



## **St. Xavier's College (Autonomous), Kolkata**

### **Advertisement for Admissions to Ph.D. Programs 2023**

**In the Post- Graduate and Research Departments of  
(Physics/Microbiology/Biotechnology/Computer  
Science/Bengali/Commerce/Political Science)**

Applications are invited for admissions to the Ph.D. Programs in the Post- Graduate and Research Departments of **(Physics / Microbiology / Biotechnology / Computer Science /Bengali/Commerce/Political Science)** at St. Xavier's College (Autonomous), Kolkata, affiliated to the University of Calcutta, in the prescribed format to be filled in **ONLINE** from the College website at <https://www.sxccal.edu/>

### **Essential Qualification:**

- Physics:** M.Sc. in Physics with at least 55% marks from a UGC recognized University.
- Microbiology:** M.Sc. in CSIR / UGC approved all branches of Life Sciences with at least 55% marks from a UGC recognized University.
- Biotechnology:** M.Sc. in CSIR/ UGC approved all branches of LifeSciences with at least 55% marks from a UGC recognized University.

**Computer Science:** M.Sc. in Computer Science or MCA or M.Tech. in Computer Science with at least 55% mark from a UGC recognized University.

**Bengali:** M.A. in Bengali with at least 55% marks from a UGC recognized University.

**Commerce:** M.Com or Equivalent Degree in Commerce/Management with at least 55% marks from a UGC recognized University.

**Political Science:** M.A. in Political Science with at least 55% marks from a UGC recognized University.

### **OTHER RELEVANT INFORMATION**

●The candidate has to have either NET/ SET/ INSPIRE/GATE or has to qualify in the Research Entrance Test (RET) conducted by the department. The RET syllabi is attached at the end of this document.

●Those who have qualified in NET/SET/INSPIRE/GATE would be exempted from the examination. They may directly submit a statement of purpose (SOP) indicating the area of research interest (not exceeding 1000 words) and appear in the interview.

### **Procedure:**

→Online Application Forms will be available at college website, [www.sxccal.edu](http://www.sxccal.edu)

→Filled in Application forms will be submitted online.

→Payment of Rs.1000 will be made online.

→All scanned photocopies and self-attested copies of mark sheets and certificates to be submitted along with the application. Incomplete applications are liable to be cancelled.

→The Research Entrance Test (RET) of 100 marks for the suitable candidates will be held and the qualifying marks will be fixed at 50%.

### Vacancy List of Scholars– Department Wise

Departments	Specialization/ Other Details	Vacancy
Biotechnology	<p>Any Branch Of Life Sciences With Expertise In Computational Biology And Genomics With NET/ GATE/ DBT BET Etc Qualifications [Scholar Should Have Own Fellowship. Running Costs Will Be Borne By The PI And Co - PI From Respective Projects.]</p> <p>Structural Biology (To Be Funded)</p>	3
Bengali	<p>Life And Works Of Rabindranath Tagore</p> <p>Bengali Poetry Of Twentieth Century</p> <p><b>রবীন্দ্র-সাহিত্য</b> (Tagore's Literature)</p> <p><b>কথাসাহিত্য</b> (Novels &amp; Short Stories)</p> <p><b>প্রাচীন ও মধ্যযুগীয় বাংলা সাহিত্য</b> (Ancient &amp; Medieval Bengali Literature)</p> <p><b>সাহিত্য ও সংস্কৃতিচর্চা</b> (Literature &amp; Cultural Studies)</p>	3

Microbiology	Molecular Microbiology [To Be Funded By DBT Builder Grant And Intramural Research Grant] Botany/Zoology/Microbiology [DBT Builder]	4
Physics	Pattern Formation, Soft Matter Physics, Characterisation Of Flow Systems	1
Computer Science	Educational Data Mining. Computational Intelligence	2
Commerce	Management-Marketing, (Branding, Advertising, Consumer Behaviour, Digital Marketing Etc.), Human Resources and Organisational Behaviour. Corporate Governance And Sustainability Corporate Social Responsibility And Integrated Reporting	8
Political Science	International Relations Including Area Studies (South & South-East Asia) , Public Administration. Comparative Federalism, Constitution, Government And Politics In India, Public Policy And Governance, Gender And Politics	6

