DEPARTMENT OF PHYSICS

B.Sc. DEGREE COURSE IN PHYSICS

SYLLABUS WITH EFFECT FROM 2020-2021

SEMESTER-I:

PROPERTIES OF MATTER AND SOUND

UNIT I: ELASTICITY (12 Hours)
Hooke's Law – Stress–Strain diagram –Elastic constants –Poisson's ratio – Relation between elastic constants and Poisson's ratio – Work done in stretching and twisting a wire – Twisting couple on a cylinder -Rigidity modulus by Static torsion– Torsional pendulum (with and without masses**).**

UNIT II: BENDING OF BEAMS (12 Hours)
Cantilever– Expression for Bending moment – Expression for depression at the loaded end of the cantilever–Oscillations of a cantilever – Expression for time period-Experiment to find Young's Modulus – Non-Uniform bending– Experiment to determine Young's Modulus by Koenig's method-Uniform Bending-Expression for elevation-Experiment to determine Young's Modulus using microscope.

UNIT III : FLUID DYNAMICS (12 Hours)
Surface tension-: Definition – Molecular forces– Excess pressure over curved surface – Application to Spherical and Cylindrical Drops and Bubbles-Variation of Surface Tension with Temperature — Jaegar's method.
Viscosity:-Definition-Streamline and Turbulent motion – Rate of flow of liquid in a capillary tube-Poiseuille's formula –Corrections-Terminal Velocity and Stoke's formula– Variation of Viscosity of a liquid with Temperature.

UNIT IV: WAVES AND OSCILLATIONS (12 Hours)
Simple Harmonic Motion – Differential Equation of SHM – Graphical representation of SHM – Composition of two S.H.M in a straight line-at right angles-Lissajous's figures-Free, Damped, Forced vibrations -Resonance and Sharpness of resonance.
Laws of transverse vibration of strings- Sonometer-Determination of AC frequency using sonometer - Determination of frequency using Melde's apparatus.

UNIT V: **ACOUSTICS OF BUILDINGS AND ULTRASONICS (12 Hours)**
Intensity of sound – Decibel – Loudness of sound –Reverberation – Sabine's reverberation formula – Acoustic Intensity – Factors affecting the Acoustics of Buildings.
Ultrasonic waves – Production of Ultrasonic Waves – Piezoelectric crystal method –Magnetostriction effect – Application of Ultrasonic Waves.

ALLIED MATHEMATICS-I

UNIT I
Algebra And Numerical Methods:
Algebra: Summation of series - simple problems.

Numerical Methods: Operators E,□,□, difference tables- Newton-Raphson method- Newton's forward and backward interpolation formulae for equal intervals, Lagrange's interpolation formula. Chapter 2, Section 2.1.3, 2.2, 2.2.1, 2.3, 2.3.3
Chapter 3, Section 3.4.1 and Chapter 5, Section 5.1 and 5.2.

UNIT II

Matrices: Symmetric, Skew-Symmetric, Orthogonal, Hermetian, Skew-Hermetian and Unitary matrices. Eigen values and Eigen-vectors, Cayley-Hamilton theorem (without proof) – verification- Computation of inverse of matrix using Cayley - Hamilton theorem.
Chapter 4, Section 4.1.1 to 4.1.6, 4.5, 4.5.2, 4.5.3.

UNIT III

Theory Of Equations: Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing or decreasing roots by a constant, reciprocal equation-simple problems.
Chapter 3, Section 3.1 to 3.4.1(omit section 3.2.1)

UNIT IV

Trigonometry:Expansions of sin(nθ) and cos(nθ) in a series of powers of sinθ and cosθ - Expansions of sinnθ, cosnθ, tannθ in a series of sines, cosines and tangents of multiples of "θ" - Expansions of sinθ, cosθ and tanθ in a series of powers of "θ" – Hyperbolic and inverse hyperbolic functions . Chapter 6, Section 6.1 to 6.3.

UNIT V

Differential Calculus:Successive differentiation, nth derivatives, Leibnitz theorem (without proof) and applications, Jacobians, Curvature and radius of curvature in Cartesian co-ordinates, maxima and minima of functions of two variables- Simple problems
Chapter 1, Section 1.1 to 1.3.1 and 1.4.3.

SEMESTER-II

THERMAL PHYSICS

UNIT I :KINETIC THEORY OF GASES AND MEAN FREE PATH

Review of results of kinetic theory of gases: (Pressure exerted by gas -rms, average and most probable speed-Equipartition Theorem – Heat capacities) - Distribution of molecular velocities in a perfect gas-Distribution of molecular speeds-Mean free path (Zeroth and First order)

UNIT II: TRANSPORT PHENOMENA AND REAL GASES

Transport phenomena- Viscosity (Zeroth order approximation)- Effects of Temperature and Pressure on viscosity- Thermal Conductivity- Diffusion – Real gases -Deviations from Perfect gas behaviour- Regnault's Experiment – Vander Waals' equation of state – Discussion of Vander Waals' equation – Joule Experiment – Porous Plug experiment – Joule –Thomson Coefficient for Vander Waals' gas

UNIT III: THERMOMETRY AND CALORIMETRY

Platinum resistance thermometer – Calendar and Griffith's bridge – Thermistor – Specific heat capacity – Specific heat capacity of solids – Dulong and Petit's law – Specific heat capacity of liquid – method of mixtures – Barton's correction – Specific heat capacity of gases – C_p and C_v by Regnault's and Callendar & Barne's methods – Variation of Specific Heat Capacity of Diatomic Gases

