SYLLABUS FOR ENTRANCE TEST

Index

PHYSICS

Part 'A' Core

1. Mathematical Methods of Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton
Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

2. Classical Mechanics

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

3. Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors.
Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields.

4.Quantum Mechanics

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of

angular momenta; Hydrogen atom. Stern-Gerlach experiment. Timeindependent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.

5. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.

6. Electronics and Experimental Methods

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

Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting,

Part 'B' Advanced

1. Mathematical Methods of Physics

Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using RungeKutta method. Finite difference methods. Tensors. Introductory group theory: SU(2), O(3).

2. Classical Mechanics

Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

3. Electromagnetic Theory

Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

4. Quantum Mechanics

Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

5. Thermodynamic and Statistical Physics

First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

6. Electronics and Experimental Methods

Linear and nonlinear curve fitting, chi-square test. Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors). Measurement and control. Signal conditioning and recovery. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques.

High frequency devices (including generators and detectors).

7. Atomic and Molecular Physics

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

8. Condensed Matter Physics

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson

junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

9.Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semiempirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions.

Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

CHEMISTRY

Inorganic Chemistry:

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity.
    a. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.

4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.

5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.

7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; LeChatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.

8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.

9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; DebyeHuckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.

12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

13. Polymer chemistry: Molar masses; kinetics of polymerization.

14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.

2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.

3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.

4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.

5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

6. Common named reactions and rearrangements – applications in organic synthesis.

7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.

8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.

9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.

10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).

12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

13. Structure determination of organic compounds by IR, UV-Vis, ^{1}H&^{13}C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

MATHEMATICS

UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum.

Sequences and series, convergence, limsup, liminf.

Bolzano Weierstrass theorem, Heine Borel theorem.

Continuity, uniform continuity, differentiability, mean value theorem.

Sequences and series of functions, uniform convergence.

Riemann sums and Riemann integral, Improper Integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.

Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation.

Metric spaces, compactness, connectedness. Normed Linear Spaces. Spaces of Continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations.

Algebra of matrices, rank and determinant of matrices, linear equations.

Eigenvalues and eigenvectors, Cayley-Hamilton theorem.

Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Inner product spaces, orthonormal basis.

Quadratic forms, reduction and classification of quadratic forms.

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions.

Analytic functions, Cauchy-Riemann equations.

Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem.

Taylor series, Laurent series, calculus of residues.

Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements.

Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots.

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.

Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain.

Polynomial rings and irreducibility criteria.

Fields, finite fields, field extensions.

UNIT – 3
Ordinary Differential Equations (ODEs):

Existence and Uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs.

General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs.

Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis :

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

Calculus of Variations:

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations:

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics:

Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis.

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). 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 behaviour of n-step transition probabilities, stationary distribution.

Standard discrete and continuous univariate distributions. Sampling distributions. Standard errors and asymptotic distributions, distribution of order statistics and range.

Methods of estimation. Properties of estimators. Confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, Likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests.

Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference.

Gauss-Markov models, estimability of parameters, Best linear unbiased estimators, tests for linear hypotheses and confidence intervals. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression.

Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and

multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.

Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

Completely randomized, randomized blocks and Latin-square designs. Connected, complete and orthogonal block designs, BIBD. 2^K factorial experiments: confounding and construction.

Series and parallel systems, hazard function and failure rates, censoring and life testing.

Linear programming problem. Simplex methods, duality. Elementary queuing and 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.

COMPUTER SCIENCE

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 Argumaents, Preprocessors. 3

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 Cipping.

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, 4

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. 5

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), Adptive 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 Requirment 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 Tesing; 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. 6

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 (NDFA), Equivalence of DFA and NDFA, 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. 7

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. 8

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 Prgamatics.

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

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

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

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

COMMERCE

Unit 1: Business Environment and International Business

- Concepts and elements of business environment: Economic environment-Economic systems, Economic policies (Monetary and fiscal policies); Political environment-Role of government in business; Legal environment-Consumer Protection Act, FEMA; Socio-cultural factors and their influence on business; Corporate Social Responsibility (CSR)
- Scope and importance of international business; Globalization and its drivers; Modes of entry into international business
- Theories of international trade; Government intervention in international trade; Tariff and non-tariff barriers; India's foreign trade policy
- Foreign direct investment (FDI) and Foreign portfolio investment (FPI); Types of FDI, Costs and benefits of FDI to home and host countries; Trends in FDI; India's FDI policy
- Balance of payments (BOP): Importance and components of BOP
- Regional Economic Integration:Levels of Regional Economic Integration; Trade creation and diversion effects; Regional Trade Agreements: European Union (EU), ASEAN, SAARC, NAFTA
- International Economic institutions:IMF, World Bank, UNCTAD
- World Trade Organisation (WTO): Functions and objectives of WTO; Agriculture Agreement; GATS; TRIPS; TRIMS

Unit 2: Accounting and Auditing

- Basic accounting principles; concepts and postulates
- Partnership Accounts: Admission, Retirement, Death, Dissolution and Insolvency of partnership firms
- Corporate Accounting: Issue, forfeiture and reissue of shares; Liquidation of companies; Acquisition, merger, amalgamation and reconstruction of companies
- Holding company accounts
- Cost and Management Accounting: Marginal costing and Break-even analysis; Standard costing; Budgetary control; Process costing; Activity Based Costing (ABC); Costing for decision-making; Life cycle costing, Target costing, Kaizen costing and JIT
- Financial Statements Analysis: Ratio analysis; Funds flow Analysis; Cash flow analysis
- Human Resources Accounting; Inflation Accounting; Environmental Accounting
- Indian Accounting Standards and IFRS

- Auditing: Independent financial audit; Vouching; Verification ad valuation of assets and liabilities; Audit of financial statements and audit report; Cost audit
- Recent Trends in Auditing: Management audit; Energy audit; Environment audit; Systems audit; Safety audit

Unit 3: Business Economics

- Meaning and scope of business economics
- Objectives ofbusiness firms
- Demand analysis: Law of demand; Elasticity of demand and its measurement; Relationshipbetween AR and MR
- Consumer behaviour: Utility analysis; Indifference curve analysis
- Law of Variable Proportions:Law of Returns to Scale
- Theory of cost: Short-run and long-run cost curves
- Price determination under different market forms: Perfect competition; Monopolistic competition; Oligopoly-Price leadership model; Monopoly; Price discrimination
- Pricing strategies: Price skimming; Price penetration; Peak load pricing

Unit 4: Business Finance

- Scope and sources of finance; Lease financing
- Cost of capital and time value of money
- Capital structure
- Capital budgeting decisions: Conventional and scientific techniques of capital budgeting analysis
- Working capital management; Dividend decision: Theories and policies
- Risk and return analysis; Asset securitization
- International monetary system
- Foreign exchange market; Exchange rate risk and hedging techniques
- International financial markets and instruments: Euro currency; GDRs; ADRs
- International arbitrage; Multinational capital budgeting

Unit 5: Business Statistics and Research Methods

- Measures of central tendency
- Measures of dispersion
- Measures of skewness
- Correlation and regression of two variables
- Probability: Approaches to probability; Bayes' theorem
- Probability distributions: Binomial, poisson and normal distributions
- Research: Concept and types; Research designs
- Data: Collection and classification of data

- Sampling and estimation: Concepts;Methods of sampling - probability and non-probability methods;Sampling distribution; Central limit theorem; Standard error; Statistical estimation
- Hypothesis testing: z-test; t-test; ANOVA; Chi–squaretest; Mann-Whitney test (U-test);Kruskal-Wallis test (H-test); Rank correlation test
- Report writing

Unit 6: Business Management and Human Resource Management

- Principles and functions of management
- Organization structure: Formal and informal organizations; Span of control
- Responsibility and authority: Delegation of authority and decentralization
- Motivation and leadership: Concept and theories
- Corporate governance and business ethics
- Human resource management: Concept, role and functions of HRM; Human resource planning; Recruitment and selection; Training and development; Succession planning
- Compensation management: Job evaluation; Incentives and fringe benefits
- Performance appraisal including 360 degree performance appraisal
- Collective bargaining and workers'participation in management
- Personality: Perception; Attitudes; Emotions; Group dynamics; Power and politics; Conflict and negotiation; Stress management
- Organizational Culture: Organizational development and organizational change

Unit 7: Banking and Financial Institutions

- Overview of Indian financial system
- Types of banks: Commercial banks;Regional Rural Banks (RRBs);Foreign banks;Cooperative banks
- Reserve Bank of India: Functions;Role and monetary policy management
- Banking sector reforms in India: Basel norms; Risk management; NPA management
- Financial markets: Money market; Capital market; Government securities market
- Financial Institutions: Development Finance Institutions (DFIs); Non-Banking Financial Companies (NBFCs); Mutual Funds; Pension Funds
- Financial Regulators in India
- Financial sector reforms including financial inclusion
- Digitisation of banking and other financial services: Internet banking; mobile banking;Digital payments systems

- Insurance: Types of insurance-Life and Non-life insurance; Risk classification and management; Factors limiting the insurability of risk; Re-insurance; Regulatory framework of insurance-IRDA and its role

Unit 8: Marketing Management
- Marketing: Concept and approaches;Marketing channels; Marketing mix; Strategic marketing planning; Market segmentation, targeting and positioning
- Product decisions: Concept;Productline;Product mix decisions; Product life cycle; New product development
- Pricing decisions:Factors affecting price determination;Pricing policies and strategies
- Promotion decisions: Role of promotion in marketing; Promotion methods-Advertising;Personalselling;Publicity; Sales promotion tools and techniques; Promotion mix
- Distribution decisions: Channels of distribution; Channel management
- Consumer Behaviour;Consumer buying process; factors influencing consumer buying decisions
- Service marketing
- Trends in marketing: Social marketing; Online marketing;Greenmarketing;Direct marketing; Rural marketing; CRM
- Logistics management

