgets
Approaches of Budgeting

Standard Costing
Basic Concepts of Standard Costing
Variance Analysis
Responsibility Accounting

COST VOLUME PROFIT ANALYSIS
Marginal Costing
Break Even Analysis
Relevant Costs for Design Making
Reporting to Management
Recent Developments in Accounting

MARKETING MANAGEMENT

NATURE AND SCOPE OF MARKETING
Meaning and Scope of Marketing
Marketing Environment
Marketing Information and Research

PRODUCT DECISIONS
Product Concepts and Classification
Markets and Market Segmentation
Market Targeting and Positioning

PRODUCT DECISIONS
Product Concepts and Classification
Product Development and Product Life Cycle
Branding, Packaging and Servicing

PRICING DECISIONS
Objectives and Methods of Pricing
Price Adjustment Strategies
Regulation of Prices
DISTRIBUTION DECISIONS
Distribution Channels
Marketing Intermediaries
Distribution Logistics

PROMOTION DECISIONS AND EMERGING ISSUES
Marketing Communication
Personal Selling and Sales Promotion
Advertising and Publicity
Emerging Issues in Marketing

FINANCIAL MANAGEMENT

FOUNDATIONS OF FINANCE
Financial Management: An Overview
Time Value of Money
Valuation of Securities
Risk and Return

INVESTMENT DECISIONS
Cost of Capital
Capital Budgeting

LONG TERM FINANCING
Sources of Long Term Finance
Capital Market
Lease Financing
Project Financing
International Business Finance

FINANCING AND DIVIDEND DECISIONS
Leverages
Capital Structure Decisions
Dividend Policy Decision

MANAGEMENT OF WORKING CAPITAL
Working Capital
Cash Management
Inventory Management
Receivables Management

INCOME TAXATION

Fundamentals of Income Tax
General Framework of Direct Taxation in India
Basic concepts of income tax
Residential Status and Tax Liability
Exempted Income
Income from Salaries

Other Heads of Income
Income from House Property
Capital Gains
Income from Business and Profession
Income from other Sources

Assessment of Individual, HUF and Institutions
Deduction from Gross Total Income
Computation of Total Income
Filing of Return and Tax Authorities
SCHOOL OF SCIENCES

Discipline: Biochemistry

PART-A: Basic science and General Aptitude paper

Questions will be designed to test basic knowledge of English, Chemistry, Physics, Mathematics and Reasoning and mental ability. They may be designed to test domain knowledge as well as non-verbal reasoning capacity (e.g., by finding the odd one out in a series of abstract pictures). They may also be of quantitative type; designed to test the student’s ability to comprehend large numbers and do simple calculations.

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


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


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; CO₂ fixation-C₃, C₄ 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 rhythms, 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.

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.
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

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, LDL and HDL.
Nuclei Acid Metabolism: Synthesis and degradation of purines and pyrimidines and their regulation. Integration of metabolic pathways, metabolism of Xenobiotics.

10) Clinical biochemistry
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.
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 biliary 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.

Discipline: Chemistry

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).
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.
8. Cages and metal clusters.
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; Hückel 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.
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.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
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.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
13. Structure determination of organic compounds by IR, UV-Vis, 1H & 13C NMR and Mass spectroscopic techniques.

**Discipline: Geography**

**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.


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, Regional Imbalances, Growth Pole and Growth Centers.

**Discipline: Geology**

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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 Geotectonics: 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 stratigraphic scales 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. **Mineral Resources 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.
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.


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 ($\mu$); 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

**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 (ANOVA) 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:**

2. Research Methodology: Methods and Statistical techniques – Santosh Gupta.

**PART-II (LIFE SCIENCES)**

**1. Cell & Molecular Biology**

Cell as a unit of life? Schleiden and Schwann cell theory re-examined. Cell separation, subcellular 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 Polytenes.

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.