### **Information :**

- The eligible candidates identified through RET/ NET/ SET/ GATE/INSPIRE, will have to submit statement of purpose (SoP) indicating the area of research interest (not exceeding 1000 words) on which a final interview will be conducted.
- The SoP (in **PDF form** ) has to be submitted along with the online application.
- NAME OF **PDF FILE** : **FIRST NAME\_SUBJECT**

### **Structure of Statement of Purpose (SoP)**

**Times New Roman ; Font : 12; Spacing : 1.5 ; Word Limit : 1000 words.**

**Name of Applicant:**

**Department:**

**Proposed Title :**

**Introduction:**

**Literature Review:**

**Research Question:**

**Proposed Research Objectives:**

**Proposed Research Methodology:**

**Previous Research Experience (if any):**

- **Candidates applying for Ph.D Programs in BENGALI may upload their SoPs in BENGALI VERSION within the word limit of 1000 words.**
- The list of finally selected candidates would be posted in the on the College website;

**Important Dates:**

- **Application for Ph.D Programs with Statement of Purpose (SOP) to be submitted online latest by : 30.09.2023**
- **List of Eligible Candidates for RET/Direct Interview to be published on College Website : 07.11.2023**
- **Dates and Details of RET Examination and Interview will be notified later on College Website.**

## RET SYLLABI 2023

### PHYSICS

#### Module I

Basics Of Research Methodology – Concept of Research- Approaches- Classifications- Research Methods and Methodologies- Research Report.

#### Module II : Subject Specific Topics

##### **Mathematical Methods**

*Vector Calculus* : Gradient, Divergence & Curl, Divergence & Stokes theorem. *Differential Equations*: Second order ordinary differential equations with non-constant coefficients. Inhomogeneous Differential Equations and Green's Function. Integral transforms. Complex variables theory: Cauchy-Riemann equations, Application of Residue Theorem. *Tensor Analysis*: Index notation, Transformation laws, Quotient theorem.

*Group Theory*: Discrete groups, Basic notions of group representations and symmetries, Lie groups

and Lie algebras :  $SU(2)$  as a case study.

##### **Classical Physics**

*Classical Mechanics*: Conservation Principles, Calculus of Variations, Lagrangian and Hamiltonian Dynamics, Poisson Brackets. Canonical Transformations, Action-angle variables, Small oscillations. Rigid bodies: Moment of Inertia Tensor, Euler equations of motion.

*Electrodynamics*: Maxwell's equations, Scalar and Vector potentials, Gauge transformations.

Green's function for wave equation. Radiation from electric dipole and accelerated charges,

Retarded potentials, Larmor formula.

*Special Relativity:* Lorentz-transformation, Four vectors and relativistic dynamics. Lagrangian for a point relativistic particle in an electromagnetic field.

## **Quantum Physics**

*Quantum Mechanics:* Formalism: Vector Space, Operators, Time evolution (pictures), Angular momentum, Identical Particles. Bound State problems in 1D, Harmonic Oscillator, Hydrogen atom problem, Coulomb Potential. Scattering theory, Born Approximation. Approximate methods: Variational method, First order time independent perturbation theory. Time dependent perturbation and Fermi Golden rule. Relativistic theory: Klein Gordon and Dirac Equations, Elementary notions on Scalar fields and simple applications of Noether's theorem.

*Solid State Physics:* Crystallography: Crystallographic point group, Bragg-Laue formulation of X-Ray

Diffraction, Schottky defects. Lattice vibrations: Phonon heat capacity (Einstein's and Debye's theory), Band theory of solids: Bloch equation, effective mass of electrons and holes, Fermi surfaces. Dielectric and Magnetic properties of solids. NMR and ESR (essential ideas only). Superconductivity: BCS theory, High Tc Superconductors (qualitative).

*Atomic and Molecular Physics:* Hydrogenic wavefunctions, Interaction with Radiation: Induced absorption and emission, Transition rates and selection rules. Fine structure splitting. Zeeman, Paschen-Back and Stark effects. Molecular Structure: bond length and dissociation energy of diatomic molecules. Molecular Rotational, Vibrational and Raman spectra of diatomic molecules. LASER: Spontaneous & Stimulated emissions, Einstein's A & B coefficients.

*Nuclear and Particle Physics:* Basic Properties: Size, Shape, Charge distribution, Parity, Isospin, Binding. Properties of Deuteron. Meson theory of nuclear Interactions. Fermi theory of beta decay, Nuclear models and Nuclear reactions. Symmetries and Conservation laws of particle interactions, Classification of hadrons, SU(2) and SU(3), Strange particles, CP violation, CPT invariance, elementary ideas about electroweak interactions and QCD.