Unit 9: Legal Aspects of Business
- Indian ContractAct, 1872:Elements of a valid contract; Capacity of parties; Free consent; Discharge of a contract; Breach of contract and remedies against breach; Quasi contracts;
- Special contracts: Contracts of indemnity and guarantee; contracts of bailment and pledge; Contracts of agency
- Sale of Goods Act, 1930:Sale and agreement to sell; Doctrine of Caveat Emptor; Rights of unpaid seller and rights of buyer
- Negotiable Instruments Act, 1881: Types of negotiable instruments; Negotiation and assignment; Dishonour and discharge of negotiable instruments
- The Companies Act, 2013: Nature and kinds of companies; Company formation; Management, meetings and winding up of a joint stock company
- Limited Liability Partnership: Structure and procedure of formation of LLP in India
- The Competition Act, 2002: Objectives and main provisions
- The Information Technology Act, 2000: Objectives and main provisions; Cyber crimes and penalties
- The RTI Act, 2005: Objectives and main provisions
- Intellectual Property Rights(IPRs) : Patents, trademarks and copyrights; Emerging issues in intellectual property
- Goods and Services Tax (GST): Objectives and main provisions; Benefits of GST; Implementation mechanism; Working of dual GST

Unit 10: Income-tax and Corporate Tax Planning

- Income-tax: Basic concepts; Residential status and tax incidence; Exempted incomes; Agricultural income; Computation of taxable income under various heads; Deductions from Gross total income; Assessment of Individuals; Clubbing of incomes
- International Taxation: Double taxation and its avoidance mechanism; Transfer pricing
- Corporate Tax Planning: Concepts and significance of corporate tax planning; Tax avoidance versus tax evasion; Techniques of corporate tax planning; Tax considerations in specific business situations: Make or buy decisions; Own or lease an asset; Retain; Renewal or replacement of asset; Shut down or continue operations
- Deduction and collection of tax at source; Advance payment of tax; E-filing of income-tax returns

ECONOMICS

Unit-1: Micro Economics
- Theory of Consumer Behaviour
- Theory of Production and Costs
- Decision making under uncertainty Attitude towards Risk
- Game Theory – Non Cooperative games
- Market Structures, competitive and non-competitive equilibria and their efficiency properties
- Factor Pricing
- General Equilibrium Analysis
- Efficiency Criteria: Pareto-Optimality, Kaldor – Hicks and Wealth Maximization
- Welfare Economics: Fundamental Theorems , Social Welfare Function
- Asymmetric Information: Adverse Selection and Moral Hazard

Unit-2: Macro Economics
- National Income: Concepts and Measurement
- Determination of output and employment: Classical & Keynesian Approach
- Consumption Function
- Investment Function
- Multiplier and Accelerator
- Demand for Money
- Supply of Money
- IS – LM Model Approach
- Inflation and Phillips Curve Analysis
- Business Cycles
- Monetary and Fiscal Policy
- Rational Expectation Hypothesis and its critique

Unit- 3: Statistics and Econometrics
- Probability Theory: Concepts of probability, Distributions, Moments, Central Limit theorem
- Descriptive Statistics – Measures of Central tendency & dispersions, Correlation, Index Numbers
- Sampling methods & Sampling Distribution
- Statistical Inferences, Hypothesis testing
- Linear Regression Models and their properties – BLUE
- Identification Problem
- Simultaneous Equation Models – recursive and non-recursive
- Discrete choice models
- Time Series Analysis

Unit-4: Mathematical Economics
- Sets, functions and continuity, sequence, series
- Differential Calculus and its Applications
- Linear Algebra – Matrices, Vector Spaces
- Static Optimization Problems and their applications
- Input-Output Model, Linear Programming
- Difference and Differential equations with applications

Unit-5: International Economics
- International Trade: Basic concepts and analytical tools
- Theories of International Trade
- International Trade under imperfect competition
- Balance of Payments: Composition, Equilibrium and Disequilibrium and Adjustment Mechanisms
- Exchange Rate: Concepts and Theories
- Foreign Exchange Market and Arbitrage
- Gains from Trade, Terms of Trade, Trade Multiplier
- Tariff and Non-Tariff barriers to trade; Dumping
- GATT, WTO and Regional Trade Blocks; Trade Policy Issues
- IMF & World Bank

Unit-6: Public Economics
- Market Failure and Remedial Measures: Asymmetric Information, Public Goods, Externality
- Regulation of Market – Collusion and Consumers' Welfare
- Public Revenue: Tax & Non-Tax Revenue, Direct & Indirect Taxes, Progressive and non-Progressive Taxation, Incidence and Effects of Taxation
- Public expenditure
- Public Debt and its management
- Public Budget and Budget Multiplier
- Fiscal Policy and its implications

Unit-7: Money and Banking
- Components of Money Supply
- Central Bank
- Commercial Banking
- Instruments and Working of Monetary Policy
- Non-banking Financial Institutions
- Capital Market and its Regulation

Unit-8: Growth and Development Economics
- Economic Growth and Economic Development

- Theories of Economic Development: Adam Smith, Ricardo, Marx, Schumpeter, Rostow, Balanced & Unbalanced growth, Big Push approach.
- Models of Economic Growth: Harrod-Domar, Solow, Robinson, Kaldor
- Technical progress – Disembodied & embodied; endogenous growth
- Indicators of Economic Development: PQLI, HDI, SDGs
- Poverty and Inequalities – Concepts and Measurement
- Social Sector Development: Health, Education, Gender

Unit-9: Environmental Economics and Demography
- Environment as a Public Good
- Market Failure
- Coase Theorem
- Cost-Benefit Analysis and Compensation Criteria
- Valuation of Environmental Goods
- Theories of Population
- Concepts and Measures: Fertility, Morbidity, Mortality
- Age Structure, Demographic Dividend
- Life Table
- Migration

Unit-10: Indian Economy
- Economic Growth in India: Pattern and Structure
- Agriculture: Pattern & Structure of Growth, Major Challenges, Policy Responses
- Industry: Pattern & Structure of Growth, Major Challenges, Policy Responses
- Services: Pattern & Structure of Growth, Major Challenges, Policy Responses
- Rural Development – Issues, Challenges & Policy Responses
- Urban Development – Issues, Challenges and Policy Responses.
- Foreign Trade: Structure and Direction, BOP, Flow of Foreign Capital, Trade Policies
- Infrastructure Development: Physical and Social; Public-Private Partnerships
- Reforms in Land, Labour and Capital Markets
- Centre-State Financial Relations and Finance Commissions of India; FRBM
- Poverty, Inequality & Unemployment

EDUCATION

Unit 1: Research in Education

a) Meaning and Scope of Educational Research, Meaning and steps of Scientific Method, Characteristics of Scientific Method (Replicability, Precision, Falsifiability and Parsimony), Types of Scientific Method (Exploratory, Explanatory and Descriptive), Aims of research as a scientific activity: Problem-solving, Theory Building and Prediction, Types of research (Fundamental, Applied and Action), Approaches to educational research (Quantitative and Qualitative), Designs in educational research (Descriptive, Experimental and Historical)

b) Variables: Meaning of Concepts, Constructs and Variables, Types of Variables (Independent, Dependent, Extraneous, Intervening and Moderator), Hypotheses - Concept, Sources, Types (Research, Directional, Non-directional, Null), Formulating Hypothesis, Characteristics of a good hypothesis, Steps of Writing a Research Proposal, Concept of Universe and Sample, Characteristics of a good Sample, Techniques of Sampling (Probability and Non-probability Sampling), Tools of Research - Validity, Reliability and Standardisation of a Tool, Types of Tools (Rating scale, Attitude scale, Questionnaire, Aptitude test and Achievement Test, Inventory), Techniques of Research (Observation, Interview and Projective Techniques)

c) Types of Measurement Scale (Nominal, Ordinal, Interval and Ratio), Quantitative Data Analysis - Descriptive data analysis (Measures of central tendency, variability, fiduciary limits and graphical presentation of data), Testing of Hypothesis (Type I and Type II Errors), Levels of Significance, Power of a statistical test and effect size, Parametric Techniques, Non- Parametric Techniques , Conditions to be satisfied for using parametric techniques, Inferential data analysis, Use and Interpretation of statistical techniques: Correlation, t-test, z-test, ANOVA, chi-square (Equal Probability and Normal Probability Hypothesis). Qualitative Data Analysis - Data Reduction and Classification, Analytical Induction and Constant Comparison, Concept of Triangulation

d) Qualitative Research Designs: Grounded Theory Designs (Types, characteristics, designs, Steps in conducting a GT research, Strengths and Weakness of GT) - Narrative Research Designs (Meaning and key Characteristics, Steps in conducting NR design), Case Study (Meaning, Characteristics, Components of a CS design, Types of CS design, Steps of conducting a CS research, Strengths and weaknesses), Ethnography (Meaning, Characteristics, Underlying assumptions, Steps of conducting ethnographic research, Writing ethnographic account, Strengths and weaknesses), Mixed Method Designs: Characteristics, Types of MM designs (Triangulation, explanatory and exploratory designs), Steps in conducting a MM designs, Strengths and weakness of MM research.