**Suggested reading:**

1. Molecular Biology of the Cell-Alberts *et al* (5th edn. 2007 or later Recent Edition)
2. The Cell: A molecular approach-Cooper and Hausman
4. Genes IX. Lewin (2008 or later Recent Edition),

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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


**Suggested reading:**

**Genetics**
1. Introduction to Genetic Analysis, by Griffiths et al, (9th edition.2008 or later edition)

**Evolution**

**3. Ecology**

Introduction to ecology. Interaction between environment and biota, Evolutionary ecology and


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.


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:
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.


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; epidemiological 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; Sulfur 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:**
2. Essential Microbiology, Stuart Hogg, John Wiley and Sons Limited.

**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 diffusion, agglutination, RIA, ELISA immune fluorescence. MHC genes, MHC complex (organization of H₂ + 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 (α, β, γ, δ) thymic selection of T. Cell APC – T. Cell interaction, T. Cell activation, super antigens, role of cytokines. Cytoxicity – T.Cell mediated cytotoxicity, NK cell mediated cytotoxicity, ADCC (antibody directed ecellular cytotoxicity)

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

**Suggested reading**
2. Text book of Immunology – C.A. Bona and FA Bomlla
3. Basic Immunology by Jacqueline Sharon.
4. Immunology by Ivan Roitt, Jonathan 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.


Suggested reading:

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.


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; $\alpha$ – levels, interpretation of test results.

**ANOVA:** One way; Two way; F – Test.

**Application and Practice:** HMM; Vital statistics.

**Suggested Books for Biostatistics**


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, Rhyncozoa), organization and general characters.

Organization of the coelom:- Acoelomates, pseudocoelomates, coelomates (Protostomia and Deuterostomia); Interrelationships of Hemichordata, Urochordata and Cephalochordata 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 quadrupedal 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, nephridia, 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.


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

**Suggested Reading Material for Chordates**
3. Comparative anatomy of vertebrates. Kent. C.G.
10. Animal Physiology


Neurophysiology:- ion transport across nerve cell membrane, electrophysiology, conduction of nerve impulse; sensing the environment- photoreceptors, mechanoreceptors, electoreceptor, 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.


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
4. Physiology by Shermann.
**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.


**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.

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**12. Plant Diversity I: Phycology**


**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**


**Pteridophyta**


**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, Bennettiales, Pentoxylales, Cycadales, Ginkgoales, Coniferales, Gnetales. Diversity distribution and economic importance of gymnosperm.

**References**

**Phycology**

**Mycology**
9. Agrawal – Mehrotra

**Bryophyta**
Depot.

**Pteridophyta**

**Gymnosperms**

13. **Plant Diversity-II - Taxonomy Of Angiosperms**


**Taxonomy**
8. Radford Albert, E. Fundamentals of Plant Systematics

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 micorrhiza 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 O₂ and H₂ 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 Absciscic 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

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:
2. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.

Discipline: Statistics
Introduction to research, 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. Sampling Techniques: Introduction to sampling, advantage of sampling over census, probability and non-probability sampling, sampling and non-sampling error, basics of simple random sampling, stratified random sampling and systematic sampling.

Introduction, primary and secondary data, methods of collecting primary data, merits and demerits of different methods of collecting primary data, non response, designing a questionnaire, pretesting a questionnaire, editing of primary data, technique of interview, collection of secondary data, scrutiny of secondary data, scale of measurements, Classification and tabulation of data, diagrammatic and graphical presentation of data.

Measures of Central tendency, measures of dispersion, simple correlation and regression, testing of hypothesis (z, t, F and chi-square tests), Interpretation of data, Review report writing, Parts of a report, Presentation of a report.

**Part-B: Statistics**

Sample Space, Discrete Probability, Independent events, Bayes theorem, Random variables, distribution functions (Univariate and Bi-variate), Expectation and moments. Independent random variables, Marginal and conditional distributions, Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jenson), Modes of convergence, Weak and Strong laws of large numbers, Central Limit Theorems (i.i.d. case).

Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes.

Hazard function and failure rates, censoring and life testing, series and parallel systems.

Standard discrete and continuous univariate distributions, sampling distributions, standard errors, asymptotic distributions.