## **Thermal Physics**

*Kinetic theory :* Maxwell's velocity distribution, mean free path & transport phenomena.



*Thermodynamics* : Laws of Thermodynamics, Entropy, Phase Transition.

*Statistical Mechanics*: Microcanonical, Canonical and Grand Canonical Ensembles, Quantum

Mechanical ensemble theory: Density matrix, Maxwell, Fermi-Dirac and Bose-Einstein Statistics.

He-3 and He-4 (introductory ideas).

## **Electronics**

*Semiconductor Physics*: Current components & Transistor biasing , junction band diagrams, Amplifiers (Class A, AB, B), Oscillators (RC, Hartley, Colpitts, Wien Bridge), h-parameters.

*Devices*: BJT, FET and MOSFETs, Tunnel Diodes, UJT and SCR. Analog Circuits: OPAMPS, Comparators and Multivibrators. Digital Circuits: Basic gates and Boolean Algebra, K-map simplifications, A/D, D/A conversion, Counters and Multiplexers. Microprocessors.

## **Computation & Laboratory Techniques**

Algorithms involving iteration and choice. Fortran / Python / C (any one) implementation of root finding techniques (iteration, bisection, Newton-Raphson) for non linear equations in one variable, integration (Simpson and Trapezoidal rules) and Solution of ordinary differential equations (Euler and modified Euler).

Estimation & propagation of errors in experiments.

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## **MICROBIOLOGY**

### **Module I**

Basics Of Research Methodology – Concept of Research- Approaches- Classifications- Research Methods and Methodologies- Research Report.

### **Module II : Subject Specific Topics**

- Biological macromolecules
- Biophysical techniques, microscopy, spectroscopy, thermodynamics
- Cell biology and cell signaling, Cellular structure and function
- Enzymes, microbial metabolism, photosynthesis
- Molecular biology (DNA replication, transformation, conjugation transduction, mutation and repair)
- Environmental microbiology
- Recombinant DNA technology
- Immunology and cancer biology
- Industrial microbiology

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## **BIOTECHNOLOGY**

### **Module I**

Basics Of Research Methodology – Concept of Research- Approaches- Classifications- Research Methods and Methodologies- Research Report.

### **Module II : Subject Specific Topics**

#### **1. BIOLOGICAL MACROMOLECULES**

A. Structure of atoms, molecules and chemical bonds.

B. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

C. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).

D. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

G. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).

H. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).

## **2. CELL BIOLOGY & CELL SIGNALING**

A. Membrane structure and function: (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes). B. Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). C. Organization of genes and chromosomes (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). D. Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle). E. Cancer Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth. F. Programmed cell death, aging and senescence G. Cell signaling General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Hormones and their receptors, cell surface receptor, signaling through G- protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

### 3. MOLECULAR BIOLOGY

A. DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination). B. RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport). C. Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins). D. Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

### 4. GENETICS

A. Mendelian principles : Dominance, segregation, independent assortment. B. Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests C. Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. D. Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. E. Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. F. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. G. Human genetics: Pedigree analysis, karyotypes, genetic disorders. H. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. I. Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications. J. Recombination: Homologous and non-homologous recombination including

transposition. K. Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift.

## **5. ECOLOGY AND EVOLUTION**

A. Ecosystem and Environment: Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition. B. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. C. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. D. Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax. E. Mechanisms of Evolution: Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

### **F. Molecular Evolution:**

Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

## **6. METHODS IN BIOLOGY**

A. Molecular Biology and Recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels. Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors. Isolation of specific nucleic acid sequences Generation of genomic and cDNA libraries in

plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms. Protein sequencing methods, detection of post translation modification of proteins. 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 Isolation, separation and analysis of carbohydrate and lipid molecules RFLP, RAPD and AFLP techniques B. Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy. C. Biophysical Methods: Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods. D. Statistical Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution Levels of significance; Regression and Correlation; t-test; Analysis of variance; X<sup>2</sup> test.

## **7. APPLIED BIOLOGY:**

A. Microbial fermentation. B. Tissue and cell culture methods for animals. Transgenic animals. C. Tissue and cell culture methods for plants. Transgenic plants, gene transfer methods. D. Gene therapy. E. Breeding in plants and animals, including marker – assisted selection F. Bioremediation and phytoremediation, Biosensors.

