

ਦਫਤਰ ਡਾਇਰੈਕਟਰ ਸਿੱਖਿਆ ਭਰਤੀ ਡਾਇਰੈਕਟੋਰੇਟ ਪੰਜਾਬ

ਸਰਕਾਰੀ ਮਾਡਲ ਸੀਨੀਅਰ ਸੈਕੰਡਰੀ ਸਕੂਲ, (ਮਾਈਕਰੋਸਾਫਟ ਬਿਲਡਿੰਗ)

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ਪਬਲਿਕ ਨੋਟਿਸ

ਮੈਰੀਟੋਰੀਅਸ ਸੁਸਾਇਟੀ ਅਧੀਨ ਮੈਰੀਟੋਰੀਅਸ ਸਕੂਲਾਂ ਵਿੱਚ ਵੱਖ ਵੱਖ ਵਿਸਿਆਂ ਦੇ ਲੈਕਚਰਾਰਾਂ ਦੀਆਂ 82 ਪੋਸਟਾਂ ਨੂੰ ਭਰਨ ਦਾ ਮਿਤੀ 01-10-2021 ਨੂੰ ਵਿਗਿਆਪਨ ਦਿੱਤਾ ਗਿਆ ਸੀ। ਮਿਤੀ 11-10-2021 ਨੂੰ ਸੋਧ ਪੱਤਰ ਜਾਰੀ ਕਰਕੇ ਵੱਖ ਵੱਖ ਵਿਸਿਆਂ ਦੇ ਲੈਕਚਰਾਰਾਂ ਦੀਆਂ ਪੋਸਟਾਂ ਦੀ ਗਿਣਤੀ ਵਿੱਚ ਵਾਧਾ ਕਰਕੇ ਪੋਸਟਾਂ ਦੀ ਗਿਣਤੀ 90 ਕਰ ਦਿੱਤੀ ਗਈ ਸੀ। ਵੱਖ ਵੱਖ ਵਿਸਿਆਂ ਦੇ ਲੈਕਚਰਾਰ ਅੰਗਰੇਜ਼ੀ, ਪੰਜਾਬੀ, ਬਾਇਓਲੋਜੀ, ਕੈਮਿਸਟਰੀ, ਕਾਮਰਸ, ਮੈਥ ਅਤੇ ਫਿਜ਼ੀਕਸ ਵਿਸਿਆਂ ਦਾ ਸਿਲੇਬਸ ਵਿਭਾਗ ਦੀ ਵੈਬਸਾਈਟ www.educationrecruitmentboard.com ਤੇ ਅਪਲੋਡ ਕਰ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਸਹਾਇਕ ਡਾਇਰੈਕਟਰ

ਸਿੱਖਿਆ ਭਰਤੀ ਡਾਇਰੈਕਟੋਰੇਟ ਪੰਜਾਬ।

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COMMERCE

Part A Accounting

Introduction to accounting

Accounting, objectives, advantages and limitations, types of accounting information, uses of accounting information and their needs. Basic accounting terms, accounting concepts, capital and revenue cash basis and accrual basis accounting standards and IFRS.

Accounting Principles, recording of transactions, origin of transactions, source documents, books of original entry

-Journal, cash books and subsidiary books ledger & trail balance, depreciation, provisions & reserves. Accounting for Bills of exchange, rectification of errors, bank reconciliation statement Financial

statements of sole proprietorship, complete & incomplete records, profit & loss accounts, gross profit, net profit, balance sheet, adjustments in preparation of financial statements.

Financial statements of not for profit organization, receipt & payment account & income and expenditure account & balance sheet.

Introduction to computer & accounting information system

Introduction to operating software, utility software & application software. Stages in automation, accounting for partnership firms; Admission, retirement, death, & dissolution & cash distribution.

Advance Company Accounts

Accounting for share capital & debentures (share capital, issue & allotment, fore feature, purchase of business, liquidations, valuation of shares amalgamation, absorption & reconstruction, holding company accounts.