Unit 2 : Learner and Learning Process

a) Growth and Development: Concept and principles ,Cognitive Processes and stages of Cognitive Development , Personality: Definitions and theories (Freud, Carl Rogers, Gordon Allport, Max Wertheimer, Kurt Koffka) , Mental health and Mental hygiene

b) Approaches to Intelligence from Unitary to Multiple: Concepts of Social intelligence, multiple intelligence, emotional intelligence Theories of Intelligence by Sternberg, Gardner, Assessment of Intelligence, Concepts of Problem Solving, Critical thinking, Metacognition and Creativity

c) Principles and Theories of learning: Behaviouristic, Cognitive and Social theories of learning, Factors affecting social learning, social competence, Concept of social cognition, understanding social relationship and socialization goals

d) Guidance and Counselling: Nature, Principles and Need, Types of guidance (educational, vocational, personal, health and social & Directive, Non-directive and Eclectic), Approaches to counselling – Cognitive-Behavioural (Albert Ellis – REBT) & Humanistic, Person-centred Counselling (Carl Rogers) - Theories of Counselling (Behaviouristic, Rational, Emotive and Reality)

Unit 3 :Educational Studies

a) Contribution of Indian Schools of philosophy (Sankhya Yoga, Vedanta, Buddhism, Jainism) with special reference to Vidya, DayanandDarshan; and Islamic traditions towards educational aims and methods of acquiring valid knowledge b) Contribution of Western schools of thoughts (Idealism, Realism, Naturalism, Pragmatism, Marxism, Existentialism) and their contribution to Education with special reference to information, knowledge and wisdom c) Approaches to Sociology of Education (symbolic Interaction, Structural Functionalism and Conflict Theory). Concept and types of social Institutions and their functions (family, school and society), Concept of Social Movements, Theories of Social Movements (Relative Deprivation, Resource Mobilization, Political Process Theory and New Social Movement Theory) d) Socialization and education- education and culture; Contribution of thinkers (Swami Vivekananda, Rabindranath Tagore, Mahatma Gandhi, Aurobindo, J.Krishnamurthy, Paul Freire,) to the development of educational thought for social change, National Values as enshrined in the Indian Constitution - Socialism, Secularism, justice, liberty, democracy, equality, freedom with special reference to education

Unit 4: Commissions & Committees

a) Committees and Commissions' Contribution to Teacher Education Secondary Education Commission (1953), Kothari Education Commission (1964-66), National Policy of Education (1986,1992), National Commission on

Teachers (1999), National Curriculum Framework 2005, National Knowledge Commission (2007), Yashpal Committee Report (2009), National Curriculum Framework for Teacher Education (2009), Justice Verma Committee Report (2012), NEP(2020)

Unit 5: Technology in/ for Education

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

B) Concept of e-learning, Approaches to elearning (Offline, Online, Synchronous, Asynchronous, Blended learning, mobile learning)

c) Emerging Trends in e learning: Social learning (concept , use of web 2.0 tools for learning, social networking sites, blogs, chats, video conferencing, discussion forum), Open Education Resources (Creative Common, Massive Open Online Courses; Concept and application), E Inclusion - Concept of E Inclusion, Application of Assistive technology in E learning , Quality of E Learning – Measuring quality of system: Information, System, Service, User Satisfaction and Net Benefits (D&M IS Success Model, 2003), Ethical Issues for E Learner and E Teacher - Teaching, Learning and Research

d) Use of ICT in Evaluation, Administration and Research: E portfolios, ICT for Research - Online Repositories and Online Libraries, Online and Offline assessment tools (Online survey tools or test generators) – Concept and Development.

Unit 6 Teacher Education

a) Meaning, Nature and Scope of Teacher Education; Types of Teacher Education Programs, The Structure of Teacher Education Curriculum and its Vision in Curriculum Documents of NCERT and NCTE at Elementary, Secondary and Higher Secondary Levels , Organization of Components of Pre-service Teacher Education Transactional Approaches (for foundation courses) Expository, Collaborative and Experiential learning

b), Meaning of Reflective Teaching and Strategies for Promoting Reflective Teaching, Models of Teacher Education - Behaviouristic, Competency-based and Inquiry Oriented Teacher Education Models

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

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

HISTORY

1: ANCIENT INDIAN HISTORY: Vedic age, Indus Valley Civilization, Mahajanpadas, Jainism and Buddhism. Rise of Magadha. The Mauryan Empire, The Satavahanas; Tamil states of Sangam Age. The Indo-Greek rulers, The Kushanas.

The Imperial Guptas. The Vakatakas; Later- Guptas, Cholas. Pallavas, Pandyas. Rashtrakutas, Rajputs: Pratiharas, Kalachuri-Chedi. Arab Contact. Conquest of Ghaznavi.

2: MEDIEVAL INDIAN HISTORY: Historiography and Sources. Iltutmish and Balban.Aladdin Khilji: Economic Reforms. Mohammed bin Tughlaq: Experiments and their Impacts. Feroze Shah Tughlaq: Welfare state. The Vijayanagar and Bahmani Kingdom.

Mughal Empire- Babar, Humayun and the Suris. Akbar, Aurengzeb. Administration under the Mughals—Civil, Judicial, Land Revenue and other sources of Income. Mansabdari and Jagirdari. Later Mughals. Marathas under Shivaji and Peshwas. Emergence of Khalsa and its impact. Banda Singh Bahadur: Career, Military Exploits. Emergence of Bengal as an economic centre.Jat and Satnami Rebellions.

3: SOCIETY, ECONOMY ANDARCHITECTURE: General Introduction- Main Features of Indian Architecture. Beginning of Rock-cut Tradition- Mauryan Period. Ashokan Pillars and Persian Influence. Buddhist Rock-cut Architecture: Chaitya and Vihara- Hinayana and Mahayana. Origin and Development of Stupa. Emergence of Hindu Structural Temples. Different Temple Styles: Nagara, Dravida and Vesara. Badami Chalukyan Temple Architecture. Rashtrakutas and Pallavas - Rock cut and Structural Temples. Zenith under the Cholas. Hoyasala Temple Architecture. Vijayanagara – Religious and Secular Architecture. Indo-Islamic Architecture during the Delhi Sultanate and Mughal period, provisional Styles – Bahamani and Bijapur.

Inland Trade. Overseas Trade - Role of Foreign Trading. Companies - Position of Indian Merchants Over-land Trade. The Mughal State and Commerce. Trend of India's Economy and Prospects during the First Half of the Eighteenth Century

4: HISTORY OF COLONIAL INDIA: British Conquest and consolidation- Colonial transformation. Constitutional Development. Socio-religious Reforms. Modernization of the Social Structure. Western impact and English

Education. Socio-Cultural Revolution. Colonial economy. Drain of Wealth. Land Tenure and Change in Indian Agrarian Structure. Commercialization of Indian Agriculture and Deindustrialization.

5: NATIONAL MOVEMENT IN INDIA: The Revolt of 1857, Moderates and Extremists. Swadeshi Movement. The Revolutionaries India and Abroad; Partition of Bengal; Home rule Movements. Swarajists. Emergence of Communalism. Gandhi- Ideology and Movements- Left Movement. Constitutional Changes, Nehru Report, Round Table Conferences, Communal Award, Demand for Pakistan.

6: Post Independent India: The Colonial Legacy: Political and economic legacies. National movements: Its significance, Value and Legacy.Integration of India as a nation, National Consolidation, Linguistic Reorganisation of states. Building of India as a secular nation. Indian Foreign Policy. Non-Aligned Movement. Indian Economy, 1947-1965: the Nehruvian Legacy. Land Reforms. Green Revolution in India.

7: HISTORY OF MODERN WORLD: The French Revolution. The American Revolution. Industrial Revolution. Rise of Capitalism and Imperialism. First World War. The League of Nations. Rise of Fascism and Militarism in Italy, Germany and Japan. Second World War. UNO. Decolonization in Asia and Africa. Disintegration of the Soviet Union.

8: HISTORIOGRAPHY: Ancient Indian Historiography, Sultanate Period: The Pioneers, The Fourteen century Historiography, Late Fourteenth and Fifteenth century Histories, Historiography under the Mughals: Akbar's Reign—Official Histories. Histories during the reign of Jahangir, Shah jahan and Aurangzeb. Schools of Historiography in Modern India: Imperialist, Nationalist, Marxist, Subaltern.Franc's Bacon, Descartes, and Cartesian Historiography. Vico's idea of History. Characteristic Features of Rankean History. Idealistic view of history—Croce and Collingwood. Towards the Total History: Marc Bloch. Antonio Gramsci: Principal Views on History.Post Modernism

Political Science

1. Political Theory: Meaning, scope, debate on decline and resurgence of political theory. Political Ideology- liberalism, Fascism, Marxism, Socialism, Feminism, Postmodernism Liberty, Equality, Justice, Rights, Democracy, Power, Authority, Legitimacy, Political Obligation- Theories of Political Obligation.

2. Western Political Thought: Plato, Aristotle, Machiavelli, Thomas Hobbes, John Locke, J.J. Rousseau, J.S. Mill, Karl Marx, Mary Wollstonecraft, Hannah Arendt, John Rawls,

3. Indian Political Thought: Kautilya, Raja Ram Mohan Roy, B.G. Tilak, Sir Syed Ahmad Khan, Mahatma Gandhi, Aurobindo Gosh, Sir Muhammad Iqbal, Jawaharlal Nehru, B.R. Ambedkar, M.N. Roy,V.D. Savarkar, Ram Manohar Lohia, Jaya Prakash Narayan.

4. Comparative Politics; Meaning, Nature, Scope.
Approaches- Traditional and Modern, Political Regimes- Democratic, Authoritarian, Corporatist, Post-Colonial.
Constitutions and Constitutionalism: forms of constitutions, rule of law, judicial independence, and liberal constitutionalism; emergency powers and crisis of constitutionalism.
Structures of Power: ruling class, power elites, democratic elitism

5. International Relations
Approaches to the study of international relations: Idealism, Realism, Neo-Realism
Theories- Game Theory, Decision-Making, Communication, Dependency
Concepts: Power, National Power, National Interest, Wars, Cold War, Weapons of Mass Destruction, Diplomacy
United Nations Organisation, European Union, ASEAN, SAARC, SCO, QUAD
Political Economy of IR; Globalisation; Global Governance and Bretton Woods System, North-South Dialogue, WTO, G-20, BRICS
Contemporary Challenges: International Terrorism, Climate Change and Environmental Concerns, Human Rights, Migration and Refugees, Culture and Identity Politics.

