First Semester B. Sc. Physics
Paper code: 16PHY101
Title of the paper: Mechanics and properties of matter
(Course duration 15 weeks with 3 hours of instruction per week)

PART-A

Frames of reference: Inertial frame, Galilean transformation equation-derivation, the Galilean principle of relativity, accelerated frames - the concept of fictitious force-illustrations; qualitative discussion of centrifugal force and its effects, Rotating frames- Coriolis force, application of Coriolis force to formation of cyclonic winds, erosion of river banks. Problems

Motion of a point particle: Concept of point mass, motion with uniform and non uniform acceleration along a straight line (expression for displacement and velocity). The position vector $r(t)$ of a moving point particle and its Cartesian components, velocity and acceleration as the vector derivatives, Motion on plane-radial and transverse components of velocity and acceleration, uniform circular motion-centripetal force. Problems

Rigid body dynamics: Rigid body, moment of inertia and its physical significance, radius of gyration, expression for kinetic energy of a rotating rigid body, Theorems of moment of inertia-statement and proof, Calculation of moment of inertia of a thin uniform rod, rectangular lamina, circular disc, solid cylinder, kinetic energy of a body rolling down an inclined plane, fly wheel-theory, theory of compound pendulum. Problems

Gravitation: Newton’s law of gravitation, Gravitational potential, vertical oscillations of a loaded spring-expression for $g$, mention of expression for escape velocity and orbital velocity, Kepler’s laws of planetary motion- derivation using Newton’s law of gravitation, condition for geostationary satellites, space programmes in India. Problems

PART-B

Elasticity: Hooke’s Law, elastic modulii and Poisson’s ratio, relation between the elastic constants $q,k,n$ and $\sigma$, limiting values for $\sigma$, work done in stretching, Bending moment, theory of light single cantilever. I-section girders, torsion-calculation of couple per unit twist, the torsional pendulum, Searle’s double bar experiment. Static torsion-theory. Problems

Conservation laws: Conservation of the linear momentum for a system of two particles, Elastic and inelastic collisions. Collisions in one dimension (Perfectly elastic, inelastic and plastic collisions) single stage rocket- expression for instantaneous velocity of rocket with and without gravity, multistage rocket, conservative and non conservative forces with examples, potential energy, conservative force as negative gradient of potential, conservation of energy in a conservative force field, angular momentum and torque, relation between angular momentum and torque. Law of conservation of angular momentum, areal velocity- derivation of $\frac{dA}{dt} = \frac{1}{2}r^2 \dot{\theta} \hat{n}$. Problems

Fluid Mechanics: Coefficient of viscosity, Variation of viscosity of liquids with temperature and pressure, Stoke’s law, determination of coefficient of viscosity by Stoke’s method. Problems
Surface Tension: Surface tension and surface energy, molecular theory of surface tension, excess pressure inside a curved liquid surface, Surface tension and Interfacial tension by drop-weight method, surface tension of mercury by Quincke’s method—Theory. Problems

2. J C Upadhyaya – Classical mechanics
3. D S Mathur- Elements of Properties of matter
4. D S Mathur- Mechanics
6. C L Arora, P S Hemne – Physics for degree students

I Semester B Sc Physics-PRACTICAL-1, Code: 16PHY102
(Course duration: 15 weeks with 3 Hours of Lab work per week)

Any Eight of the following experiments

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (graphical method).
2. Fly wheel: Determination of moment of inertia, mass and density.
3. Drop weight method: Determination of surface tension of liquid and the interfacial tension between two liquids.
4. Quincke’s method: Determination of surface tension and angle of contact of mercury.
5. Young’s modulus by the single cantilever method.
6. Searle’s double bar: Determination of young’s modulus, the rigidity modulus and poisson’s ratio.
7. Torsional pendulum: Determination of the rigidity modulus
8. Determination of the Young’s modulus by Dynamic method (using graph).
9. Spiral spring: Determination of the acceleration due to gravity (graphical method).
10. Determination of co-efficient of viscosity by Stoke’s method.
Second Semester B Sc Physics
Paper code: 16PHY201
Title of the paper: Heat and Thermodynamics
(Course duration 15 weeks with 3 hours of instruction per week)