Cost & Management Accounting

Ratio analysis, Funds flow analysis, cash flow analysis, Marginal costing & break even analysis, standard costing budgetary control, costing for decision making, responsibility accounting.

Capital structure, financial and operating leverage, cost of capital, capital budgeting, Working capital management, dividend policy, hire purchase, consignment & joint venture.

Balance sheet of a company in the prescribed form with major heading (Schedule VI) Financial analysis.

BUSINESS STUDIES

Nature & Purpose of Business:

Concept & Characteristics

Business profession & Employment-Distinctive Features

Objectives of Business-Economic, Social & Human

Business Risks- Nature & Causes

Role of profit in Business

A brief outline of the evolution of Business Activities In India

STRUCTURE OF BUSINESS

Classifications of Business activities, Industry & Commerce

Industry & Types: Primary & Secondary

E-Commerce- Meaning, Opportunities & benefits, Resources required for successful E-Commerce implementation, Security & safety for Business Transactions.

Outsourcing of Services: Nature, Need & Types, Financial services, Advertising, Customer Support services.

SERVICE SECTOR & BUSINESS

Banking: Types of Banks & Functions of Commercial banks.

Insurance : Principles, Types : Life & General, Fire & marine and Insurance of other Risks, Health Insurance, Fidelity Insurance.

Communication : Postal & Telecommunications

Warehousing : Types & Functions

SOCIAL RESPONSIBILITY OF BUSINESS AND BUSINESS ETHICS

Concept of Social Responsibility.

Case of Social Responsibility & Human Rights.

Responsibility towards Consumers, Government & community in General.

Business & Environment Protection.

Business Ethics: Concepts & Elements.

FORMS AND FORMATION OF BUSINESS ENTERPRISES

Meaning, Features, Merits & Limitations of following Forms:

Sole Proprietorship

Joint Hindu Business

Partnership: Partnership Deed (main clauses), Types of Partners & Partnership formation, Registration.

Co-operative Societies.

Company : Types of Companies- Private, Public & Deemed Company.

public Company, Privileges of private

Choice of Form of Business Enterprise

Factors to be considered for starting a Business

Scope of setting up a Small Business Enterprises

SECTORAL ORGANISATION OF BUSINESS

Meaning, Features, Merits & Limitations of Following:

- Private Sector, Public Sector & Joint Sector.

Forms of public Sector Enterprises

Departmental Undertaking

Co-Operative Organisation

Government Company

Global Enterprise (Multi national Company)

Business economics and quantitative methods:

BUSINESS STATISTICS:

Introduction to Statistics:

Statistics: Meaning, Definition; Its Need and Importance in Business, Functions and Distrust of Statistics.
Statistical tools used in economical analysis.

Collection of Data:

Meaning of Data, Sources of Data, types of data, Methods of Collecting Data, Construction of Questionnaire

Theory of Sampling:

Census and Sampling Methods, Principles of Sampling, Qualities of Good Sampling, Methods or Techniques of Sampling, need and error of sampling, normal distribution, hypothesis testing, analysis and interpretation of data, Census of India and National Sample Survey Organisation

Organisation of Data:

Meaning and types of variables; Frequency Distribution

Presentation of Data:

Tabular Presentation and Diagrammatic Presentation of Data:

- (i) Geometric forms (bar Diagrams and pie diagrams)
- (ii) Frequency diagrams (histogram, polygon and ogive)
- (iii) Arithmetic line Graphs (time series graph).

Statistical Tools and Interpretation:

Measures of Central Tendency - mean (simple and weighted), median and mode.

Measures of Dispersion - absolute dispersion (range Deciles, Percentile, quartile deviation, mean deviation and standard Deviation)

Relative dispersion (co-efficient of quartile-deviation, co-efficient of mean deviation, co-efficient of Variation)

Lorenz Curve: Meaning and its application.