6. India's Foreign Policy and Diplomacy
Perspectives on India's Foreign Policy:India' Identity as post-Colonial, Development, Rising Power. Continuity and change in India's Foreign Policy: Principles and Determinants; Non-Alignment Movement- Historical background and Relevance of NonAligned Movement in globalized world. India's Relations with Major Powers- USA, USSR/Russia, People's Republic of China. India's Relations with Neighbours- Pakistan, Bangladesh, Sri Lanka, Afghanistan, Bhutan, Nepal, Maldives, Look East/Act East. Contemporary

Challenges: Maritime Security, Energy Security, Migrants and Refugees, International Terrorism, Cyber Security.

7. Indian Government and Politics
Historical Background, Preamble, Basic Structure, Features of Indian Constitution.
Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Amendment of Constitution. Judiciary- Independence of Judiciary, Judicial Review, Judicial Activism, PIL.
Grievance Redress System: Ombudsman, Lokpal, Lokayukta Grassroots Governance- Panchayat Raj Institutions and their Functioning Institutions- Election Commission, NITI Aayog, Finance Commission, Goods and Services Tax Council, National Commission for SCs, National Commission for STs,National Commission for Women Union Executive, Union Legislature, State Executive, State Legislature.
Political Parties and Party System in India.

8. Public Administration
Meaning and Evolution; Public and Private Administration, New Public Administration, Development Administration
Comparative Public Administration, New Public Management, changing nature of Public Administration in the era of liberalisation and Globalisation
Principles of Organization: Hierarchy, Unity of Command, Span of Control.
Decentralization-Meaning, advantages & disadvantages Delegation-Meaning, advantages & disadvantages
Theories and Principles of Organisation- Scientific Management, Bureaucratic theory, Human Relations Theory.
Managing the Organisation- Theories of Leadership and Motivation

Punjabi

Unit - I ਸਾਹਿਤ, ਸਾਹਿਤ ਰੂਪ, ਸਾਹਿਤ ਸ਼ਾਸਤਰੀ ਪਰੰਪਰਾ ਅਤੇ ਸਾਹਿਤ ਇਤਿਹਾਸਕਾਰੀ

- **ਸਾਹਿਤ** : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ।
- ਸਾਹਿਤ ਦਾ ਹੋਰ ਅਨੁਸ਼ਾਸਨਾਂ ਨਾਲ ਸਬੰਧ (ਭਾਸ਼ਾ, ਸਮਾਜ, ਇਤਿਹਾਸ, ਮਨੋਵਿਗਿਆਨ, ਸਭਿਆਚਾਰ, ਧਰਮ, ਦਰਸ਼ਨ ਅਤੇ ਰਾਜਨੀਤੀ)।
- ਸਾਹਿਤ ਪ੍ਰਗਟਾਅ ਦੀ ਵਿਧੀਆਂ : ਪ੍ਰਗੀਤਕ, ਬਿਰਤਾਂਤਕ ਅਤੇ ਨਾਟਕੀ।
- ਸਾਹਿਤ, ਸਾਹਿਤ ਵਿਗਿਆਨ ਅਤੇ ਸਾਹਿਤ ਇਤਿਹਾਸ ਦਾ ਅੰਤਰ-ਨਿਖੇੜ।
- **ਸਾਹਿਤ ਦੇ ਰੂਪ :**
  - ➢ ਮੱਧਕਾਲੀ ਰੂਪ : ਸ਼ਬਦ, ਸਲੋਕ, ਕਾਫ਼ੀ, ਬਾਰਹਮਾਹ, ਸੀਹਰਫ਼ੀ, ਕਿੱਸਾ, ਵਾਰ, ਜੰਗਨਾਮਾ, ਜਨਮਸਾਖੀ, ਟੀਕਾ ਅਤੇ ਪਰਚੀਆਂ।
  - ➢ ਆਧੁਨਿਕ ਰੂਪ : ਗੀਤ, ਨਜ਼ਮ, ਗ਼ਜ਼ਲ, ਰੁਬਾਈ, ਹਾਇਕੂ, ਨਾਵਲ, ਨਿੱਕੀ ਕਹਾਣੀ, ਨਾਟਕ ਅਤੇ ਇਕਾਂਗੀ, ਨਿਬੰਧ, ਸਫ਼ਰਨਾਮਾ, ਡਾਇਰੀ, ਜੀਵਨੀ, ਸਵੈ-ਜੀਵਨੀ ਅਤੇ ਰੇਖਾ ਚਿੱਤਰ।
- **ਯੂਨਾਨੀ ਕਾਵਿ ਸ਼ਾਸਤਰ** : ਸੁਕਰਾਤ, ਪਲੈਟੋ, ਅਰਸਤੂ, ਲੌਂਜਾਈਨਸ।
- **ਭਾਰਤੀ ਕਾਵਿ ਸ਼ਾਸਤਰ :**
  - ➢ ਕਾਵਿ ਦੇ ਭੇਦ : ਸ੍ਰਵ ਅਤੇ ਦ੍ਰਿਸ਼।
  - ➢ ਰਸ ਸੰਪਦਾਇ, ਧੁਨੀ ਸੰਪਦਾਇ, ਅਲੰਕਾਰ ਸੰਪਦਾਇ, ਵਕ੍ਰੋਕਤੀ ਸੰਪਦਾਇ, ਰੀਤੀ ਸੰਪਦਾਇ, ਔਚਿਤੇ ਸੰਪਦਾਇ।
- **ਪੱਛਮੀ ਸਾਹਿਤ ਚਿੰਤਨ** : ਰੂਪਵਾਦ, ਮਾਰਕਸਵਾਦ, ਸੰਰਚਨਾਵਾਦ, ਮਨੋਵਿਗਿਆਨ, ਚਿਹਨ ਵਿਗਿਆਨ, ਵਿਰਚਨਾ ਸਾਹਿਤ ਸਿਧਾਂਤ, ਨਾਰੀ ਚਿੰਤਨ, ਦਲਿਤ ਚਿੰਤਨ ਅਤੇ ਉੱਤਰ ਆਧੁਨਿਕ ਸਾਹਿਤ ਸਿਧਾਂਤ।
- **ਪੰਜਾਬੀ ਸਾਹਿਤ ਚਿੰਤਕ** : ਸੰਤ ਸਿੰਘ ਸੇਖੋਂ, ਕਿਸ਼ਨ ਸਿੰਘ, ਹਰਿਭਜਨ ਸਿੰਘ, ਨਜਮ ਹੁਸੈਨ ਸੱਯਦ, ਤਰਲੋਕ ਸਿੰਘ ਕੰਵਰ ਅਤੇ ਹਰਿਭਜਨ ਸਿੰਘ ਭਾਟੀਆ।
- ਸਾਹਿਤ ਦੀ ਇਤਿਹਾਸਕਾਰੀ : ਸੰਕਲਪ ਅਤੇ ਸਰੂਪ
- ਸਾਹਿਤ ਇਤਿਹਾਸ ਅਤੇ ਸਾਹਿਤ ਸਮੀਖਿਆ : ਅੰਤਰ ਨਿਖੇੜ
- ਸਾਹਿਤ ਇਤਿਹਾਸ ਅਤੇ ਇਤਿਹਾਸ ਸ਼ਾਸਤਰ ਦਾ ਅੰਤਰ ਨਿਖੇੜ
- ਸਾਹਿਤ ਇਤਿਹਾਸਕਾਰੀ ਦੌਰਾਨ ਸਾਹਿਤਕ ਤੱਥਾਂ ਦੇ ਨਿਰਣੇ ਦੀਆਂ ਸਮੱਸਿਆਵਾਂ
- ਸੰਯੁਕਤ ਪੰਜਾਬੀ ਸਾਹਿਤ ਦੀ ਇਤਿਹਾਸਕਾਰੀ : ਕਾਲ ਵੰਡ ਅਤੇ ਵਰਗੀਕਰਨ ਦੀਆਂ ਸਮੱਸਿਆਵਾਂ
- ਪੰਜਾਬੀ ਸਾਹਿਤ ਇਤਿਹਾਸ ਲਿਖਤਾਂ ਦਾ ਮੈਟਾ ਅਧਿਐਨ।

Unit - II ਪੰਜਾਬੀ ਸੂਫ਼ੀ ਕਾਵਿ ਧਾਰਾ ਅਤੇ ਗੁਰਮਤਿ ਕਾਵਿ ਧਾਰਾ

- ਪੰਜਾਬੀ ਸੂਫ਼ੀ ਕਾਵਿ ਧਾਰਾ : ਆਰੰਭ, ਵਿਕਾਸ ਪੜਾਅ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਪ੍ਰਮੁੱਖ ਪੰਜਾਬੀ ਸੂਫ਼ੀ ਕਵੀ : ਬਾਬਾ ਫ਼ਰੀਦ, ਸ਼ਾਹ ਹੁਸੈਨ, ਬੁੱਲ੍ਹੇ ਸ਼ਾਹ, ਸੁਲਤਾਨ ਬਾਹੂ ਅਤੇ ਵਜ਼ੀਦ।
- ਪੰਜਾਬੀ ਸੂਫ਼ੀ ਕਾਵਿ ਸੰਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਮੈਟਾ ਅਧਿਐਨ
- ਗੁਰਮਤਿ ਕਾਵਿ ਧਾਰਾ : ਆਰੰਭ, ਵਿਕਾਸ ਪੜਾਅ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਸ੍ਰੀ ਗੁਰੂ ਗ੍ਰੰਥ ਸਾਹਿਬ : ਸੰਪਾਦਨ-ਕਲਾ ਅਤੇ ਸਾਹਿਤਕ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਪ੍ਰਮੁੱਖ ਗੁਰੂ ਕਵੀ : ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਜੀ, ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਜੀ, ਗੁਰੂ ਅਰਜਨ ਦੇਵ ਜੀ, ਗੁਰੂ ਤੇਗ ਬਹਾਦਰ ਜੀ ਅਤੇ ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ ਜੀ।
- ਪ੍ਰਮੁੱਖ ਭਗਤ ਕਵੀ : ਰਵਿਦਾਸ, ਨਾਮਦੇਵ ਅਤੇ ਕਬੀਰ।
- ਵਾਰਾਂ ਭਾਈ ਗੁਰਦਾਸ।
- ਗੁਰਮਤਿ ਕਾਵਿ ਧਾਰਾ ਸੰਬੰਧੀ ਪ੍ਰਾਪਤ ਸਮੀਖਿਆ ਦਾ ਮੈਟਾ ਅਧਿਐਨ।