## **8. IMMUNOLOGY**

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, 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, inflammation, hypersensitivity and autoimmunity, vaccines.

Histochemical and Immunotechniques: Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy.

## **9. DEVELOPMENTAL BIOLOGY**

A. Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development B. Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in gamete recognition; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers. C. Morphogenesis and organogenesis in animals: Axes and pattern formation in *Drosophila*, amphibia and chick; eye lens induction, limb development and regeneration in vertebrates; post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination. D. Morphogenesis and organogenesis in plants: Shoot and root development; leaf development and phyllotaxy; flowering and floral development.

E. Programmed cell death, aging and senescence.

## **COMPUTER SCIENCE**

### **Module I**

Basics Of Research Methodology – Concept of Research- Approaches- Classifications- Research Methods and Methodologies- Research Report.

### **Module II : Subject Specific Topics**

#### **Unit - 1 : Discrete Structures and Optimization**

**Mathematical Logic:** Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference.

**Sets and Relations:** Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering.

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

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

**Graph Theory:** Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.

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

**Optimization:** Linear Programming - Mathematical Model, Graphical Solution, Simplex and Dual Simplex Method, Sensitive Analysis; Integer Programming, Transportation and Assignment Models, PERT-CPM: Diagram Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

## **Unit - 2 : Computer System Architecture**

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

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

**Register Transfer and Microoperations:** Register Transfer Language, Bus and Memory Transfers, Arithmetic, Logic and Shift Microoperations.



**Basic Computer Organization and Design:** Stored Program Organization and Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output, Interrupt.

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

**Microprogrammed Control:** Control Memory, Address Sequencing, Design of Control Unit.

**Central Processing Unit:** General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer.

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

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.

**Memory Hierarchy:** Main Memory, Auxillary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

**Multiprocessors:** Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.

### **Unit - 3 : Programming Languages and Computer Graphics**

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

**Elementary Data Types:** Properties of Types and Objects; Scalar and Composite Data Types.

**Programming in C:** Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Arguments, Preprocessors.

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

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

**Web Programming:** HTML, DHTML, XML, Scripting, Java, Servlets, Applets.

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

**2-D Geometrical Transforms and Viewing:** Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms, Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-Port Coordinate Transformation, Viewing Functions, Line and Polygon Clipping Algorithms.

**3-D Object Representation, Geometric Transformations and Viewing:** Polygon Surfaces, Quadric Surfaces, Spline Representation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces; Illumination Models, Polygon Rendering Methods, Viewing Pipeline and Coordinates; General Projection Transforms and Clipping.

## **Unit – 4 : Database Management Systems**

**Database System Concepts and Architecture:** Data Models, Schemas, and Instances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS.

**Data Modeling:** Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations; Relational Algebra and Relational Calculus; Codd Rules.

**SQL:** Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection.

**Normalization for Relational Databases:** Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases; Database Security and Authorization.

**Enhanced Data Models:** Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems, Genome Data Management, Distributed Databases and Client-Server Architectures.

**Data Warehousing and Data Mining:** Data Modeling for Data Warehouses, Concept Hierarchy, OLAP and OLTP; Association Rules, Classification, Clustering, Regression,

Support Vector Machine, K-Nearest Neighbour, Hidden Markov Model, Summarization, Dependency Modeling, Link Analysis, Sequencing Analysis, Social Network Analysis.

**Big Data Systems:** Big Data Characteristics, Types of Big Data, Big Data Architecture, Introduction to Map-Reduce and Hadoop; Distributed File System, HDFS.

**NOSQL:** NOSQL and Query Optimization; Different NOSQL Products, Querying and Managing NOSQL; Indexing and Ordering Data Sets; NOSQL in Cloud.

## **Unit – 5 : System Software and Operating System**

**System Software:** Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers.

**Basics of Operating Systems:** Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; System Boot.

**Process Management:** Process Scheduling and Operations; Interprocess Communication, Communication in Client-Server Systems, Process Synchronization, Critical-Section Problem, Peterson's Solution, Semaphores, Synchronization.

**Threads:** Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues.

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

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

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

**Storage Management:** Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.

**File and Input/Output Systems:** Access Methods, Directory and Disk Structure; File-System Mounting, File Sharing, File-System Structure and Implementation; Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance; Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.