UNIT IV: FIRST AND SECOND LAW OF THERMODYNAMICS

Thermodynamic system, surroundings, boundaries-State of system and Thermodynamic variables – Thermodynamic equilibrium- Processes- The Zeroth law and concept of temperature- origin of the

first law- Internal energy-Basic thermal, mechanical and diffusive interactions-the first law-applications of first law(heat capacities of gas, adiabatic equation of state and lapse rate)- Enthalpy-Second law –Origin of second law - Heat engines –The Carnot cycle- Carnot cycle as refrigerator – Kelvin, Planck and Clausius statements-Carnot's theorem

UNIT IV: ENTROPY AND THERMODYNAMIC RELATIONS

Entropy- Entropy change in reversible processes – Reversible heat transfer- Clausius inequality - Entropy change in irreversible process-the principle of increase of entropy- Joule's expansion-the entropy form of first law- Entropy of an Ideal gas- Entropy of mixing - Unavailable energy: Thermal death of universe - Physical concept of entropy- Maxwell relations- Thermodynamic relations involving heat capacities- TdS equations.

Books for Study:

1. Thermal Physics, S.C.Garg, RM Bansal & CK Ghosh ,Tata McGraw Hill Publications, 2nd edition. (2018).

Books for Reference:

1. Heat and Thermodynamics, Zemansky, McGraw – Hill Book Co. Inc., New York.
2. Heat and Thermodynamics , Brijlal and N. Subramanyam, S.Chand& Co, New Delhi (2000)
3. Heat, Narayana Moorthy and KrishnaRao, Triveni Publishers, Madras (1969).
4. Fundamentals of Physics, Resnick Halliday and Walker, 6th edition, , John Willey and Sons, Asia Pvt.Ltd., Singapore.
5. Fundamentals of Thermodynamics, Carroll M.Leonard, Prentice-Hall of India (P) Ltd., New Delhi (1965).

ALLIED MATHEMATICS –II

UNIT I

Integral Calculus:Bernoullis formula – Reduction formulae- , , (m,n being positive integers), Fourier series for functions in (0,2 , (-).

Chapter 2: Section 2.7 & 2.9 , Chapter 4: Section 4.1.

UNIT II

Differential Equations:

Ordinary Differential Equations: second order non- homogeneous differential equations with constant coefficients of the form ay" +by'+ cy = X where X is of the form and -Related problems only.

Partial Differential Equations: Formation, complete integrals and general integrals, four standard types and solving Lagrange's linear equation P p +Q q= R.

Chapter 5: Section 5.2.1, Chapter 6: Section 6.1 to 6.4

UNIT III

Laplace Transforms: Laplace transformations of standard functions and simple properties, inverse Laplace transforms,Application to solution of linear differential equations up to second order- simple problems.

Chapter 7: Section 7.1.1 to 7.1.4& 7.2 to 7.3

UNIT IV

Vector Differentiation: Introduction, Scalar point functions, Vector point functions, Vector differential operatorGradient,Divergence, Curl, Solenoidal, irrotational, identities.

Chapter 8, Section 8.1 to 8.4.4

UNIT V

Vector Integration:Line, surface and volume integrals, Gauss, Stoke's and Green's theorems (without proofs). Simple problems on these.
Chapter 8, Section 8.5 to 8.6.3.

PHYSICS PRACTICAL – I

1.Young's modulus – Non-uniform Bending – Pin and microscope.

2. Young's modulus – Uniform Bending – Scale and Telescope

3. Rigidity modulus – Torsional pendulum (without symmetrical masses)

4. Rigidity modulus and Moment of Inertia – Torsional pendulum (With symmetric masses)

5. Surface Tension and Interfacial Surface Tension – Drop Weight Method

6. Coefficient of Viscosity of Liquid – Graduated Burette (radius of capillary tube by Mercury pellet method).

7. Sonometer–Frequency of Tuning Fork

8. Sonometer – Relative Density of a Solid and Liquid

9. Specific heat capacity of liquid–Method of Mixtures (Half-time correction).

10. Comparison of Viscosities of two Liquids–Burette Method

11. Focal length, Power, R and Refractive Index of a long Focus Convex Lens

12. Focal length, Power, R and Refractive Index of a Concave Lens

13. P.O. Box – Temperature coefficient of resistance

14. Spectrometer – Refractive index of a Glass Prism

15. Spectrometer – Hollow Prism- Refractive index of a liquid.

16. Newton's law of cooling-Specific heat Capacity of the Liquid

17. Carey Foster's Bridge-Resistance and Specific Resistance

18. Potentiometer – Calibration of a Low Range Voltmeter

19. Deflection magnetometer – Tan A Position

SEMESTER – III

MATHEMATICAL METHODS IN PHYSICS

UNIT I: VECTOR CALCULUS

Scalar and Vector Fields - Gradient of a Scalar function - Divergence of a Vector function - Curl - Line Integral, Surface Integral and Volume Integral (Simple Problems) - Gauss Divergence Theorem - Stoke's Theorem and Green's Theorem (Statement and Proof)- Spherical Polar Coordinates - Expressions for Gradient, Divergence, Curl and Laplacian Operator in Cartesian and Spherical Polar Coordinates.

UNIT II: SPECIAL FUNCTIONS

Special Functions - Beta and Gamma Functions - Definitions - Symmetry Property of Beta function - Evaluation of Integrals using Beta function - Transformation of Beta function - Evaluation of Gamma Function - The value of **1/2** - Transformations of Gamma function (Other

forms) - Relation between Beta and Gamma functions - Simple Problems in beta and gamma functions - Series Solutions for Bessel, Legendre and Hermite Differential Equations. □

UNIT III: MATRICES

Special Types of Matrices - Symmetric and Skew-symmetric Matrices -Hermitian and Skew-Hermitian Matrices - Orthogonal Matrices - Unitary Matrices -Properties - Characteristics Equation - Determination of Eigen values and Eigen vectors - Properties - Statement and Proof of Cayley - Hamilton Theorem - Simple Problems - Inverse of Matrix by CH Theorem - Diagonalization of 2x2 Real Symmetric Matrices.