Unit -III ਪੰਜਾਬੀ ਕਿੱਸਾ ਕਾਵਿ ਅਤੇ ਬੀਰ ਵਾਰ ਕਾਵਿ ਧਾਰਾ

- ਪੰਜਾਬੀ ਕਿੱਸਾ ਕਾਵਿ ਧਾਰਾ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਪ੍ਰਮੁੱਖ ਕਿੱਸਾਕਾਰ : ਦਮੋਦਰ, ਪੀਲੂ, ਵਾਰਿਸ, ਹਾਸ਼ਮ ਤੇ ਕਾਦਰਯਾਰ।
- ਪੰਜਾਬੀ ਬੀਰ ਵਾਰ ਕਾਵਿ ਅਤੇ ਜੰਗਨਾਮਾ ਕਾਵਿ ਧਾਰਾ : ਆਰੰਭ ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਪ੍ਰਮੁੱਖ ਵਾਰਕਾਰ : ਗੁਰੂ ਗੋਬਿੰਦ ਸਿੰਘ, ਨਜਾਬਤ ਅਤੇ ਪੀਰ ਮੁਹੰਮਦ।
- ਪ੍ਰਮੁੱਖ ਜੰਗਨਾਮਾਕਾਰ : ਸ਼ਾਹ ਮੁਹੰਮਦ, ਸ਼ਮਸ਼।
- ਪੰਜਾਬੀ ਕਿੱਸਾ ਕਾਵਿ , ਬੀਰ ਵਾਰ ਕਾਵਿ ਅਤੇ ਜੰਗਨਾਮਾ ਕਾਵਿ ਸੰਬੰਧੀ ਪ੍ਰਮੁੱਖ ਆਲੋਚਨਾ ਦਾ ਸਿੱਟਾ ਅਧਿਐਨ।

Unit -IV ਪੰਜਾਬੀ ਵਾਰਤਕ

- ਮੱਧਕਾਲੀ ਪੰਜਾਬੀ ਵਾਰਤਕ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ (ਜਨਮਸਾਖੀ ਪਰੰਪਰਾ : ਪੁਰਾਤਨ ਜਨਮਸਾਖੀ, ਆਦਿ ਸਾਖੀਆਂ, ਵੇਂਤੂ ਨਾਲ ਵਾਲੀ ਜਨਮਸਾਖੀ, ਮਿਹਰਬਾਨ ਵਾਲੀ ਜਨਮਸਾਖੀ, ਜਨਮਸਾਖੀ ਭਾਈ ਬਾਲਾ; ਕਿਸ਼ਨ ਦਤਨਾਵਲੀ, ਗੁਰ ਬਿਲਾਸ, ਰੀਤਾਂ, ਪਰਵਾਣਿਆ, ਫ਼ਰੇਰਨਾਮੇ ਅਤੇ ਟੀਕੇ ਦੇ ਸੰਦਰਭ ਵਿਚ)
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਵਾਰਤਕ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਵਾਰਤਕ ਵਿਚ ਨਵੇਂ ਰੁਝਾਨ
- ਪਰਵਾਸੀ ਪੰਜਾਬੀ ਵਾਰਤਕ ਦਾ ਸਰਵੇਖਣ
- ਪਾਕਿਸਤਾਨੀ ਪੰਜਾਬੀ ਵਾਰਤਕ ਦਾ ਸਰਵੇਖਣ
- ਪ੍ਰਮੁੱਖ ਵਾਰਤਕਕਾਰ : ਭਾਈ ਵੀਰ ਸਿੰਘ, ਪੂਰਨ ਸਿੰਘ, ਨਾਹਰ ਸਿੰਘ, ਤੇਜਾ ਸਿੰਘ, ਗੁਰਬਖਸ਼ ਸਿੰਘ ਪ੍ਰੀਤਲੜੀ, ਕਪੂਰਤ ਸਾਹਨੀ, ਕੁਲਵੰਤ ਗਾਰਗੀ, ਗੁਲਜ਼ਾਰ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਨਰਿੰਦਰ ਸਿੰਘ ਕਪੂਰ।
- ਮੱਧਕਾਲੀ ਪੰਜਾਬੀ ਵਾਰਤਕ ਸੰਬੰਧੀ ਪ੍ਰਮੁੱਖ ਆਲੋਚਨਾ ਦਾ ਸਿੱਟਾ ਅਧਿਐਨ।
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਵਾਰਤਕ ਸੰਬੰਧੀ ਪ੍ਰਮੁੱਖ ਆਲੋਚਨਾ ਦਾ ਸਿੱਟਾ ਅਧਿਐਨ।

Unit -V ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ

- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਵਿਚ ਪ੍ਰਮੁੱਖ ਰੁਝਾਨ (ਆਦਰਸ਼ਵਾਦੀ, ਯਥਾਰਥਵਾਦੀ, ਪ੍ਰਗਤੀਵਾਦੀ, ਪ੍ਰਯੋਗਸ਼ੀਲ, ਰੁਮਾਂਟਵਾਦੀ, ਨਾਰੀ-ਦ੍ਰਿਸ਼ਟੀ ਅਤੇ ਦਲਿਤ-ਦ੍ਰਿਸ਼ਟੀ ਦੇ ਸੰਦਰਭ ਵਿਚ)
- ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਕਵਿਤਾ ਵਿਚ ਨਵੇਂ ਰੁਝਾਨ
- ਪਰਵਾਸੀ ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਸਰਵੇਖਣ
- ਪਾਕਿਸਤਾਨੀ ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਸਰਵੇਖਣ
- ਪ੍ਰਮੁੱਖ ਪੰਜਾਬੀ ਕਵੀ : ਭਾਈ ਵੀਰ ਸਿੰਘ, ਪੂਰਨ ਸਿੰਘ, ਧਨੀ ਰਾਮ ਚਾਤ੍ਰਿਕ, ਮੋਹਨ ਸਿੰਘ, ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ, ਬਾਵਾ ਬਲਵੰਤ, ਹਰਿਭਜਨ ਸਿੰਘ, ਜਸਵੰਤ ਸਿੰਘ ਨੇਕੀ, ਸ਼ਿਵ ਕੁਮਾਰ, ਪਾਸ਼, ਸੁਰਜੀਤ ਪਾਤਰ ਅਤੇ ਜਸਵੰਤ ਦੀਦ।
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਸੰਬੰਧੀ ਪ੍ਰਮੁੱਖ ਆਲੋਚਨਾ ਦਾ ਸਿੱਟਾ ਅਧਿਐਨ।

Unit -VI ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਨਾਵਲ

- ਪੰਜਾਬੀ ਨਾਵਲ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਵਾਲ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਪੰਜਾਬੀ ਨਾਵਲ ਵਿਚ ਪ੍ਰਮੁੱਖ ਰੁਝਾਨ (ਆਦਰਸ਼ਵਾਦੀ, ਯਥਾਰਥਵਾਦੀ, ਪ੍ਰਗਤੀਵਾਦੀ, ਇਤਿਹਾਸਕ, ਮਨੋਵਿਗਿਆਨਕ, ਨਾਰੀ-ਦ੍ਰਿਸ਼ਟੀ ਅਤੇ ਦਲਿਤ ਦ੍ਰਿਸ਼ਟੀ ਦੇ ਸੰਦਰਭ ਵਿਚ)
- ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਨਾਵਲ ਵਿਚ ਨਵੇਂ ਰੁਝਾਨ
- ਪਰਵਾਸੀ ਪੰਜਾਬੀ ਨਾਵਲ ਦਾ ਸਰਵੇਖਣ
- ਪਾਕਿਸਤਾਨੀ ਪੰਜਾਬੀ ਨਾਵਲ ਦਾ ਸਰਵੇਖਣ

3

- ਪ੍ਰਸਿੱਧ ਪੰਜਾਬੀ ਨਾਵਲਕਾਰ : ਨਾਨਕ ਸਿੰਘ, ਜਸਵੰਤ ਸਿੰਘ ਕੰਵਲ, ਗੁਰਦਿਆਲ ਸਿੰਘ, ਦਲੀਪ ਕੌਰ ਟਿਵਾਣਾ, ਰਾਮ ਸਰੂਪ ਅਣਖੀ, ਤਰਸੇਮ ਸਿੰਘ ਅਤੇ ਮਨਮੋਹਨ ਬਾਵਾ।
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਸੰਗ ਤੋਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਵਿਚ ਪ੍ਰਮੁੱਖ ਰੁਝਾਨ (ਅਦਰਸ਼ਵਾਦੀ, ਯਥਾਰਥਵਾਦੀ, ਦੇਸ਼-ਵੰਡ ਨਾਲ ਸਬੰਧਤ, ਪ੍ਰਗਤੀਵਾਦੀ, ਮਨੋਵਿਗਿਆਨਕ, ਨਾਰੀ ਦ੍ਰਿਸ਼ਟੀ ਅਤੇ ਦਲਿਤ ਦ੍ਰਿਸ਼ਟੀ ਦੇ ਸੰਦਰਭ ਵਿਚ)
- ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਕਹਾਣੀ ਵਿਚ ਨਵੇਂ ਰੁਝਾਨ
- ਪਰਵਾਸੀ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਸਰਵੇਖਣ
- ਪਾਕਿਸਤਾਨੀ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਸਰਵੇਖਣ
- ਪ੍ਰਸਿੱਧ ਪੰਜਾਬੀ ਕਹਾਣੀਕਾਰ : ਗੁਰਬਖਸ਼ ਸਿੰਘ, ਕਰਤਾਰ ਸਿੰਘ ਦੁੱਗਲ, ਸੰਤ ਸਿੰਘ ਸੇਖੋਂ, ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ, ਅਜੀਤ ਕੌਰ, ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼, ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਲਾਲ ਸਿੰਘ।
- ਪੰਜਾਬੀ ਨਾਵਲ ਸੰਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਮੁੱਲਾ ਅਧਿਐਨ
- ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਸੰਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਮੁੱਲਾ ਅਧਿਐਨ।