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

**Virtual Machines:** Types of Virtual Machines and Implementations; Virtualization.

**Linux Operating Systems:** Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Interprocess Communication, Network Structure.

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

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

## **Unit – 6 : Software Engineering**

**Software Process Models:** Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods, Agile Process Models – Extreme Programming (XP), Adaptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering.

**Software Requirements:** Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirement and Specification (SRS) Document.

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

**Software Quality:** McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability.

**Estimation and Scheduling of Software Projects:** Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

**Software Testing:** Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.

**Software Configuration Management:** Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.

## **Unit – 7 : Data Structures and Algorithms**

**Data Structures:** Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B\* Tree, Data Structure for Sets, Graphs, Sorting and Searching Algorithms; Hashing.

**Performance Analysis of Algorithms and Recurrences:** Time and Space Complexities; Asymptotic Notation, Recurrence Relations.

**Design Techniques:** Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound.

**Lower Bound Theory:** Comparison Trees, Lower Bounds through Reductions.

**Graph Algorithms:** Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

**Complexity Theory:** P and NP Class Problems; NP-completeness and Reducibility.

**Selected Topics:** Number Theoretic Algorithms, Polynomial Arithmetic, Fast Fourier Transform, String Matching Algorithms.

**Advanced Algorithms:** Parallel Algorithms for Sorting, Searching and Merging, Approximation Algorithms, Randomized Algorithms.

## **Unit – 8 : Theory of Computation and Compilers**

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

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

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

**Turing Machines (TM):** Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis; Recursive and Recursively-Enumerable Languages; Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems.

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

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

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

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

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

**Code Generation and Code Optimization:** Control-flow, Data-flow Analysis, Local Optimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling.

## **Unit – 9 : Data Communication and Computer Networks**

**Data Communication:** Components of a Data Communication System, Simplex, Half-Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and

Latency; Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing, Transmission Media, Transmission Errors, Error Handling Mechanisms.

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

**Network Models:** Layered Architecture, OSI Reference Model and its Protocols; TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques.

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

IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery; Routing Algorithms, TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

**World Wide Web (WWW):** Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP.

**Network Security:** Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

**Mobile Technology:** GSM and CDMA; Services and Architecture of GSM and Mobile Computing; Middleware and Gateway for Mobile Computing; Mobile IP and Mobile Communication Protocol; Communication Satellites, Wireless Networks and Topologies; Cellular Topology, Mobile Adhoc Networks, Wireless Transmission and Wireless LANs; Wireless Geolocation Systems, GPRS and SMS.

**Cloud Computing and IoT:** SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT.



## **Unit – 10 : Artificial Intelligence (AI)**

**Approaches to AI:** Turing Test and Rational Agent Approaches; State Space Representation of Problems, Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures.

**Knowledge Representation:** Logic, Semantic Networks, Frames, Rules, Scripts, Conceptual Dependency and Ontologies; Expert Systems, Handling Uncertainty in Knowledge.

**Planning:** Components of a Planning System, Linear and Non Linear Planning; Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.

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

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

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

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

**Artificial Neural Networks (ANN):** Supervised, Unsupervised and Reinforcement Learning; Single Perceptron, Multi Layer Perceptron, Self Organizing Maps, Hopfield Network.

## **BENGALI**

### **Module I**

Basics Of Research Methodology – Concept of Research- Approaches- Classifications- Research Methods and Methodologies- Research Report.

## **Module II : Subject Specific Topics**

মডিউল-১

ভাষাতত্ত্ব

১. ধ্বনিতত্ত্ব

২. রূপতত্ত্ব

৩. অণুয়তত্ত্ব

৪. বাংলা উপভাষাচর্চার বিকাশ

মডিউল-২

মধ্যযুগ

১. মঙ্গলকাব্য- মনসামঙ্গল, চণ্ডীমঙ্গল, ধর্মমঙ্গল

২. চরিত সাহিত্য- চৈতন্যজীবনী ও পার্শ্বদজীবনী

৩. আরাকান বা রোসাঙ্গ রাজসভার সাহিত্য

৪. অনূদিত সাহিত্য (রামায়ণ, মহাভারত ও ভাগবত)