UNIT IV: COMPLEX VARIABLES (12 Hours)

Basics of Complex Numbers and their Graphical Representation - Euler's Formula, De-Moivre's Theorem - Functions of Complex Variables - Limit, Continuity and Differentiability - Analytic Function -Definition - Cauchy-Riemann Conditions - Examples of Analytic Functions (Analyticity) - Cauchy-Riemann Conditions in Polar Form

UNIT V: FOURIER SERIES (12 Hours)

Fourier Series in the interval ($-\pi$ to π) - Definition – Dirichlet's Conditions (Statement Only) - Determination of Fourier Coefficients -Even and Odd Functions and their Fourier expansions. Sine and Cosine Periodic Functions - Simple Problems in Fourier Series in the interval ($-\pi$ to π) - Applications of Fourier series - Half Wave Rectifier and Saw Tooth Wave.

ALLIED CHEMISTRY – I

Unit I: NUCLEAR CHEMISTRY (10 Hours)

Fundamental particles of nucleus, isobars, isotones and isomers - Differences between chemical reactions; fusion and fission - Radioactive series, group displacement law - Mass defect, derivation of 1amu = 931 MeV - nuclear binding energy and calculation - Applications of radio isotopes - carbon dating and in medicine.

Unit II: INDUSTRIAL CHEMISTRY (15 Hours)

Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas – Fertilizers - Classification - urea, Ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications. Hardness of water: temporary and permanent hardness, disadvantages of hard water -Softening of hard water - Zeolite process, demineralization process and reverse osmosis - Purification of water for domestic use: use of chlorine, ozone and UV light - definition and determinations of BOD and COD. Polymers: General method of preparation and properties of the following: PVC, Polyethylene, Teflon, Bakelite, Nylon 6 and Nylon6,6.

Unit III: FUNDAMENTALS OF ORGANIC Chemistry

Classification of organic compounds -.Hybridization in methane, ethane, ethylene, acetylene, benzene - classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions- addition, substitution, elimination andpolymerisation.

Unit IV: THERMODYNAMICS (10 Hours)

Definition of certain terms - system, surrounding, reversible and irreversible processes - Limitations of I law , Need for II Law - Different Statements of II. Law - Carnot cycle - Efficiency - Carnot Theorem - Thermodynamic Scale of Temperature - Entropy- Definition, Unit

and change of entropy for phase transformation, Free energy - nature of process in terms of free energy and entropy-Statement of Third Law.

Unit V: CHEMICAL KINETICSANDPHOTOCHEMISTRY (15 Hours)

Rate of chemical reaction- Differential rate expression - order and molecularity - Integrated rate expression for first and second, order reactions (same concentration of reactants only)-Half-life period- Effect of temperature on rate - Activation energy . Arrhenius equation - Homogeneous and heterogeneous catalysis. Photochemistry - Statement of Grotthus- Draper Law, Stark-Einstein's Law, Quantum Yield. Hydrogen chlorine reaction (elementary idea only) Photosynthesis, Photosensitization, Phosphorescence Fluorescence, Chemiluminescence-Definition with examples.

SEMESTER – IV

MECHANICS

UNIT I: NEWTON'S LAWS OF MOTION

Newton's Laws of Motion- Forces and Equations of Motion- Motion of a Particle in a Uniform Gravitational Field- Newtonian law of Universal Gravitation-Examples-Electric and Magnetic Forces on a Charged Particle-The Magnetic Field and Lorentz Force-Examples- Motion of Charged Particle in a Uniform Electric and Magnetic Field-Conservation of Momentum-Contact Forces: Friction- Problems

UNIT II : CONSERVATION LAWS

Definition of concepts-Conservation of Energy-Work-Kinetic and Potential energy- Examples-Conservative Forces-Potential Energy and Conservation of Energy in Gravitational and Electric field- Examples.

Conservation of Linear and Angular Momentum: Internal forces and Momentum conservation-Center of mass- Examples- General Elastic Collision of Particles of Different Masses- System with Variable Mass-Examples- Conservation of Angular Momentum-Torque due to Internal Forces-Torque due to Gravity- Angular momentum about Center Of Mass- Proton scattering by heavy nucleus.

UNIT III: HARMONIC OSCILLATOR AND INVERSE SQUARE LAW OF FORCE

Mass on spring-Simple Pendulum (Force, energy and torque method)-Compound Pendulum-LC circuit- Motion of systems displaced from position of stable equilibrium-Average kinetic energy and potential energy.

Inverse Square Law of Forces and Static Equilibrium- Orbits: Equation and Eccentricity-Circular orbit-Kepler's laws- Examples

UNIT IV: ELEMENTARY RIGID BODY DYNAMICS

The Equation of Motion-Angular Momentum and Kinetic Energy-Moment of inertia-Parallel Axis Theorem- Perpendicular Axis Theorem- Examples-Rotation about fixed axis: Time Dependence of Motion- Examples- Rolling without slipping (three methods)-Torque about Center of Mass-Examples.

UNIT V: SPECIAL RELATIVITY

Constancy of Speed of light-Michelson-Morley Experiment-Invariance of 'c' – Basic assumptions- Lorentz Transformation- Length Contraction-Examples- Time Dilation of Moving Clocks–Examples–Velocity Transformation– Velocity Addition–Variation of Mass with Velocity-Aberration of light–Longitudinal Doppler Effect.