Skewness:

Meaning of Measures of Skewness

Difference between Dispersion & Skewness

Measures of Skewness:

- a) Absolute measures
- b) Relative Measures & Coefficient of Skewness

(i) Bowley's Coefficient of Skewness

(ii) Kelly's Coefficient of Skewness

(iii) Karl Pearson's Coefficient of Skewness

Introduction to Index Numbers:

Meaning, types, features and uses of index numbers

Wholesale price index

Consumer price index and index of industrial production

Problems of construction of index numbers

Inflation and index numbers.

Methods of Construction of Index Number, Cost of Living Index Numbers,

Choice of base for Computing Index Numbers, Base Shifting.

Some Mathematical tools used in Economics: Equation of a line, slope of a line, slope of a curve.

CORRELATION & REGRESSION ANALYSIS

Small sample test - T-test, f-test and chi-square test.

Data processing – elements, data entry, data processing and computer applications.

BUSINESS ECONOMICS:

Nature and uses of business economics: Concept of profit and wealth maximisation, Definition, Characteristics of Managerial Economics Difference between Managerial Economics and Economics- Its Scope, Uses and Role & Responsibility of Managerial Economics.

Microeconomics

Meaning of microeconomics and macroeconomics

What is an economy

Central problems of an economy, what, how and for whom to produce.

Concepts of production possibility frontier and opportunity cost.

Consumer Equilibrium and Demand

Consumer's equilibrium – meaning of utility, marginal utility, law of diminishing marginal utility, law of equi-marginal utility, conditions of consumer's equilibrium using marginal utility analysis.

Indifference curve analysis of consumer's equilibrium-the consumer's budget (budget set and budget line), preferences of the consumer (indifference curve, indifference map) and conditions of consumer's equilibrium (one and two commodity cases).

Demand, market demand, determinants of demand, law of demand, demand schedule, demand curve, movement along and shifts in the demand curve; price elasticity of demand - factors affecting price elasticity of demand; measurement of price elasticity of demand – (a) percentage-change method and (b) geometric method (linear demand curve); relationship between price elasticity of demand and total expenditure.

Producer Behaviour and Supply

Production function; returns to factor and returns to scale;

Total Product, Average Product and Marginal Product.

Returns to a Factor.

Cost and Revenue: Short run costs - total cost, total fixed cost, total variable cost; Average fixed cost, average variable cost and marginal cost-meaning and their relationship.

Revenue - total, average and marginal revenue.

Producer's equilibrium-meaning and its conditions in terms of marginal revenue-marginal cost.

Supply, market supply, determinants of supply, law of supply, supply schedule, supply curve, movements along and shifts in supply curve, price elasticity of supply; measurement of price elasticity of supply – (a) percentage change method and (b) geometric method.

Forms of Market and Price Determination

Forms of Market-Perfect Competition, Monopoly, Monopolistic Competition-Their Meaning and Features, Price Determination in different market situations: Perfect competition, monopolistic competition, monopoly, price discrimination and oligopoly, pricing strategies.

Macroeconomics:

NATIONAL INCOME AND RELATED AGGREGATES.

Basic Concepts and Measurement of National Income.

(i) Macro Economics-Meaning, Circular Flow of Income, Concepts of GDP, GNP, NDP, NNP, (At Market Price and Factor Cost) National Disposable Income (Gross and Net) Private Income, Personal Income and Personal Disposable Income.

(ii) Measurement of National Income-Value Added Method, Income Method and Expenditure Method.

Money and Banking:

(i) Money- Meaning, Evolution and Functions. Supply of money – Currency held by the public and net demand deposits held by commercial banks. Money creation by the commercial banking system.

(ii) Central Bank- Meaning and Functions

(iii) Commercial Banks- Meaning and Functions

(iv) Recent Significant Reforms and Issue in Indian Banking System, Privatization and Modernization.

Government budget and Economy:

(i) Government Budget- Meaning and its Components, Objectives of Government Budget.

(ii) Classification of Receipts- Revenue and Capital

(iii) Classification of Expenditure-Revenue and Capital, Plan and Non-Plan and Developmental and Non-Developmental.