মডিউল-৩

বাংলা লোকসাহিত্য ও লোকসংস্কৃতি

১. ছড়া

২. ধাঁধা

৩. লোককথা

৪. প্রবাদ প্রবচন

মডিউল-৪

১ নাট্যতত্ত্ব- সংরূপগত ধারণা

২ বাংলা নাটকের ইতিহাস (মৌলিক নাটকের সূচনা, উনিশ ও বিশ শতকের নাটকরচনার প্রধান ধারা)

৩ নাট্যমঞ্চের ইতিহাস (স্বদেশি থিয়েটারভাবনা, শখের থিয়েটার থেকে গ্রুপ থিয়েটার- যাত্রাপথ)

মডিউল-৫

উনিশ শতক

১. মুদ্রণ সংস্কৃতির প্রসার ও বাংলা সাহিত্যিক গদ্যের আদিপর্ব
২. ব্রাহ্মধর্ম ও ব্রাহ্মসমাজ আন্দোলনের প্রভাব
৩. বাংলা নকশা ও বাংলা উপন্যাসের সূচনাকাল
৪. বাংলা গীতিকবিতার সূত্রপাত

#### মডিউল-৬

##### রবীন্দ্রসাহিত্য-

১. কবিতা- 'নৈবেদ্য' থেকে 'বলাকা' পর্ব
২. গদ্যনাটক- 'শারদোৎসব' থেকে 'রথের রশি' পর্ব
৩. ছোটগল্প- সাধনা-ভারতী পর্ব
৪. পত্র ও পত্রসাহিত্য

#### মডিউল-৭

##### দুই বিশ্বযুদ্ধকালের পটভূমিতে বাংলা সাহিত্য

১. মন্বন্তর, খাদ্য ও বস্ত্রসংকট
২. তেভাগা ও গণ আন্দোলন
৩. দেশভাগ ও দাঙ্গা
৪. কথাসাহিত্যে শহরবিকেন্দ্রিকতা, আঞ্চলিক পরিসর ও পটভূমিকার ক্রমবিস্তার

#### মডিউল-৮

##### বিশ শতকের নানা সাহিত্য-আন্দোলন

- ১ হাংরি
- ২ শ্রুতি
- ৩ নিমসাহিত্য
- ৪ শাস্ত্রবিরোধী

## **POLITICAL SCIENCE**

### **Module I**

Basics Of Research Methodology – Concept of Research- Approaches-  
Classifications- Research Methods and Methodologies- Research Report.

### **Module II**

#### **Unit - 1 : Political Theory**

Concepts

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

Political Traditions

Liberalism

Conservatism

Socialism

Marxism

Feminism

Ecologism

Multiculturalism

Postmodernism

#### **Unit - 2 : Political Thought**

Confucius, Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Hegel,  
Mary

Wollstonecraft, John Stuart Mill, Karl Marx, Gramsci, Hannah Arendt, Frantz

Fanon, Mao Zedong, John Rawls

### **Unit - 3 : Indian Political Thought**

Dharamshastra, Kautilya, Aggannasutta, Barani, Kabir, Pandita Ramabai, Bal Gangadhar Tilak, Swami Vivekanand, Rabindranath Tagore, M.K Gandhi, Sri Aurobindo, Periyar E. V. Ramasamy, Muhammad Iqbal, M.N.Roy, V D Savarkar,

Dr. B.R.Ambedkar, J L Nehru, Ram Manohar Lohia, Jaya Prakash Narayan, Deendayal Upadhyaya

### **Unit - 4 : Comparative Political Analysis**

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

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

decolonization

Nationalism: European and non-European.

State theory: debate over the nature of state in capitalist and socialist societies; post-colonial state; welfare state; globalization and nations-states

Political regimes: democratic (Electoral, Liberal, Majoritarian and Participatory)

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

Constitutions and Constitutionalism: forms of constitutions, rule of law, judicial independence and liberal constitutionalism; emergency powers and crisis of constitutionalism.

Democratisation: democratic transition and consolidation.

Development: Underdevelopment, Dependency, Modernization, World Systems Theory, development and democracy.

Structures of Power: ruling class, power elites, democratic elitism

Actor and Processes: Electoral Systems, Political Parties and Party System, Interest

groups, Social movements, new social movements, Non Governmental Organisations (NGOs) and civil society campaigns; Revolutions.

### **Unit - 5 : International Relations**

Approaches to the study of International relations: Idealism, Realism, Structural Marxism, Neoliberalism, Neorealism, Social Constructivism, Critical International

Theory, Feminism, Postmodernism.