ALLIED CHEMISTRY – II

Unit I: COORDINATION CHEMISTRY

Definition of terms - Classification of Ligands - Nomenclature - Chelation - EDTA and its application - Werner's Theory - Effective Atomic Number - Pauling's theory - Postulates - Hybridisation, Geometry and magnetic properties of[Ni(CN)4]-2, [NiCl4]-2, [Fe(CN)6]-4, [Co(NH3)6]+3 and [CoF6]-3- Biological Role of hemoglobin and Chlorophyll (elementary idea only) - Identification of metal ions like Cu, Fe and Ni.

Unit II: BIOMOLECULES

Classification, preparation and reactions of glucose and fructose. Interconversion of glucose to fructose and vice versa - Preparation and properties of sucrose. Diabetes - causes and control: measures RNA and DNA (elementary idea only) - Amino acids: classification, preparation and properties of alanine.

Unit III: PHASE DIAGRAM

Phase rule: Definition of terms, application of phase rule to water system - reduced phase rule and its application to Pb-Ag system. Freezing mixture - Completely miscible and partially miscible liquid systems - upper and lower critical solution temperatures.

Unit IV: ELECTROCHEMISTRY (10 Hours)

Electrolytic conductance in metals and in electrolytic solution – specific conductance and equivalent conductance – Arrhenius theory of electrolytic dissociation and its limitations - weak and strong electrolytes according to Arrhenius theory – Ostwald's dilution law – applications and limitations – Conductometric titrations – strong acid vs strong base only.

Unit V: ANALYTICAL CHEMISTRY (10 Hours)

Introduction to Qualitative and Quantitative Analysis - Separation techniques - extraction – crystallization- Chromatographic separations - Principles and applications of column, paper, thin layer, gas-liquid and ion-exchange.

ALLIED CHEMISTRY I & II (PRACTICALS)

I. VOLUMETRIC ANALYSIS

1. Estimation of Sodium hydroxide using standard Sodium Carbonate.
2. Estimation of Hydrochloric acid using standard Oxalic acid.
3. Estimation of Ferrous sulphate using standard Mohr's salt
4. Estimation oxalic acid using standard Ferrous Sulphate.
5. Estimation of Potassium permanganate using standard Sodium hydroxide.
6. Estimation of iron from iron tablets using standard potassium permanganate
7. Estimation of magnesium using EDTA.
8. Estimation of calcium from calcium tablets using EDTA
9. Estimation of Ferrous ion using diphenylamine as internal indicator.

II. Systematic analysis of Organic compounds

The analysis must be carried out as follows

a) Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Glucose, Benzaldehyde, Aniline (Aniline not to be given for exam)

b) Detection of elements (N. S. Halogens)

c) Distinguish between aliphatic and aromatic
d) Saturated and unsaturated compounds

PHYSICS PRACTICAL – II

1.Young's Modulus-Cantilever-Depression-(Static method-Scale and Telescope).
2. Young's Modulus –Uniform bending – Pin &Microscope.
3. Rigidity Modulus-Static Torsion (Scale and Telescope)
4. Compound Pendulum-g and k
5. Sonometer-A.C. Frequency-Steel and Brass wires.
6. Melde's string- Frequency, Relative Density of a solid and liquid.
7. Thermal conductivity o f a bad conductor-Lee's disc method.
8. Spectrometer-Grating N and λ-minimum deviation method.
9. Spectrometer-μ of a glass prism -i-d Curve
10. Air wedge -Thickness of a wire.
11. Deflection Magnetometer – Tan B position
12. m and BH -Deflection Magnetometer-Tan C position and vibration magnetometer
13. Carey Foster Bridge - Temperature coefficient of resistance of a coil.
14. Potentiometer – Specific resistance of the given wire.
15. Potentiometer-Ammeter calibration.
16. Potentiometer- Emf of thermocouple.
17. Figure of merit of galvanometer (Mirror or Table Galvanometer).
18. Surface tension – Capillary rise method.
19. Specific heat of capacity – Joule's calorimeter.

SEMESTER - V

OPTICS & SPECTROSCOPY

UNIT I: GEOMETRICAL OPTICS

Aberration in lenses **-** Spherical aberration in a lens **-** Methods of minimizing spherical aberration **-** Condition for minimum spherical aberration in the case of two lenses separated by a distance **-** Chromatic aberration in lenses **-** Condition for achromatism of two thin lenses (In and out of contact) **-** Dispersion produced by a thin prism **-** Achromatic prisms **-** Combination of prisms to produce (i) Dispersion without deviation (ii) Deviation without dispersion **-** Direct vision spectroscope.
Eyepieces **-**Ramsden's and Huygens's eyepieces **-**Construction, Theory

UNIT II: INTERFERENCE

Analytical treatment of interference - Expression for intensity - Condition for maxima and minima in terms of phase and path difference - Coherent sources, Interference in thin films – transmitted and reflected - Colour of thin films -Air wedge - Determination of diameter of thin wire - Test for optical flatness - Determination of wavelength of light using Newton's rings -

Haidinger's fringes - Michelson's Interferometer – Theory - Applications - Determination of wavelength - Thickness of thin transparent material and resolution of interferometer.

UNIT III: DIFFRACTION

Fresnel diffraction - diffraction at a circular aperture and narrow wire – Fraunhofer diffraction - Single slit - Double slit - (Simple theory) - Plane diffraction grating – Plane transmission grating element – Missing order - Overlapping spectra - Maximum number of orders - Determination of wavelengths using grating - Normal incidence - Dispersive power of a grating - Rayleigh's criterion for resolution - Limit of resolution of the eye - Resolving power of Telescope and microscope - Resolving power of prism and grating - Difference between resolving power and dispersive power.