(iv) Balanced Budget-Surplus Budget and Deficit Budget; Meaning and Implications.

(v) Revenue Deficit, Fiscal Deficit and Primary Deficit; Meaning and Implications; Measures to correct different Deficits. Fiscal Policy and its role

Balance of Trade and Balance of payments:

(i) Foreign Exchange Rate- Meaning (Flexible and Fixed and managed floating) Merits and Demerits, Determination in a free market.

(ii) Balance of Payment Accounts-Meaning and Components,
A Brief Analysis about recent Exchange Rate issues.

English

a) Critical and historical understanding of

- **Indian English Writers:** R.k.Narayan, Rajarao, Arundhati Roy, Khushwant Singh, Mulk Raj Anand, Anita Desai, Rabindranath Tagore, Sarojini Naidu,
- **Jacobean to Restoration:** John Donne, John Milton,
- **Augustan Age:** Alexander Pope, Jonathan Swift, Joseph Addison, Samuel Richardson, Henry Fielding
- **Romantic Period:** William Blake, William Wordsworth, Samuel Taylor Coleridge, Lord Byron, P.B. Shelley, John Keats, Dorothy Wordsworth Jane Austen, Sir Walter Scott, Mary Shelley, Mathew Gregory Lewis.
- **Victorian Period:** Alfred, Lord Tennyson, Robert Browning, E.B. Browning, Thomas Carlyle, John Ruskin, Walter Pater, Florence Nightingale, Charlotte Bronte, Emily Bronte, Charles Dickens, Thomas Hardy,
- **Modern Period:** T.S. Eliot, Virginia Woolf, Joseph Conrad, James Joyce, E. M. Forster, D H. Lawrence, W. B. Yeats, George Bernard Shaw.
- **Contemporary Period:** Philip Larkin, Ted Hughes, Stevie Smith, Seamus Heaney, Eavan Boland, George Orwell, William Golding, Doris Lessing, Graham Greene, Salman Rushdie, V.S. Naipaul, Stephen Leacock.
- **Literary Terms**

b) Grammar and Linguistics

- Phrase structure rule, Transformational generative grammar (with reference to Chomsky), Transformational rule, a brief introduction to Semitic languages, sociolinguistics, language variety, dialect, accent and register, psycholinguistics nature and application, behaviorist, cognitive and mental views of language learning, individual differences
- Linguistics (sign, speed and writing, anthropologist, organ of speech, description and classification of sounds, morphology and word formation.

Biology

Unit I Diversity in Living World

- **Biology**- its meaning of relevance to mankind
- **Taxonomy** – Concept of species and taxonomical hierarchy
- **Systematic** – Introduction to plant Systematic, its aims , objectives and importance , classification , brief history , introduction , various systems of classification of living organism [Two kingdom system , five kingdom system) Brief introduction to nomenclature and binomial system of nomenclature
- **Salient features and classification of kingdom Monera** (including Archaeobacteria and cyano bacteria) General structure ,occurrence ,reproduction and economics importance.
- **Kingdom protista**- General structure ,occurrence , reproduction and economic importance
- **Kingdom Fungi**- General structure, occurrence, reproduction and economic importance, diseases of economically important crop plant , rusts , smuts, downy and powdery mildew damping off.
- **Kingdom Plantae**- salient features and classification of plants into major groups.
Algae- General account, structure, life cycle of biological importance of green algae, brown algae and red algae .
Bryophytes- General account , structure, life cycle and economic importance of liverworts and mosses.
- **Pteridophytes**- General account , structure, classification, life cycle and economic importance.
- **Gymnosperms**- General account , structure, classification life cycle and economic importance.
- **Angiosperms**- classification up to class ,General account , structure, life cycle and economic importance.
Viruses- General structure, types and reproduction of viruses
Lichens- General account ,structure and life history.
- **Kingdom Animalia** – salient features (in the reference to habitat , habits morphology and economic importance)and classification of non chordates up to phylum level.
Salient features (in the reference to habitat , habits, morphology and economic importance) classification of chordates up to class level.