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

traditional and non- traditional.

Conflict and Peace: Changing Nature of Warfare; Weapons of mass destruction; deterrence; conflict resolution, conflict transformation.

United Nations: Aims, Objectives, Structure and Evaluation of the Working of UN;

Peace and Development perspectives; Humanitarian intervention. International law; International Criminal Court

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

Regional Organisations: European Union, African Union, Shanghai Cooperation

Organisation, ASEAN.

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

### **Unit - 6 : India's Foreign Policy**

Perspectives on India's Foreign Policy: India's Identity as postcolonial,

development, rising power and as emerging political economy

Continuity and change in India's Foreign Policy: Principles and determinants;

Non-Alignment movement: historical background and relevance of Non Aligned

Movement; India's Nuclear Policy

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

India's Engagement with multipolar world: India's relations with European Union,

BRICS, ASEAN, Shanghai Cooperation Organisation, African Union, Southern African Development Community, Gulf Cooperation Council

India's relations with neighbourhood: SAARC, Gujaral doctrine, Look East/Act

East, Look West.

India's Negotiation Strategies in International Regimes: The United Nations, World Trade Organisation, International Monetary Fund, Intergovernmental Panel

on Climate Change

Contemporary challenges: maritime security, energy security, environmental security, migrants and refugees, water resources, international terrorism, cyber security

## **Unit - 7 : Political Institutions in India**

Making of the Indian Constitution: Colonialism heritage and the contribution

Indian National Movement to the making of the Indian Constitution

Constituent Assembly: Composition, Ideological Moorings, Constitutional Debates

Philosophy of the Constitution: Preamble, Fundamental Rights, Directive Principles

Constitutionalism in India: Democracy, Social Change, National Unity, Checks and Balances, Basic Structure Debate, Constitutional Amendments

Union Executive: President, Prime Minister and Council of Ministers

Union Parliament: Structure, Role and Functioning, Parliamentary Committees

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

Reform.

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

Legislature

Federalism in India: Strong Centre Framework, Asymmetrical Federal Provisions

and Adaption, Role of Intergovernmental Coordination Mechanisms, Inter-State Council, Emerging Trends.

Electoral Process and Election Commission of India: Conduct of Elections, Rules,

Electoral Reforms.

Local Government Institutions: Functioning and reforms.

Constitutional and Statutory Bodies: Comptroller and Auditor General, National Commission for Scheduled Castes, National Commission for Scheduled Tribes, National Commission for Human Rights, National Commission for Women, National Commission for Minorities.

## **Unit - 8 : Political Processes in India**

State, Economy and Development: Nature of Indian State, Development Planning

model, New Economic Policy, Growth and Human Development.

Process of globalisation: social and economic implications.

Identity Politics: Religion, Tribe, Caste, Region, Language.

Social Movements: Dalit, Tribal, Women, Farmers, labour



Civil Society Groups: Non-Party Social Formations, Non-Governmental Organisations, Social Action Groups.

Regionalisation of Indian Politics: Reorganisation of Indian States, States as Political and Economic Units, Sub-State Regions, Regional disparities, Demand for New States,

Gender and Politics in India: Issues of Equality and Representation.

Ideology and Social basis of Political Parties: National Parties, State Parties.

Electoral Politics: Participation, Contestation, Representation, Emerging trends.

### **Unit - 9 : Public Administration**

Public Administration: meaning and evolution; public and private administration

Approaches: System Theory, Decision Making, Ecological Approach

Public administration theories and concepts: Scientific Management Theory,

Rational Choice theory, New Public Administration, Development Administration,

Comparative Public Administration, New Public Management, changing nature of

Public Administration in the era of liberalisation and Globalisation

Theories and Principles of Organization: Scientific Management Theory,

Bureaucratic Theory, Human Relations Theory

Managing the organization: Theories of leadership and motivation.

Organisational Communication: Theories and Principles, Chester Bernard

Principles of Communication, Information Management in the organization

Managing Conflict in the Organization: Mary Parker Follett

Management by Objectives- Peter Drucker

### **Unit – 10 : Governance and Public Policy in India**

Governance, good governance and democratic governance, role of state, civil society and individuals.