Methods of estimation, properties of good estimators, Exponential families, Mean Square error, minimum variance unbiased estimators, Rao-Blackwell theorem, completeness, Lehmann-Scheffe theorem, Cramer-Rao lower bound, Basics of Testing of Hypothesis, most powerful and uniformly most powerful tests, likelihood ratio tests, Unbiased test, Neyman-Pearson Lemma, Non-parametric tests for one or more samples problems, Elementary Bayesian Inference.


Multivariate Normal distribution, Wishart distribution with its properties, Distribution of quadratic forms, Inference for parameters, Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.

Simple random sampling, Stratified sampling, Systematic sampling, Probability proportional to size sampling, Ratio and Regression methods, Product estimation, Cluster Sampling, Multi Stage Sampling, Two-Phase Sampling.

Analysis of Variance and Covariance, Completely randomized designs, randomized block designs, Latin-square designs, Missing Plot Techniques, Orthogonality, BIBD, $2^k$ factorial experiments: confounding and construction.

Linear programming problem, simplex methods, Duality, Elementary queueing, inventory models.

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, M/G/1.
1. **Nature of Research – An Introduction:**
   - **10 Marks**
     (i) What is Research?
     (ii) Relevance of Legal Research?
       - Objective of Legal Research.
       - Need for Legal Research and Importance of inter-disciplinary approach.
       - Significance of Legal Research in India.
       - Legal Research as a profession in India.
     (iii) Types of Research
       - Doctrinal or Traditional Research.
       - Non-doctrinal or Empirical Research.
       - Descriptive and Analytical Research.
       - Applied and Fundamental Research.
       - Qualitative and Quantitative Research.
       - Law Reform Research.
       - Historical Research.
       - Sociological Research.

2. **Research Processes**
   - **05 Marks**
     - Identification of Research Problems.
     - Review of Literature.
     - Selection of a Research Problem
     - Formulation of a Hypothesis.
     - Research Design.
     - Hypothesis.

3. **Methods of Investigation and tools for collection of data**
   - **10 Marks**
     (i) **Primary Data method.**
       - Experimental and Participatory/ Scientific Method.
       - Case Study Method.
       - Survey Method.
       - Discussion Method.
       - Observation Method.
       - Interview Method.
       - Mail Survey Method.
       - Questionnaire (Open ended and Close ended)
       - Pilot Study Method.
     (ii) **Secondary Data Method.**
       - Case Law Method.
       - Cumulative Record Cards.
     (iii) **Tabulation and Evaluation of Data.**
4. **Sampling**  
   10 Marks  
   (i) Advantages and Limitations of Sampling.  
   (ii) Theoretical basis of Sampling  
      - Probability and Non-probability Sampling  
   (iii) Classifications of sampling  
      - Simple Random Sampling  
      - Stratified Sampling  
      - Cluster Sampling  
      - Systematic Sampling  
      - Non-random sampling  
      - Purposive Sampling  
      - Convenience Sampling  
      - Judgment Sampling  
   (iv) Sampling and Non-sampling Error.

5. **Analysis and Interpretation of Data**  
   10 Marks  
   - Application of Content Analysis in Legal Research.  
   - Analysis of aggregate Data.  
   - Data Interpretation.  
   - Legal input Analysis, the ideal and the practicable.  
   - Data Processing- Summarizing of data, Codification and Tabulation.  
   - Writing a Research Report- Types, Contents and steps involved in drafting of a Report.

6. **Scientific Tools in Research**  
   05 Marks  
   - Introduction.  
   - Jurimetrics.  
   - Use of SPSS and other packages in Legal research.  
   - Avoiding/Detecting plagiarism.  
   - Writing the research report/Bibliography/Presentation styles

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Part – B (Discipline : Law)

(Weightage Maximum : 50 per cent = 50 Marks)

1. **Constitutional Law of India**  
   10 Marks  
   - Preamble  
   - Fundamental Rights and Duties.  
   - Directive Principles of State Policy.  
   - Judiciary  
   - Executive  
   - Union State Legislative Relations.  
   - Emergency Provisions  
   - Amendment of the Constitution.  
   - Writ Jurisdiction