UNIT IV: POLARISATION

Double refraction - Nicol prism - Polarizer and analyser - Huygens explanation of double refraction in uni-axial crystals - Dichroism - Polaroids and their uses - Double image polarizing prisms - Quarter wave plate and Half wave plate - Plane, elliptically and circularly polarized light - Production and detection - Babinet's Compensator - Optical Activity - Fresnel's explanation of optical activity - Specific rotatory power - Determination using Laurent's half shade polarimeter.

UNIT V: SPECTROSCOPY

Introduction to spectroscopy - Electromagnetic spectrum - Characterization of electromagnetic radiation - Quantization of energy - Regions of the spectrum – Classification of molecules – Microwave spectroscopy – Rigid rotator - Vibrational spectroscopy – Harmonic oscillator - Raman effect - Experimental set up - Characteristics of Raman lines -Ultraviolet spectroscopy- Origin and theory of ultraviolet spectra- Introduction to Nuclear Magnetic Resonance – Quantum description of NMR- Larmor equation - Chemical shift (Qualitative study).

BASIC ELECTRONICS

UNIT I: SEMICONDUCTORS

Band gap-Forbidden Gap-Valence and Conduction Bands-Pure Semiconductors-Impurity in Semiconductors-Energy band Diagram and Fermi level-Fermi Energy and Carrier Concentration of Intrinsic and Extrinsic Semiconductors-PN junction- barrier- Voltage across the junction - Junction Diodes- Zener Diodes- V-I characteristics-Light Emitting Diodes-Photo Diodes

UNIT II : TRANSISTOR AMPLIFIER

Transistors- CB and CE modes-Characteristics-Two Port Representation of a Transistor- h-parameters-AC equivalent circuit using 'h' parameters-Analysis of an Amplifier using h parameters (CE configuration only)-Expression for current gain, voltage gain, input impedance, output impedance and power gain- RC Coupled Amplifier - Frequency Response - Analysis of low, mid and high frequency regions - Classification of Amplifiers - Class A Power Amplifier – Push Pull- Class B Power Amplifier - Emitter Follower

UNIT III : OSCILLATORS AND MULTIVIBRATORS

Feedback in amplifiers - Effect of Negative Feedback- Barkhuesen Condition For Oscillations - Hartley and Colpit's Oscillators, Phase Shift and Wien's Bridge Oscillators - Expression for Frequency of Oscillation and condition for Oscillation in each case.

Multivibrators - Astable, Monostable and Bistable Multivibrator - using transistors

UNIT IV: SPECIAL SEMICONDUCTOR DEVICES AND WAVE SHAPING CIRCUITS

Unipolar Devices- FET – Construction- Working -Characteristics - FET Amplifiers-UJT – Construction-Working- Characteristics - UJT-Saw Tooth Wave Generator- SCR – Characteristics – SCR as a Switch-SCR Rectifier.
Clipping and Clamping Circuits - Biased Clipper - RC Time Constant -Integrating and Differentiating Circuits

UNIT V: BASICS OF INSTRUMENTATION

Definition of measurement and Instrument - Block Diagram of an Instrument – Components – Input, Output, Processing element of an instrument – Functional Elements of Pressure Thermometer– Types of instrument – Basic definition – Accuracy, Precision, Sensitivity, Threshold, Resolution, Drift, Dead Zone, Selectivity, Hysteresis, Range, Bias, Repeatability, Reproducibility – Errors.

QUANTUM MECHANICS

UNIT I: ORIGIN OF QUANTUM MECHANICS

Limitations of Classical Physics- Black – Body Radiation Curve- Optical Spectra- Photoelectric Effect- Specific Heat of Solids – Planck's Quantum Hypothesis - Compton Effect- Quantum Theory of Specific Heat-Bohr Atom Model of Hydrogen Atom- Franck and Hertz Experiment – Inadequacy of (Old) Quantum Theory

UNIT II: WAVE MECHANICS

Wave Nature of Particles – Matter Waves – Diffraction Experiment- Heisenberg's Uncertainty Principle - Application of Uncertainty Relation – Principle of Super Position –Wave Packet - Time dependent Schrodinger Wave Equation- Interpretation of the Wave Function, Probability Interpretation, Probability Current Density and Equation of Continuity- Ehrenfest theorem-Time Independent Schrodinger Wave Equation-Stationary States, Admissibility Conditions.

UNIT III: FORMALISM OF QUANTUM MECHANICS

Linear Vector Space –Orthogonal Functions –Linear Operator -Eigen Functions and Eigenvalues- Hermitian Operator- Postulates of Quantum Mechanics – Simultaneous Measurability of Observables-Eigen Values of Angular Momentum Operators-Ladder Operators

UNIT IV: ONE DIMENSIONAL EIGEN VALUE PROBLEMS

Square Well Potential: Rigid Walls, Finite Walls and Potential Barrier – Alpha Emission - Linear Harmonic Oscillator (Series Method) – Free Particle

UNIT V: THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS

Particle Moving in a Spherically Symmetric Potential – Radial and Angular Part of Schrodinger Equation - System of Two Interacting Particles -Rigid Rotator – Hydrogen Atom- Radial Equation –Solution to Radial Equation – Energy Eigen Values and Eigen Functions