Accountability and control: Institutional mechanism for checks and balances, legislative control over executive, administrative and budgetary control, control through parliamentary committees, judicial control over legislature and executive,

administrative culture, corruption and administrative reforms

Institutional mechanisms for good governance: Right to Information, Consumer Protection Act, Citizen Charter; Grievance redress system: Ombudsman, Lokpal,

Lokayukta

Grassroots Governance: Panchayati Raj Institutions and their functioning

Planning and Development: Decentralised planning, planning for development, sustainable development, participatory development, e-governance; NITI Aayog

Public policy as an instrument of socio-economic development: public policies with special reference to housing, health, drinking water, food security, MNREGA,

NHRM, RTE

Monitoring and evaluation of public policy; mechanisms of making governance process accountable: jansunwai, social audit.

## COMMERCE

### Unit—1

#### Business Environment

- Meaning and Elements of Business Environment
- Economic environment, Economic Policies, Economic Planning
- Legal environment of Business in India, Competition policy, Consumer protection, Environment protection
- Policy Environment: Liberalization, Privatization and Globalization, Second generation reforms, Industrial policy and implementation. Industrial growth and structural changes

## **Unit—2**

### **Accounting**

#### A: Financial Accounting

Basic Accounting concepts, Capital and Revenue, Preparation of Financial Statements

Partnership Accounts: Admission, Retirement, Death and Dissolution

Advanced Company Accounts: Issue and forfeiture of shares, Valuation of shares, Amalgamation and Reconstruction of Companies, Holding

#### Company Accounts

Ratio Analysis

Cash Flow Analysis,

Accounting standards in India

#### B: Cost and Management Accounting

Marginal costing and Break-even analysis

Standard costing

Costing for decision-making

Budgetary control

## **Unit—3**

### **Business Economics**

Nature and uses of Business Economics, Concept of Profit and Wealth maximization, Demand Analysis and Elasticity of Demand, Indifference Curve Analysis,

Utility Analysis and Laws of Returns and Law of proportions Cost, Revenue,

Price determination in different market situations: Perfect competition, Monopolistic competition, Monopoly, Price discrimination and Oligopoly, Pricing strategies

National Income- Concepts of GDP, GNP, NNP, NI- Measurement of NI- CPI and GDP Deflator- Saving-Investment Identities in open and closed economies.

#### **Unit—4**

##### **Business Statistics**

- Data types, Data collection, Analysis and Interpretation of Data
- Correlation and Regression
- Normal distribution
- Correlation and Regression
- Sampling, need, errors and methods of sampling
- Hypothesis testing - small sample tests—t-test, F-test and chi-square test

#### **Unit—5**

##### **Business Management**

- Principles of Management
- Planning- Objectives, Strategies, Planning process, Decision-making
- Organising- Organizational structure, Formal and Informal organizations, Organizational culture
- Staffing
- Leading: Motivation, Leadership, Committees, Communication
- Controlling
- Corporate Governance
- Value and Ethics

#### **Unit—6**

##### **Marketing Management**

- The evolution of marketing, Concepts of marketing mix, Marketing environment
- Consumer behavior, Market segmentation
- Product decisions
- Pricing decisions

- Distribution decisions
- Promotion decisions
- Marketing Research
- On- line marketing
- Direct Marketing; Social ethical and legal aspects of marketing in India

## **Unit—7**

### **Financial Management**

- Financial management- Concept, Objectives and Functions
- Capital Structure, leverage
- Cost of capital, Capital budgeting
- Working capital management
- Dividend Policy
- Money and Capital market, working of stock exchanges in India, NSE, OTCEI, NASDAQ, Derivatives and Options

## **Unit—8**

### **Human Resources Management**

- Concepts, Role and Functions of Human Resource management
- Human Resource Planning, Job analysis, Job description and specifications, Use of Job analysis information, Recruitment and Selection
- Training and Development, Succession Planning
- Compensation: Wage and Salary administration, Incentives and Fringe benefits, Morale and Productivity
- Performance Appraisal
- Industrial Relations in India, Health, Safety, Welfare and Social Security, Workers participation in Management

## **Unit—9**

### **Income-tax Law and Tax Planning**

- Basic concepts, Residential status and tax incidence, exempted incomes, computation of taxable income under various heads
- Computation of taxable income of individuals and firms
- Deduction of tax, filing of returns, different types of assessment; Defaults and penalties
- Tax planning: Concept, Significance and problems of tax planning, Tax evasion and tax avoidance, methods of planning
- Goods and Service Tax: Applicability and Basic Provisions

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