Unit- VII ਪੰਜਾਬੀ ਨਾਟਕ ਅਤੇ ਇਕਾਂਗੀ

- ਪੰਜਾਬੀ ਨਾਟਕ ਅਤੇ ਇਕਾਂਗੀ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਸੰਗ ਤੋਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ।
- ਸਮਕਾਲੀ ਪੰਜਾਬੀ ਨਾਟਕ ਵਿਚ ਪ੍ਰਮੁੱਖ ਰੁਝਾਨ
- ਪਰਵਾਸੀ ਪੰਜਾਬੀ ਨਾਟਕ ਤੇ ਇਕਾਂਗੀ ਦਾ ਸਰਵੇਖਣ
- ਪਾਕਿਸਤਾਨੀ ਪੰਜਾਬੀ ਨਾਟਕ ਤੇ ਇਕਾਂਗੀ ਦਾ ਸਰਵੇਖਣ
- ਪ੍ਰਸਿੱਧ ਪੰਜਾਬੀ ਨਾਟਕਕਾਰ ਤੇ ਇਕਾਂਗੀਕਾਰ : ਈਸ਼ਵਰ ਚੰਦਰ ਨੰਦਾ, ਸੰਤ ਸਿੰਘ ਸੇਖੋਂ, ਹਰਚਰਨ ਸਿੰਘ, ਬਲਵੰਤ ਗਾਰਗੀ, ਗੁਰਸ਼ਰਨ ਸਿੰਘ ਸੋਢੀ, ਚਰਨਦਾਸ ਸਿੱਧੂ, ਆਤਮਜੀਤ ਸ਼ੀਲਖ, ਆਤਮਜੀਤ ਅਤੇ ਸਵਰਾਜ ਬੀਰ।
- ਪੰਜਾਬੀ ਰੰਗਮੰਚ : ਆਰੰਭ, ਵਿਕਾਸ ਪ੍ਰਸੰਗ, ਸਮੱਸਿਆਵਾਂ ਅਤੇ ਭਵਿੱਖ
- ਪੰਜਾਬੀ ਨਾਟਕ ਅਤੇ ਇਕਾਂਗੀ ਸੰਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਮੁੱਲਾ ਅਧਿਐਨ

Unit -VIII ਲੋਕਧਾਰਾ ਤੇ ਪੰਜਾਬੀ ਲੋਕਧਾਰਾ ਅਤੇ ਸਭਿਆਚਾਰ ਤੇ ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ

- ਲੋਕਧਾਰਾ : ਪਰਿਭਾਸ਼ਾ, ਪ੍ਰਕਿਰਤੀ ਤੇ ਤੱਤ
- ਲੋਕਧਾਰਾ, ਆਧੁਨਿਕਤਾ ਅਤੇ ਸੰਚਾਰ ਮਾਧਿਅਮ
- ਲੋਕ ਸਾਹਿਤ ਅਤੇ ਵਿਸ਼ਿਸ਼ਟ ਸਾਹਿਤ
- ਲੋਕ ਸਾਹਿਤ : ਨੇਮਾਪ ਅਤੇ ਪ੍ਰਮੁੱਖ ਵੰਨਗੀਆਂ
- ਲੋਕਧਾਰਾ ਦੀਆਂ ਵਿਭਿੰਨ ਪ੍ਰਣਾਲੀਆਂ ਵਿਧੀਆਂ (ਲੋਕ ਗੀਤ, ਲੋਕ ਕਥਾ, ਲੋਕ ਵਿਸ਼ਵਾਸ, ਧੰਮੀ ਵਿਚਾਰ, ਲੋਕ ਨਾਟਕ, ਲੋਕ ਪਰਮ, ਲੋਕ ਕਲਾਵਾਂ ਅਤੇ ਲੋਕ ਨਾਚ)
- ਵਿਸ਼ਵ ਪ੍ਰਸਿੱਧ ਲੋਕਧਾਰਾ ਸ਼ਾਸਤਰੀਆਂ ਦਾ ਯੋਗਦਾਨ (ਵਿਲੀਅਮ ਥਾਮਸ, ਵੀ. ਪ੍ਰਾਪ ਅਤੇ ਸਿੰਥਨ ਥੌਪੀ)।
- ਲੋਕਧਾਰਾ ਵਿਗਿਆਨ : ਪਰਿਭਾਸ਼ਾ, ਪ੍ਰਕਿਰਤੀ ਤੇ ਤੱਤ।
- ਲੋਕਧਾਰਾ ਵਿਗਿਆਨ ਦੀ ਦ੍ਰਿਸ਼ਟੀ ਤੋਂ ਸਾਹਿਤ ਦਾ ਅਧਿਐਨ।
- ਪੰਜਾਬੀ ਲੋਕਧਾਰਾਵਾਦੀ ਸਾਮੰਗਰੀ ਦੇ ਵਿਭਿੰਨ ਰੂਪ ਅਤੇ ਵਰਗੀਕਰਨ
- ਪੰਜਾਬੀ ਲੋਕ ਵਿਕਾਸ, ਲੋਕ ਸਿਆਣਪ, ਧੀਂ-ਰਸਮਾਂ ਅਤੇ ਵਿਸ਼ੁੱਧ
- ਪੰਜਾਬੀ ਲੋਕ-ਕਲਾਵਾਂ, ਲੋਕ-ਨਾਚ ਅਤੇ ਲੋਕ-ਸੰਗੀਤ।
- ਪੰਜਾਬੀ ਲੋਕ ਸਾਹਿਤ ਦਾ ਵਰਗੀਕਰਨ : ਲੋਕ ਗੀਤ, ਲੋਕ ਕਥਾਵਾਂ, ਲੋਕ ਨਾਟ।
- ਪੰਜਾਬੀ ਲੋਕ ਪੰਵੇ, ਲੋਕ ਰਹਿਣੇ, ਲੋਕ ਪਹਿਰਾਵਾ ਅਤੇ ਲੋਕ ਖੇਡਾ।
- ਪੰਜਾਬੀ ਲੋਕਧਾਰਾ ਸੰਗ੍ਰਹਿ, ਸੰਪਾਦਨ ਅਤੇ ਸਮੀਖਿਆ ਦਾ ਇਤਿਹਾਸ।

- ਪੰਜਾਬੀ ਦੇ ਪ੍ਰਸਿੱਧ ਲੋਕਧਾਰਾ ਚਿੰਤਕਾਂ/ਵਿਦਵਾਨਾਂ ਦਾ ਯੋਗਦਾਨ (ਆਰ.ਸੀ. ਟੈਂਪਲ, ਦਵਿੰਦਰ ਸਤਿਆਰਥੀ, ਸ.ਸ. ਵਣਜਾਰਾ ਬੇਦੀ, ਮਹਿੰਦਰ ਸਿੰਘ ਰੰਧਾਵਾ, ਕਰਨੈਲ ਸਿੰਘ ਥਿੰਦ ਅਤੇ ਨਾਹਰ ਸਿੰਘ)।
- ਪੰਜਾਬੀ ਲੋਕਧਾਰਾ ਅਧਿਐਨ ਸਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਸਿੰਟਾ ਅਧਿਐਨ।
- ਸਭਿਆਚਾਰ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ।
- ਸਭਿਆਚਾਰ ਅਤੇ ਸਭਿਅਤਾ ਦਾ ਅੰਤਰ-ਸਬੰਧ
- ਸਭਿਆਚਾਰਕ ਰੂਪਾਂਤਰਣ ਪ੍ਰਕਿਰਿਆ
- ਸਭਿਆਚਾਰ, ਸਮਾਜ ਅਤੇ ਭਾਸ਼ਾ ਦਾ ਅੰਤਰ-ਸਬੰਧ
- ਸਭਿਆਚਾਰ ਅਧਿਐਨ ਦੀਆਂ ਵਿਭਿੰਨ ਦ੍ਰਿਸ਼ਟੀਆਂ
- ਸਭਿਆਚਾਰ ਦਾ ਭੂਗੋਲ, ਆਰਥਿਕਤਾ, ਧਰਮ ਅਤੇ ਰਾਜਨੀਤੀ ਨਾਲ ਸੰਬੰਧ
- ਲੋਕਧਾਰਾ ਅਤੇ ਸਭਿਆਚਾਰ ਦਾ ਅੰਤਰ-ਸਬੰਧ
- ਸਭਿਆਚਾਰ ਵਿਗਿਆਨ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ
- ਵਿਸ਼ਵ ਪ੍ਰਸਿੱਧ ਸਭਿਆਚਾਰ ਸ਼ਾਸਤਰੀਆਂ ਦਾ ਯੋਗਦਾਨ (ਰੇਮੰਡ ਵਿਲੀਅਮਜ਼, ਫ੍ਰਾਂਤਜ਼ ਅਤੇ ਮੈਲਿਨਵਸਕੀ ਸਟੀਵਰਡ)।
- ਪੰਜਾਬ, ਪੰਜਾਬੀ ਅਤੇ ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਦੇ ਪ੍ਰਗਟ ਚਿੰਨ੍ਹ
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਉੱਪਰ ਭਾਰਤੀ ਤੇ ਸਾਮੀ ਸਭਿਆਚਾਰ ਦਾ ਪ੍ਰਭਾਵ
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਦਾ ਕੌਮੀ ਪ੍ਰਸੰਗ
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ, ਸਿਆਸਤ ਅਤੇ ਸੰਪ੍ਰਦਾਇਕਤਾ
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਅਤੇ ਸਾਹਿਤ/ਵਾਰੀ ਪ੍ਰਬੰਧ
- ਵਿਸ਼ਵੀਕਰਨ ਦੇ ਦੌਰ ਵਿਚ ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਸਨਮੁਖ ਚੁਣੌਤੀਆਂ
- ਪ੍ਰਸਿੱਧ ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਸ਼ਾਸਤਰੀਆਂ ਦਾ ਯੋਗਦਾਨ (ਟੀ.ਆਰ. ਵਿਨੋਦ, ਗੁਰਬਖਸ਼ ਸਿੰਘ ਫਰੈਂਕ ਅਤੇ ਜਸਵਿੰਦਰ ਸਿੰਘ)।
- ਪੰਜਾਬੀ ਸਭਿਆਚਾਰ ਅਧਿਐਨ ਸਬੰਧੀ ਪ੍ਰਾਪਤ ਆਲੋਚਨਾ ਦਾ ਸਿੰਟਾ ਅਧਿਐਨ।