ELECTRICITY AND ELECTROMAGNETISM

UNIT I: ELECTROSTATICS I

Properties of charges - Coulomb's law and its Validity –Superposition Principle – Electric field and Electric Potential – Relations between field and potential - Energy consideration – Flux – Gauss law – Linear, Surface and Volume charge distributions – Solutions of Laplace equation – Stability of Charges – Electric dipole – Multipole expansion

UNITII: CONDUCTORS, CAPACITORS AND DIELECTRICS

Electrical Images and its Applications (Earthed sheet and earthed Spherical conductor) –Capacitance – Energy Consideration – Classical Radius of an Electron –Polarization Density – Polarization

Charge Densities – Relation between D, E and P, Gauss's law in the presence of a dielectric – Boundary condition on D and E

UNIT III : MAGNETIC EFFECTS OF AN ELECTRIC CURRENT

Biot-Savart's law and its Application to Circular Loop-Helmholtz Galvanometer-Ampere's Circuital Law both in Integral and Differential Form and its Application to Current Carrying Loop, Solenoid and Toroid-Properties of B: Curl and Divergence. Force on a current element in a magnetic field-Moving coil Ballistic Galvanometer-Damping Correction-Figure of Merit-Determination of Absolute Capacitance of a capacitor

UNIT IV: ELECTROMAGNETIC INDUCTION

Faraday's law of Electromagnetic Induction (Differential and Integral form)-Lenz's law-Self Inductance– Mutual Inductance – Coefficient of Coupling-Self Inductance of a long solenoid-Mutual Inductance of two coils- Measurement of L and M using Ballistic Galvanometer-Transformers-Construction and working -Efficiency and Energy loss

UNIT V: ELECTROMAGNETIC WAVES

Types of currents-Concept of Displacement Current – Maxwell's equations – Maxwell's equations in Free Space-Electromagnetic Waves Equations-Velocity of EM wave-Transverse nature of EM wave-Poynting vector and its significance-Reflection and Transmission of electromagnetic waves at an interface of non-conducting medium.

ELECTIVE:

NUMERICAL METHODS

UNIT I: SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS

Method of Triangularisation - Gauss elimination method - Inverse of a matrix - Gauss- Jordan method

UNIT II : NUMERICAL SOLUTION OF ALGEBRAIC, TRANSCENDENTAL AND DIFFERENTIAL EQUATION

Bisection method – Regula falsi method - Newton - Raphson method - - Horner's method - Solution of ordinary differential equation - Euler's method.

UNIT III : INTERPOLATION

Finite differences – Operators Δ, ∇, D – Relation between operators –Linear interpolation – Interpolation with equal intervals – Newton forward interpolation formula –Newton backward interpolation formula.

UNIT IV: CURVE FITTING

Principles of least squares - fitting a straight line - linear regression - fitting an exponential curve.

UNIT V: NUMERICAL INTEGRATION

Trapezoidal Rule - Simpson's 1/3 rule and 3/8 rule - Applications - Weddle's rule

SEMESTER - VI

NUCLEAR & RADIATION PHYSICS

UNIT I: GENERAL PROPERTIES OF NUCLEI

Nuclear size, charge, mass-Determination of nuclear radius-Mirror nucleus method-Mass defect and Binding energy-Packing Fraction - Nuclear Spin - Magnetic dipole moment -Electric quadrupole moment-Nuclear models-Liquid drop model-Weizacker semi empirical mass formula-Shell model and Magic numbers-Collective model-Nuclear forces-Meson theory of Nuclear Force (qualitative).

UNIT II: RADIOACTIVITY

Natural Radioactivity-Law of Disintegration-half life and mean life period-units of Radioactivity-Transient and Secular equilibrium-Radiocarbon Dating-Age of Earth - Alpha rays-Characteristics-Geiger-Nuttal law-α-ray Spectra-Gamow's Theory of α-decay (qualitative study)-Beta rays-Characteristics-Beta ray spectra-Neutrino hypothesis-Violation of Parity Conservation-Experimental Verification with Co_{60}-gamma rays and Internal conversion-Nuclear Isomerism.

UNIT III: RADIATION DETECTORS AND PARTICLE ACCELERATOR

Ionisation chamber-G.M.Counter-Quenching and Resolving time-Scintillation Counter-Photo Multiplier Tube – Thermoluminescence -Thermoluminescence Dosimetry (TLD)- Linear Accelerator-Cyclotron-Synchrocyclotron -Betatron.

UNIT IV: RADIATION PHYSICS

Nuclear fission - Chain reaction - Reactor theory – Critical size of a reactor - General aspect of reactor design - Classification of reactors - Pressurized heavy water reactor – Fast breeder reactor - Radiation hazards - Biological effects of radiation – Radiation sickness - Radiation units and Operational limits - Radiation Survey Meters -Pocket Dosimeter - Control of Radiation hazards - Radioisotopes used for therapy - Nuclear medicine - Industrial applications – Food preservatives.

Unit V: ELEMENTARY PARTICLES

Classification of Elementary Particles-Fundamental Interaction-Elementary Particle- Quantum Numbers - Isospin and Strangeness - Conservation laws and Symmetry-Basic Ideasabout Quark-Quark Model.

ATOMIC PHYSICS & LASERS

UNIT I: PHOTO-ELECTRIC EFFECT

Richardson and Compton experiment - Laws of Photoelectric emission - Einstein Photo Electric Equation - Millikan's Experiment - Verification of Photoelectric equation -Photo electric cells - Photo emissive cells - Photovoltaic cell - Photo conducting cell - Photomultiplier.

UNIT II: ATOMIC STRUCTURE

Bohr and Sommerfeld atom models - Vector atom model - Pauli's exclusion principle - Explanation of periodic table - various quantum numbers - angular momentum and magnetic moment - coupling schemes - LS and JJ coupling - special quantisation - Bohr magnetron – Stern and Gerlach experiments.