Unit II Structural organization in plants

- **Tissue** ,Tissue system in plants
- **Morphology**, function and modification of root , stem and leaf

- **Anatomy** of root , stem and leaf , primary and secondary growth in dicot stem
- **Inflorescence**, Types of Inflorescence, flower (including position and arrangement of different whorls) placentation , fruit, types of fruit, seed.
- **Diagnostics features**, economic importance and distribution pattern of Angiospermic families
 - A) Family Brassicaceae
 - B) Family Fabaceae
 - C) Family Solanaceae
 - D) Family Liliaceae
 - E) Family Poaceae

Unit III Plant Physiology

Transport in Plants - Movement of water (including diffusion , osmosis, plasmolysis and water relations of cell) and nutrients, long distance of water – absorption, apoplast , symplast , transpiration pull, root pressure and guttation , transpiration opening and closing of stomata, uptake and translocation of mineral nutrients- Transport of food , phloem transport , mass flow hypothesis.

Mineral Nutrition – Essential minerals , macro and micro nutrients and their role , deficiency symptoms , Mineral toxicity, Elementary idea of hydroponics as a method to study mineral nutrition.

Nitrogen Metabolism - Biological nitrogen fixation , Nitrogen cycle.

Photosynthesis - Photosynthesis as means of autotrophic nutrition, pigments involved in Photosynthesis , absorption and action spectra , photochemical and biosynthetic phases of Photosynthesis , photophosphorylation : cyclic and non cyclic of photophosphorylation, chemiosmotic hypothesis, photorespiration, factors affecting Photosynthesis.

Respiration- Aerobic respiration : Glycolysis; Krebs's cycle Electron transport chain and oxidative phosphorylation , Anaerobic respiration , respiratory substance and respiratory quotient

Plant Growth and development – phases of plant growth and plant growth rate , conditions of growth , Differentiation, and dedifferentiation, Redifferentiation Growth regulators – Role of auxins, gibberellin, cytokinin, ethylene, abscisic acid photoperiodism, role of phytochrome and hormones in photoperiodism, Dormancy, methods of breaking seed dormancy, vernalization.

Plant movements- Tropic movements , phototropism , gravitropism and their mechanism, Nastic movements.

Unit IV Structural organization in Animals

-Tissue in animals

- Morphology, anatomy and function of different systems (digestive, circulatory respiratory nervous and reproductive)
of earthworm, frog and an insect (Cockroach)

Unit V Animal Physiology

Human Physiology

Digestion and absorption :- Alimentary canal and digestive glands , role of digestive enzymes and gastrointestinal hormones , digestion, absorption and assimilation of proteins carbohydrates and fats, egestion , nutrition and digestive disorders.

Breathing and respiration – respiratory organs in human beings , Mechanism of Breathing and its regulation in human, Transport of respiratory gases, Respiratory volumes , respiratory disorders .

Circulation

Composition of Blood , Blood groups, coagulation of blood , composition of lymph and its functions , structure of human heart and blood vessels , Cardiac cycle, Cardiac output, ECG , double circulation , Disorders of circulatory systems .

Excretion- Modes of excretion, structure and function of excretory system , Urine formation , osmoregulation, Regulation of kidney function , Renin- angiotensin , role of other organs in excretion , Disorders of excretory system.

▪ **Locomotion and Movement** ;- Types of movement , Skeletal muscle – contractile proteins and muscle contraction , skeletal system and its function , joints. Disorders of muscular and skeletal system **Neural control and coordination**: Neuron and nerves; Nervous system in humans- central nervous system, peripheral nervous system and visceral nervous system; Generation and conduction of nerve impulse; Reflex action; Sense organs; Elementary structure and function of eye and ear.