Unit -IX ਭਾਸ਼ਾ, ਭਾਸ਼ਾ ਵਿਗਿਆਨ, ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ

- ਭਾਸ਼ਾ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਭਾਸ਼ਾ, ਸਮਾਜ, ਸਭਿਆਚਾਰ ਅਤੇ ਸਾਹਿਤ ਦਾ ਅੰਤਰ-ਸਬੰਧ।
- ਭਾਸ਼ਾ, ਉਪਭਾਸ਼ਾ ਅਤੇ ਲਿਪੀ ਦਾ ਅੰਤਰ-ਸਬੰਧ।
- ਭਾਸ਼ਾ ਅਤੇ ਸੰਚਾਰ ਮਾਧਿਅਮ (ਪ੍ਰਿੰਟ, ਇਲੈਕਟ੍ਰਾਨਿਕ ਅਤੇ ਨਿਊ ਮੀਡੀਆ)।
- ਵਿਸ਼ਵ ਭਾਸ਼ਾ ਪਰਿਵਾਰ
- ਆਧੁਨਿਕ ਭਾਰਤੀ ਆਰੀਆ ਭਾਸ਼ਾਵਾਂ
- ਭਾਸ਼ਾ ਵਿਗਿਆਨ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਖੇਤਰ।
- ਭਾਸ਼ਾ ਵਿਗਿਆਨ ਅਤੇ ਭਾਸ਼ਾ ਸਮਾਰ
- ਸਾਰਿਣੀਕ ਦੇ ਭਾਸ਼ਾਈ ਸੰਕਲਪ : ਚਿਹਨ : ਚਿਹਨਕ ਤੇ ਚਿਹਨਿਤ, ਲਿੰਗ ਤੇ ਪੈਰੋਲ, ਵਿਕਾਸਕ ਤੇ ਦੁਰਾਗਕ, ਰਖਸੀਦਾਰ ਤੇ ਰਖਸੀਦਾਰ।
- ਨੋਮ ਚੌਮਸਕੀ ਦੇ ਭਾਸ਼ਾਈ ਸੰਕਲਪ : ਸੌਰਫੇਸ ਤੇ ਡਿਪਲੀ, ਕਾਹਿਤ ਤੇ ਸਰੀਂਚੀ ਹੁਰਤ, ਵਾਰਸ਼ ਉਪਜਾਊ ਨੇਮ, ਰੂਪਾਂਤਰੀ ਨੇਮ, ਧੁਨੀ ਰੂਪਾਂਤਰਕ ਨੇਮ।
- ਧੁਨੀ ਤੇ ਧੁਨੀ ਵਿਗਿਆਨ : ਸੰਕਲਪ ਤੇ ਵਰਗੀਕਰਨ
- ਭਾਵਾਂਸ਼/ਰੂਪੀਮ ਤੇ ਭਾਵਾਂਸ਼/ਰੂਪੀਮ-ਪ੍ਰਬੰਧ : ਸੰਕਲਪ ਤੇ ਵਰਗੀਕਰਨ
- ਵਾਕ ਅਤੇ ਵਾਕ ਵਿਗਿਆਨ : ਸੰਕਲਪ ਤੇ ਵਰਗੀਕਰਨ
- ਅਰਥ ਅਤੇ ਅਰਥ ਵਿਗਿਆਨ : ਸੰਕਲਪ ਤੇ ਵਰਗੀਕਰਨ
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਆਰੰਭ, ਵਿਕਾਸ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ

5

- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਉੱਪਰ ਹੋਰ ਭਾਸ਼ਾਵਾਂ ਦੇ ਪ੍ਰਭਾਵ
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੀਆਂ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਪੰਜਾਬੀ ਦੀਆਂ ਉੱਪਭਾਸ਼ਾਵਾਂ
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੇ ਵਿਕਾਸ ਅਦਾਰੇ
- ਪੰਜਾਬੀ ਭਾਵਾਸ/ਰੂਪੀਮ-ਵਿਗਿਆਨ/ਵਿਉਂਤ
- ਪੰਜਾਬੀ ਵਾਕ-ਵਿਗਿਆਨ/ਵਿਉਂਤ
- ਪੰਜਾਬੀ ਅਰਥ-ਵਿਗਿਆਨ/ਵਿਉਂਤ
- ਗੁਰਮੁਖੀ ਲਿਪੀ ਦਾ ਨਿਕਾਸ, ਵਿਕਾਸ ਤੇ ਵਿਸ਼ੇਸ਼ਤਾਵਾਂ
- ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿਪੀ ਦਾ ਅੰਤਰ ਸੰਬੰਧ
- ਪ੍ਰਮੁੱਖ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨੀ (ਦੁਨੀ ਚੰਦਰ, ਹਰਕੀਰਤ ਸਿੰਘ, ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ ਸਿੰਘ ਅਤੇ ਪਰਮਜੀਤ ਸਿੰਘ ਸਿੱਧੂ)।

Unit -X ਭੂਟਕਾਲ (ਪਰਵਾਸ, ਅਨੁਵਾਦ ਅਤੇ ਖੋਜ ਵਿਗਿਆਨ)

- ਪਰਵਾਸ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ
- ਡਾਇਸਪੋਰਾ ਅਤੇ ਪਰਵਾਸ : ਅੰਤਰ-ਨਿਖੇੜ
- ਪਾਰਰਾਸਟਰੀਅਤਾ ਅਤੇ ਪਰਵਾਸੀ ਸਾਹਿਤ
- ਬਹੁ ਸਭਿਆਚਾਰਵਾਦ : ਸੰਕਲਪ ਤੇ ਸਰੂਪ
- ਪਰਵਾਸੀ ਸੰਵੇਦਨਾ ਅਤੇ ਪਰਵਾਸੀ ਚੇਤਨਾ : ਅੰਤਰ-ਨਿਖੇੜ
- ਪੰਜਾਬੀ ਪਰਵਾਸ : ਇਤਿਹਾਸ, ਮਸਲੇ ਅਤੇ ਵੰਗਾਰਾਂ।
- ਅਨੁਵਾਦ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ
- ਅਨੁਵਾਦ ਦੀਆਂ ਕਿਸਮਾਂ
- ਅਨੁਵਾਦ ਦੀ ਮਹੱਤਤਾ
- ਅਨੁਵਾਦ ਅਤੇ ਮਸ਼ੀਨ ਅਨੁਵਾਦ
- ਕਾਵਿ ਅਨੁਵਾਦ ਦੀਆਂ ਸਮੱਸਿਆਵਾਂ
- ਦੋ-ਭਾਸ਼ੀਆ ਦਾ ਰੋਲ
- ਅਨੁਵਾਦ ਅਤੇ ਮੀਡੀਆ
- ਪੰਜਾਬੀ ਵਿਚ ਅਨੁਵਾਦਤ ਸਾਹਿਤ : ਕੌਮੀ ਅਤੇ ਕੌਮਾਂਤਰੀ।
- ਖੋਜ : ਪਰਿਭਾਸ਼ਾ, ਸਰੂਪ ਤੇ ਤੱਤ
- ਖੋਜ ਵਿਧੀ ਦੇ ਸੋਦ
- ਖੋਜ ਅਤੇ ਆਲੋਚਨਾ : ਅੰਤਰ-ਨਿਖੇੜ
- ਖੋਜ-ਵਿਧੀਆਂ
- ਖੋਜ-ਨਿਬੰਧ ਅਤੇ ਸ਼ੋਧ-ਪ੍ਰਬੰਧ : ਅੰਤਰ-ਨਿਖੇੜ
- ਖੋਜ ਅਤੇ ਇੰਟਰਨੈਟ ਸਾਮੰਗਰੀ
- ਖੋਜ ਅਤੇ ਡਿਜੀਟਲ ਲਾਇਬ੍ਰੇਰੀ
- ਪੰਜਾਬੀ ਖੋਜ ਦੀਆਂ ਪ੍ਰਾਪਤੀਆਂ ਤੇ ਨਵੀਨ ਸੰਭਾਵਨਾਵਾਂ
- ਪੰਜਾਬੀ ਖੋਜ-ਪਰੰਪਰਾ

Management

Unit – I

Management – Concept, Process, Theories and Approaches, Management Roles and Skills
Functions – Planning, Organizing, Staffing, Coordinating and Controlling.
Communication – Types, Process and Barriers.
Decision Making – Concept, Process, Techniques and Tools
Organisation Structure and Design – Types, Authority, Responsibility, Centralisation, Decentralisation and Span of Control
Managerial Economics – Concept & Importance
Demand analysis – Utility Analysis, Indifference Curve, Elasticity & Forecasting
Market Structures – Market Classification & Price Determination
National Income – Concept, Types and Measurement
Inflation – Concept, Types and Measurement
Business Ethics & CSR
Ethical Issues & Dilemma
Corporate Governance
Value Based Organisation