UNIT III: FINE STRUCTURE OF SPECTRAL LINES

Excitation and Ionization Potential – Frank and Hertz's experiment - Davis and Goucher's method-Spectral terms and notions - selection rules - intensity rule and interval rule -fine structure of sodium D_2 lines - Alkali Spectra - Fine Structure of Alkali Spectra - Spectrum of Helium - Zeeman effect - Larmor's theorem - Debye's explanation of normal Zeeman effect-Anomalous Zeeman effect - theoretical explanation- Lande's `g' factor and explanation of splitting of D_1 and D_2 lines of sodium - Paschen-Back effect - Stark effect (qualitative study only).

UNIT IV: X-RAYS

X-rays: Bragg's law - X-ray spectroscopy - characteristic X-ray spectra - continuous X-ray spectra - X-ray absorption and fluorescence - Moseley's law - uses of X-rays-Compton effect -Experimental verification of Compton effect.

UNIT V: Lasers

Basic principles of laser – Einstein Coefficients – Condition for light amplification - Population inversion - Threshold condition – Optical resonators (Qualitative only) -Types of Lasers –Solid State lasers - Ruby and Nd-YAG Laser - Gas lasers - He-Ne and Co_2 Lasers- Construction and Working-Semiconductor lasers - (Homojunction & Heterojunction)-Industrial and Medical Applications.

SOLID STATE PHYSICS

UNIT I: CRYSTAL STRUCTURE

Crystal lattice – Primitive and Unit cells – Bravais lattices: Two Dimensional and Three Dimensional Bravais lattices – Miller Indices – Structure of Crystals – Close Packing: Hexagonal close packing and Cubic close packing – Sodium chloride structure, ZincBlende structure, Diamond structure.

UNIT II: X RAY DIFFRACTION ANDDEFECTS IN SOLIDS

X ray diffraction – Bragg's law –Van Laue equations- Experimental methods: Laue method, Powder crystal method and Rotating crystal method.

Defects in solids - Point defects - Frenkel and Schottky defects – Equilibrium concentrations - Line defects - Edge dislocation and Screw dislocation - Surface defects -Grain boundary - Effects of Crystal imperfections.

UNIT III: CHEMICAL BONDS

Interatomic forces –Condition for bonding - Different types of chemical bonds - Ionic bond – Cohesive energy of Ionic Crystals and Madelung constant - Born Haber cycle-Covalent bond - Metallic bond - van der Waals bond - Hydrogen bond.

UNIT IV: DIELECTRIC PROPERTIES

Dielectric materials - Polarization, Susceptibility and Dielectric constant - Local fieldor Internal field - Clausius - Mossotti relation - Sources of Polarizability– Electronic Polarizability–Ionic Polarizability–Orientational Polarizability - Frequency and temperature effects on polarization - Dielectric Breakdown – Properties of different types of Insulating materials.

UNIT V: MAGNETISM AND INTRODUCTION TO SUPERCONDUCTORS

Different types of magnetic materials - Classical theory of Diamagnetism (Langevin theory) - Langevin theory of Paramagnetism - Weiss theory of Para magnetism– Heisenberg interpretation on Internal field and Quantum theory of Ferromagnetism –Antiferromagnetism- Hard and soft Magnetic materials.

Superconductivity - General properties –Critical Temperature and Critical Magnetic field - Type I and II Superconductors –Meissner effect - BCS theory - Applications of Super conductors.

ELECTIVE:

INTEGRATED ELECTRONICS

UNIT I: FUNDAMENTAL DIGITAL ELECTRONICS

Number systems – Binary – Hexadecimal – Binary addition – subtraction (1's and 2's compliment method) – Multiplication - Division - BCD – Conversion – Simplification of logic circuits - using (i) Boolean algebra, (ii) Karnaugh map – Demorgan's theorems -NAND and NOR as Universal Building Blocks.

UNIT II: COMBINATIONAL LOGIC CIRCUITS

Binary Half & Full adder and Subtractor Circuits - BCD Half & Full Adder and Subtractor Circuits – 4 Bit Binary Adder/Subtractor (IC 7483) - Encoder – Decoder - Multiplexer - Demultiplexer.

UNIT III: SEQUENTIAL LOGIC CIRCUITS

1 bit Memory-Latch –R-S flip flop- J-K flip flop, D flip flop and T-flip flops -Race around condition - J-K Master/Slave flip flop – Asynchronous and Synchronous Counters - BCD counter – Up/Down counters - Ring and Twisted Ring Counter-Shift Registers - Serial And Parallel Registers.

UNIT IV: OP-AMP- BASIC APPLICATIONS

Characteristics Parameters – Differential Gain – CMRR – Slew Rate – Bandwidth -Applications – Unity Follower**,** Inverter, Non-Inverter, Integrator, Differentiator, Summing, Difference and Averaging Amplifier - Solving Simultaneous Equations - Comparator - Square Wave Generator - Schmitt Trigger-Wien's Bridge Oscillator

UNIT V: TIMER, DAC/ADC

Timer 555 - Internal Block Diagram and Working – Astable Multivibrator–Monostable Multivibrator-Schmitt Trigger-D/A Converter - Binary Weighted Method - A/D Converter – Successive Approximation Method.

MICROPROCESSOR 8085 AND MICROCONTROLLER

Unit I: Microprocessor 8085 Architecture

Introduction to Microprocessor – Architecture of Microprocessor 8085-Internal registers (8-bit & 16-bit)-CPU-ALU-Types of System Bus-Bus Structure- multiplexing and demultiplexing address/data bus-Instruction Register and Decoder - Timing and Control Unit-Interrupts and Serial I/O (principle only)-external memory – Block diagram of 8085-Programmer's model of 8085-pin configuration of 8085.