2. **Legal Theory**  
   05 Marks
• Nature and Sources of Law.
• Theories of Punishment.
• Rights and Duties.
• Concepts of Possession and Ownership.
• Judicial Process and Social Transformation
• Judicial Activism
• Social Justice
• Empowerment of women

3. Public International Law:
05 Marks
• Nature of International Law and its relationship with Municipal Law.
• Sources of International Law.
• Recognition of States and Governments.
• United Nations
• Settlement of International Disputes.
• Human Rights

4. Law of Contracts General Principles
05 Marks
• Essentials of a valid contract.
• Offer, acceptance and consideration.
• Capacity to Contract: Minor's contact.
• Elements vitiating contract: Mistake, fraud, misrepresentation, public policy, coercion, undue influence, frustration of contract.
• Remedies for breach of contract: Damages.

5. Law of Torts
05 Marks
• Foundation of Tortuous Liability.
• General Defences to an action of Tort.
• Vicarious Liability
• Remoteness: of Damages. Contributory Negligence
• Absolute and Strict Liability.

05 Marks
• Nature and Definition of Offence.
• General Exceptions
• Common Intention and Common Object.
• Criminal Attempt, Conspiracy and Abetment.
• Offences against Women and Child.

7. Labour Law:
05 Marks
• Concepts: Industry, Industrial Dispute and Workman.
• Trade Unions: Rights and Immunities of Registered Trade Union; Registration and its advantages.
• Methods for Settlement of Industrial Disputes under Industrial Disputes Act, 1947.
• Strike and Lockout as Instruments of Collective Bargaining.
• Retrenchment, Lay-off and Closures.

8. (a) **Information Technology Act 2000**  
  • Digital Signature
  • Electronic Governance
  • Attribution acknowledgment and dispatch of Electronic records
  • Regulation of Certifying Authorities
  • Digital Signature
  • Duties of Subscribers
  • Penalties and Adjudication
  • The Cyber Regulations Appallate Tribunal
  • Offences
  • Network service providers not to be liable in certain cases

(b) **Right to Information Act, 2005**  
  • Right to information and obligations of public authorities
  • The Central Information Commission
  • The State Information Commission
  • Powers and functions of the Information Commissions, appeal and penalties

9. **Environmental Law**  
  • Concept of environment
  • Environment law and polity in India.
    • The Water (Prevention and Control of Pollution) Act, 1974
    • The Air (prevention and control of pollution) Act, 1981
    • Right to Fair Compensation and Transparency in land Acquisition, Rehabilitation and Resettlement Act, 2013
  • Environmental protection Act, 1986
  • Wildlife Protection Act, 1972.
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;
8. Children and Media Violence: Social learning Theory/Social Cognition (Bandura); Disinhibition and Cue Theory (Berkowitz); and Arousal Theory / Excitation Transfer (Tannenbaum and Zillman).
9. “Middle Range” Theories (Selections): Uses and Gratifications; Agenda Setting by the Media; Cultivation of Perceptions of Reality (George Gerber); Limited and Selective Influences Theory.
10. 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
11. 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
12. 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.
13. 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.
SCHOOL OF SOCIAL WORK

Discipline : Social Work

Part -A: Research Methodology
- Basics of research in social work
- Research methods in social work
- Tools and methods of data collection
- Data processing and analysis

Part -B: Social Work
- Origin and Development of Social Work
- Professional Social Work: Indian Perspectives
- Basic Social Science Concepts
- Social Work and Social Development
- Social Work Practicum and Supervision
- Social Work Research
- Social Work Practicum
- Case Work and Counseling: Working with Individuals
- Social Group Work: Working with Groups
- Community Organization Management for Community Development

Question Paper Pattern

1. The entrance examination is based on MA in Social Work or MSW syllabus.
2. Maximum Marks : 100
3. Time Allowed : 3 hours
4. The question paper comprises of essay type questions including long answers and short answer questions.
5. Question paper will be divided into 2 parts comprising of 50 marks each.
6. Part- A will be focused on Research Methodology whereas Part-B will be pertaining to Core Social Work discipline.
7. Candidates will be asked to attempt all the questions.