Unit – II

Organisational Behaviour – Significance & Theories
Individual Behaviour – Personality, Perception, Values, Attitude, Learning and Motivation
Group Behaviour – Team Building, Leadership, Group Dynamics
Interpersonal Behaviour & Transactional Analysis
Organizational Culture & Climate
Work Force Diversity & Cross Culture Organisational Behaviour
Emotions and Stress Management
Organisational Justice and Whistle Blowing
Human Resource Management – Concept, Perspectives, Influences and Recent Trends
Human Resource Planning, Recruitment and Selection, Induction, Training and Development
Job Analysis, Job Evaluation and Compensation Management

Unit – III

Strategic Role of Human Resource Management
Competency Mapping & Balanced Scoreboard
Career Planning and Development
Performance Management and Appraisal
Organization Development, Change & OD Interventions
Talent Management & Skill Development
Employee Engagement & Work Life Balance Industrial Relations: Disputes & Grievance Management, Labour Welfare and Social Security
Trade Union & Collective Bargaining
International Human Resource Management – HR Challenge of International Business

Green HRM

Unit– IV
Accounting Principles and Standards, Preparation of Financial Statements
Financial Statement Analysis – Ratio Analysis, Funds Flow and Cash Flow
Analysis, DuPont Analysis
Preparation of Cost Sheet, Marginal Costing, Cost Volume Profit Analysis
Standard Costing & Variance Analysis
Financial Management, Concept & Functions
Capital Structure – Theories, Cost of Capital, Sources and Finance
Budgeting and Budgetary Control, Types and Process, Zero base Budgeting
Leverages – Operating, Financial and Combined Leverages, EBIT–EPS
Analysis, Financial Breakeven Point & Indifference Level.

Unit –V
Value & Returns – Time Preference for Money, Valuation of Bonds and
Shares, Risk and Returns;
Capital Budgeting – Nature of Investment, Evaluation, Comparison of
Methods; Risk and Uncertainly Analysis
Dividend – Theories and Determination
Mergers and Acquisition – Corporate Restructuring, Value Creation, Merger
Negotiations, Leveraged Buyouts, Takeover
Portfolio Management – CAPM, APT
Derivatives – Options, Option Payoffs, Option Pricing, Forward Contracts &
Future Contracts
Working Capital Management – Determinants, Cash, Inventory, Receivables
and Payables Management, Factoring
International Financial Management, Foreign exchange market

Unit - VI
Strategic Management – Concept, Process, Decision & Types
Strategic Analysis – External Analysis, PEST, Porter's Approach to industry
analysis, Internal Analysis – Resource Based Approach, Value Chain
Analysis
Strategy Formulation – SWOT Analysis, Corporate Strategy – Growth,
Stability, Retrenchment, Integration and Diversification, Business Portfolio
Analysis - BCG, GE Business Model, Ansoff's Product Market Growth Matrix
Strategy Implementation – Challenges of Change, Developing Programs
Mckinsey 7s Framework
Marketing – Concept, Orientation, Trends and Tasks, Customer Value and
Satisfaction
Market Segmentation, Positioning and Targeting
Product and Pricing Decision – Product Mix, Product Life Cycle, New Product
development, Pricing – Types and Strategies
Place and promotion decision – Marketing channels and value networks,
VMS, IMC, Advertising and Sales promotion

Unit –VII

Consumer and Industrial Buying Behaviour: Theories and Models of Consumer Behaviour

Brand Management – Role of Brands, Brand Equity, Equity Models, Developing a Branding Strategy; Brand Name Decisions, Brand Extensions and Loyalty

Logistics and Supply Chain Management, Drivers, Value creation, Supply Chain Design, Designing and Managing Sales Force, Personal Selling

Service Marketing – Managing Service Quality and Brands, Marketing Strategies of Service Firms

Customer Relationship Marketing – Relationship Building, Strategies, Values and Process

Retail Marketing – Recent Trends in India, Types of Retail Outlets.

Emerging Trends in Marketing – Concept of e-Marketing, Direct Marketing, Digital Marketing and Green Marketing

International Marketing – Entry Mode Decisions, Planning Marketing Mix for International Markets

Unit –VIII
Statistics for Management: Concept, Measures Of Central Tendency and Dispersion, Probability Distribution – Binominal, Poison, Normal and Exponential

Data Collection & Questionnaire Design

Sampling – Concept, Process and Techniques

Hypothesis Testing – Procedure; T, Z, F, Chi-square tests

Correlation and Regression Analysis

Operations Management – Role and Scope

Facility Location and Layout – Site Selection and Analysis, Layout – Design and Process

Enterprise Resource Planning – ERP Modules, ERP implementation Scheduling; Loading, Sequencing and Monitoring

Quality Management and Statistical Quality Control, Quality Circles, Total Quality Management – KAIZEN, Benchmarking, Six Sigma; ISO 9000 Series Standards

Operation Research – Transportation, Queuing Decision Theory, PERT / CPM

Unit –IX
International Business – Managing Business in Globalization Era; Theories of International Trade; Balance of payment

Foreign Direct Investment – Benefits and Costs

Multilateral regulation of Trade and Investment under WTO

International Trade Procedures and Documentation; EXIM Policies

Role of International Financial Institutions – IMF and World Bank

Information Technology – Use of Computers in Management Applications; MIS, DSS

Artificial Intelligence and Big Data

Data Warehousing, Data Mining and Knowledge Management – Concepts

Managing Technological Change

Unit – X

Entrepreneurship Development – Concept, Types, Theories and Process, Developing Entrepreneurial Competencies

Intrapreneurship – Concept and Process

Women Entrepreneurship and Rural Entrepreneurship

Innovations in Business – Types of Innovations, Creating and Identifying Opportunities, Screening of Business Ideas

Business Plan and Feasibility Analysis – Concept and Process of Technical, Market and Financial Analysis

Micro and Small Scale Industries in India; Role of Government in Promoting SSI

Sickness in Small Industries – Reasons and Rehabilitation

Institutional Finance to Small Industries – Financial Institutions, Commercial Banks, Cooperative Banks, Micro Finance.

Zoology

1. Molecules and their interaction relevant to Biology

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).

i) Stability of proteins and nucleic acids.

j) Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. Cellular Organization

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) **Microbial Physiology** (Growth yield and characteristics, strategies of cell division, stress response)

3. Fundamental Processes

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. Cell Communication and cell signaling

a) **Host parasite interaction** Recognition and entry processes of different pathogens like bacteria, viruses 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.

b) **Cell signaling** 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.

c) **Cellular communication** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

d) **Cancer** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

e) **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 immune deficiencies, vaccines.

5. **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 sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.
   c) **Morphogenesis and organogenesis inanimals:** Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.
   d) **Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*
   e) **Programmed cell death, aging and senescence**

6. **System Physiology – Plant**
   a) **Photosynthesis** -Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways.
   b) **Respiration and photorespiration** – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
   c) **Nitrogen metabolism** - Nitrate and ammonium assimilation; amino acid biosynthesis.
   d) **Plant hormones** – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.
   e) **Sensory photobiology** - Structure, function and mechanisms of action of phytochromes, cryptochromes and phytotropins; stomatal movement; photoperiodism and biological clocks.
   f) **Solute transport and photo assimilate translocation –** uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photo assimilates.
   g) **Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
   h) **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

7. System Physiology – Animal

a) **Blood and circulation** -Blood corpuscles, hemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, hemoglobin, immunity, haemostasias.

b) **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

c) **Respiratory system** - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

d) **Nervous system** -Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

e) **Sense organs** -Vision, hearing and tactile response.

f) **Excretory system** - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

g) **Thermoregulation** - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

h) **Stress and adaptation**

i) **Digestive system** -Digestion, absorption, energy balance, BMR.

j) **Endocrinology and reproduction** -Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

8. Inheritance Biology

a) **Mendelian principles:** Dominance, segregation, independent assortment.

b) **Concept of gene:** Allele, multiple alleles, pseudo allele, 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, lod score for linkage testing, karyotypes, genetic disorders.
h) **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.
i) **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
j) **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
k) **Recombination:** Homologous and non-homologous recombination including transposition.

9. Diversity of Life Forms

a) **Principles & methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms.
b) **Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.
c) **Outline classification of plants, animals & microorganisms:** Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.
d) **Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent.
e) **Organisms of health & agricultural importance:** Common parasites and pathogens of humans, domestic animals and crops.
f) **Organisms of conservation concern:** Rare, endangered species. Conservation strategies.

10. Ecological Principles

a) **The Environment:** Physical environment; biotic environment; biotic and abiotic interactions.
b) **Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
c) **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.
d) **Species Interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

e) **Community Ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

f) **Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax.

g) **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).

h) **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

i) **Applied Ecology:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

j) **Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

11. Evolution and Behaviour

a) <u>Emergence of evolutionary thoughts</u> Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

b) <u>Origin of cells and unicellular evolution:</u> Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

c) <u>Paleontology and Evolutionary History:</u> The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

d) <u>Molecular Evolution:</u> 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.

e) <u>The Mechanisms:</u> 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; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

f) <u>Brain, Behavior and Evolution:</u> Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks;

Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

12. Applied Biology
   a) Microbial fermentation and production of small and macro molecules.
   b) Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals.
   c) Transgenic animals and plants, molecular approaches to diagnosis and strain identification.
   d) Genomics and its application to health and agriculture, including gene therapy.
   e) Bioresource and uses of biodiversity.
   f) Breeding in plants and animals, including marker – assisted selection
   g) Bioremediation and phytoremediation
   h) Biosensors

13. 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) **Histochemical and Immuno techniques** Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.
   c) **Biophysical Method:** 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; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X^2 test; Basic introduction to Muetrovariate statistics, etc.

e) **Radiolabeling techniques:** Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

f) **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.

g) **Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

h) **Methods in field biology:** Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.