Unit II: Instruction Set-I

Machine Language and Assembly Language-Addressing modes-types of instruction format-Data Transfer type instructions-Arithmetic and logical instructions–Branching instructions-looping and time delay -system clock-T-state-instruction and machine cycles-Timing diagram for MOV R**d**, R**s** - MVI A, data8 - LXI RP, 16bits, memory read and memory write cycle.

Unit III: Instruction Set-II and Programming

Special Instructions: Rotate instructions-stack and subroutine related instructions-PSW-peripheral instructions-I/O and Machine Control Instructions.

Assembly Language Programs – Addition– Subtraction– Multiplication (8-bit) – Division (8-bit) Ascending / Descending Order, Largest/Smallest (single byte)-Addition of N numbers (single byte)-code conversion program.

Unit IV: Memory/Io Interface

Memory Interface (Basics) – memory mapped I/O & I/O mapped I/O- Generating Control Signals – Interfacing 2KX8 EPROM – 2KX8 RAM **-**Interfacing I/O ports to 8085-Hand shake signals-Functional block diagram and working of PPI-8255-Interfacing 8255 to 8085-LED Interface.

Unit V: Interrupts and Introduction to Microcontrollers

Interrupts in 8085- Generation of RST codes-Hardware, software interrupts and their function-Interrupts pulse width and Triggering levels-Interrupt priority-Vector interrupt model -SIM and RIM instructions-Simple polled and Interrupt controlled data transfer-Introduction to Microcontroller – Comparison of Microprocessor and Microcontroller.

PHYSICS PRACTICAL – III (General)

1. Young's modulus of the material of the beam- Non uniform Bending - Koenig's method.
2. Young's modulus of the material of the beam- Uniform Bending - Koenig's method.
3. Newton's rings - R_1, R_2 and μ of convex lens.
4. Spectrometer - (i - i') curve - Refractive Index.

5. Spectrometer - Small angled prism - Normal incidence and emergence. Determination of the refractive index of the material of prism.

6. Spectrometer – Dispersive power of a prism.

7. Spectrometer – Dispersive power of a grating.

8. Spectrometer - Cauchy's constant.

9. Bifilar pendulum – Parallel threads – verification of two theorems.

10. Field along the axis of a circular coil - Deflection magnetometer - B_H and M.

11. Field along the axis of a circular coil - vibration magnetic needle - B_H.

12. Potentiometer - Calibration of high range voltmeter.

13. Potentiometer – conversion of galvanometer into voltmeter.

14. Potentiometer – conversion of galvanometer into ammeter.

15. Ballistic Galvanometer - Absolute capacitance of a capacitor.
16. Ballistic Galvanometer-Charge Sensitivity
17.Ballistic Galvanometer- Comparison of Mutual inductances.
18.Ballistic Galvanometer.-Comparison of Capacities
19. Determination of wavelength He-Ne Laser by diffraction.
20. Spectrometer Grating-Normal incidence method -Wavelength of Mercury Spectrum

PHYSICS PRACTICAL – IV (Basic Electronics)

1. A.C. Circuit – LCR – Series resonance.

2. A.C. Circuit – LCR – Parallel resonance.

3. Bridge rectifier - Zener regulated power supply - 9V characteristics.

4. Verification of Demorgan's theorem.

5. Emitter follower.

6. FET characteristics.

7. Common Source FET amplifier.

8. UJT characteristics

9. UJT as Relaxation oscillator.

10. SCR characteristics.

11. Transistor – Astable multivibrator.

12. Transistor – Bistable multivibrator.

13. Transistor – Phase shift oscillator.

14. Transistor – Wien's bridge oscillator.

15. NAND and NOR as universal gates.

16. Half Adder &Full adder (using basic logic gates and Ex-OR gate or NAND gates only).

17. Half Subtractor& Full subtractor (using basic logic gates and Ex-OR gate or NAND gates only).

18. RC coupled single stage CE Transistor amplifier – frequency response.
19.Decode Counter using 7490
20. 4 Bit Shift Register using 7473/7476

21. 4 Bit ripple Counter using 7473/7476

PHYSICS PRACTICAL – V (Applied Electronics)

1. Microprocessor – 8085 – 8 bit Addition
2. Microprocessor – 8085 – 8 bit Subtraction
3. Microprocessor – 8085 – 8 bit Multiplication
4. Microprocessor – 8085 – 8 bit Division
5. Microprocessor – 8085 – Sorting of given set of numbers in ascending order
6. Microprocessor – 8085 – Sorting of given set of numbers in descending order
7. Microprocessor – 8085 – Finding the largest no. in a given set of numbers.
8. Microprocessor– 8085 – Finding the smallest no. in a given set of numbers.
9. Microprocessor– 8085 – reversing the elements in an array.
10. Microprocessor – 8085 – Addition of N Number of single byte numbers
11. Op amp 741 - Inverting, Non - Inverting amplifier, unity follower.
12. Op amp 741 - Summing and difference amplifier
13. Op amp 741 – Differentiator, integrator
14. OP amp 741 – Solving simultaneous equations.
15. OP amp 741 – Astable multivibrator.
16. Op amp 741 – Wien's Bridge oscillator
17. Op amp 741 - Phase Shift oscillator
18. Op amp 741-Solving Simultaneous Equations
19. 555 - Timer - Schmitt Trigger
20. 555 - Timer - Astable operation
21. D/A Converter – 4 bit, binary weighted resistor method