▪ **Chemical coordination and regulation**: Endocrine glands and hormones; Human endocrine system-Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone action (Elementary Idea); Role of hormones as messengers and regulators, Hypo-and hyperactivity and related disorders (Common disorders e.g. Dwarfism)

Unit VI Reproduction

Reproduction in organisms: Reproduction, a characteristic feature of all organisms for continuation of species; Modes of reproduction – Asexual and sexual; Asexual reproduction; Modes-Binary fission, sporulation, budding, gemmule, fragmentation; vegetative propagation in plants.

Sexual reproduction in flowering plants: Flower structure; Development of male and female gametophytes; Pollination-types, agencies and examples; Outbreeding devices; Pollen-Pistil interaction; Double fertilization; Post fertilization events-Development of endosperm and

embryo, Development of seed and formation of fruit; Special modes-apomixis, parthenocarpy, polyembryony; Significance of seed and fruit formation.

Human Reproduction: Male and female reproductive systems; Microscopic anatomy of testis and ovary; Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilisation, embryo development upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition (Elementary idea); Lactation (Elementary idea).

Reproductive health: Need for reproductive health and prevention of sexually transmitted diseases (STD); Birth control-Need and Methods, Contraception and Medical Termination of Pregnancy (MTP); Amniocentesis; Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (Elementary idea for general awareness).

Unit VII Cell biology, genetics and Evolution.

Structure and function of bio molecules : Carbohydrates, lipids proteins, and nucleic acid.

Enzymes- types, properties, functions and enzymes action

Cell-physico-chemical nature of plasma membrane , cell wall.

Ultra structure of cell organelles with brief description and functions.

1. Endoplasmicreticulum, golgibodies, lysosome, vacuoles, mitochondria, ribosomes, plastids, cilia, flagella, centrioles nucleolus.
2. Cell division : cell cycle, mitosis , meiosis and their significance.

Heredity and variation: Mendelian Inheritance; Deviations from Mendelism-Incomplete dominance, Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; Chromosome theory of inheritance; Chromosomes and genes; Sex determination-In humans, birds, honey bee; Linkage and crossing over; Sex linked inheritance-Haemophilia, Colour blindness; Mendelian disorders in humans-Thalassemia; Chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

- Molecular basis of Inheritance: Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; Transcription, genetic code, translation; Gene expression and regulation-Lac Operon; Genome and human genome project; DNA finger printing.

- Evolution: Origin of life; Biological evolution and evidences for biological evolution from Paleontology, comparative anatomy, embryology and molecular evidence); Lamarck's theory of evolution Darwin's contribution, Modern Synthetic theory of Evolution; Mechanism of evolution-Variation (Mutation and Recombination) and Natural Selection with examples, types of natural selection; Gene flow and genetic drift; Hardy-Weinberg's principle; Adaptive Radiation; Human evolution.

UNIT VIII Biology and Human Welfare

Health and Disease; Pathogens; parasites causing human diseases (Malaria, Filariasis, Ascariasis, Typhoid, Pneumonia, common cold, amoebiasis, ring worm); Basic concepts of immunology-vaccines; Cancer, HIV and AIDS; Adolescence, drug and alcohol abuse.

- Improvement in food production; Plant breeding, tissue culture, single cell protein, Biofortification; Apiculture and Animal husbandry.

- Microbes in human welfare: In household food processing, industrial production, sewage treatment, energy generation and as biocontrol agents and biofertilizers.

UNIT IX Biotechnology and Its Applications

- Principles and process of Biotechnology: Genetic engineering (Recombinant DNA technology).

- Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy; Genetically modified organisms-Bt crops; Transgenic Animals; Biosafety issues- Biopiracy and patents.

UNIT X Ecology and environment

- Organisms and environment: Habitat and niche; Population and ecological adaptations; Population interactions-mutualism, competition, predation, parasitism; Population attributes-growth, birth rate and death rate, age distribution.

- Ecosystem: Patterns, components; productivity and decomposition; Energy flow; Pyramids of number, biomass, energy; Nutrient cycling (carbon and phosphorous); Ecological succession; Ecological Services-Carbon fixation, pollination, oxygen release. Biogeochemical cycle

- Biodiversity and its conservation: Concept of Biodiversity; Patterns of Biodiversity; Importance of Biodiversity; Loss of Biodiversity; Biodiversity conservation; Hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, National parks and sanctuaries.

- Environmental issues: Air pollution and its control; Water pollution and its control; Agrochemicals and their effects; Solid waste management; Radioactive waste management; Greenhouse effect and global warming; Ozone depletion; Deforestation; Any three case studies as success stories addressing environmental issues.

PHYSICS

I. Mathematical Methods of Physics

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

II. Classical Mechanics

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; 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, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, wave motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass-energy equivalence, work power energy, gravitation, pressure, motion of fluids, viscosity, surface tension.

III. Electromagnetic Theory

Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces,; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, optical instrument, defects of eye. Fresnel's Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell's equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials, current electricity-Kirchhoff's Law, Wheat Stone Bridge, Potentio meter & Slide Wire Bridge.

IV. Quantum Mechanics

Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; WKB approximation;

Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

V. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to non-equilibrium processes; Diffusion equation.

VI. Electronics and Experimental methods

Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photodetectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics, Logic gates, communication system.

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

VII. Experimental Techniques and data analysis

Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; 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.

Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments.

VIII. Atomic & Molecular Physics

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

IX. Condensed Matter Physics

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

X. Nuclear and Particle Physics

Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; 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; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

Chemistry

Physical Chemistry

1. **Basic principles of chemistry:-** Importance of chemistry, Nature of Matter, Properties of Matter and their measurement, Uncertainty in measurements, Laws of chemical combinations, Dalton's Atomic Theory, Atomic and Molecular Masses, Mole concept and molar masses Percentage Composition, Stoichiometry and Stoichiometric Calculations
2. **Atomic structure:-** Sub atomic Particles, Atomic models, Developments Leading to the Bohr's model of atom, Bohr's Model for hydrogen atom, towards Quantum Mechanical model of the Atom, Quantum mechanical model of Atom, Nature of electromagnetic radiation, photoelectric effect limitations of Bohr's model, Dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle, various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance, shapes of s, p and d – orbitals, electron spin quantum number, Rules for filling electrons in orbitals-aufbau principle ; Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.
3. **States of Matter:-** Intermolecular Forces, Thermal Energy, Intermolecular forces vs thermal interactions, The Gaseous state, The Gas laws, Ideal gas equation, Kinetic Molecular theory of Gases, Liquefaction of Gases, Liquid state
4. **Chemical Bonding and Molecular Structure:-** Kossel – Lewis approach to chemical bond formation, concept of ionic and covalent bonds, Ionic Bonding, Formation of Ionic bonds, factors affecting the formation of ionic bonds, calculation of lattice enthalpy, Covalent Bonding, Concept of electronegativity, Fajan's rule, dipole moment, Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules, Quantum mechanical approach to covalent bonding , Valence bond theory – its important features, concept of hybridization involving s, p and d orbitals, Resonance, Molecular Orbital Theory , LCAOs , types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbitals electronic configurations of homonuclear diatomic molecules, concept of bond order, bond length and bond energy , Elementary idea of metallic bonding , Hydrogen bonding and its applications.
5. **Basic principles and applications of spectroscopy:-** Rotational, vibrational, electronic, Raman, ESR, NMR
6. **Thermodynamics:-** Fundamental of thermodynamics , System and surroundings, extensive and intensive properties, state functions, types of processes, First law of thermodynamics , concept of work, heat internal energy and enthalpy , heat capacity, molar heat capacity, Hess's law of constant heat summation , Enthalpies of bond dissociation, combustion , formation, atomization, sublimation , phase transition, hydration, ionisation and solution. Second law of thermodynamics, Spontaneity of processes, ΔS of the universe and ΔG of the system as criteria for spontaneity, ΔG° (standard Gibbs energy change) and equilibrium constant.