PART-A

**Kinetic theory:** Basic postulates of Kinetic theory of gases, Brownian motion, Degrees of freedom, Atomicity of gases, Principle of equipartition of energy, Derivation of $U = \frac{3}{2} RT$. Mean free path (Derivation), Maxwell’s law of distribution of molecular velocity (no derivation), calculation of mean velocity, most probable velocity and RMS velocity, Real gases, Vander-Waal’s equation-correction for finite size of molecules and intermolecular forces. Expressions for critical constants (No Derivation), Andrew’s isothermal, Andrews experiment on CO$_2$. Problems 7 Hrs

**Thermal Conductivity:** Fundamental equation of thermal conduction, Co-efficient of thermal conductivity, Rectilinear flow of heat along a bar, Determination of thermal conductivity of a bad conductor by Lee and Charlton method. 4 Hrs

**Radiation:** Review of basic concepts, Distribution of energy in black body spectrum, Kirchoff’s law, radiation pressure for normal incidence and diffuse radiation, Stefan’s law-determination of Stefan’s constant using thermocouple, Wien’s Displacement law, Rayleigh-Jeans law – Ultraviolet catastrophe and Planck’s quantum theory of radiation, Derivation of Planck’s law of radiation using Quantum theory of radiation, Deduction of Stefan’s law, Rayleigh-Jeans law and Wien’s Displacement law from Planck’s law, Problems. 6 Hrs

**Thermodynamics:** Second law of thermodynamics, Carnot’s theorem and its proof, Clausius-Clapeyron first latent heat equation, Effect of pressure on melting point of a solid, Effect of pressure on boiling point of a liquid, Heat engines in practice-types of engine, Internal combustion engine( Otto engine )-expression for efficiency, Diesel engine (qualitative only). Problems 5 Hrs

PART-B

**Entropy:** The concept of entropy, change of entropy in reversible and irreversible cycles. Change in entropy in mixture of gases, calculation of change of entropy, Principle of increase of entropy-Clausius inequality, Second law of thermodynamics in terms of entropy, Change in entropy of ideal gas, T-dS diagram, Probability and entropy -Boltzmann relation, concept of absolute zero and the third law of Thermodynamics. Problems 7 Hrs

**Thermodynamic potentials:** Internal energy, enthalpy, Helmholtz function, Gibbs function and their significance, condition for thermodynamic equilibrium, Maxwell’s thermodynamic relations, Applications of Maxwell’s thermodynamic relations (i) relation between $C_p$ and $C_v$ (both for ideal and real gas) (ii) Change in temperature during adiabatic process. 5 Hrs

**Low temperature Physics:** Ideal and real gas, Joule Thomson expansion, Porous plug experiment and its theory, expression for the temperature of inversion, Inversion curve, relation between Boyle

Thermoelectricity: Introduction, Seebeck effect, thermo couple, thermo emf, variation of thermo emf with temperature, Law of intermediate metals and the law of intermediate temperature, Peltier effect-experimental demonstration, Peltier co-efficient, explanation of thermo emf on the basis of Peltier effect, Thomson effect-experimental demonstration, Thomson co-efficient, Applications of thermodynamics to a thermocouple. Problems 5Hrs

Book for reference:

1. Brijlal N Subramanyam : Heat and Thermodynamics
2. N Sunder Rajan, George Thomas and Syed Azeez ; College Physics Vol-1
3. S C Gupta : Thermodynamics
4. Singal, Agarwal and Prakash : Heat, Thermodynamics and Statistical Physics
5. S R Shankar Narayana : Heat and Thermodynamics
7. T H Dittman and M W Zemansky : Heat and Thermodynamics

II Semester  B Sc Physics-Practical-2, Code: 16PHY202
(Course duration: 15 weeks with 3 Hours of Lab work per week)

Any Eight of the following experiments

1. Verification of Gaussian distribution law -Monte Carlo experiment
2. Specific heat of a liquid by cooling-graphical method
3. Determination of thermal conductivity of a bad conductor by Lee-Charlton method
4. Verification of Stefan-Boltzmann law using Meter Bridge or a potentiometer
5. Determination of boiling point of a liquid using platinum resistance thermometer
6. Determination of Stefan’s constant using thermocouple
7. Determination of Young’s modulus of the material of the wire by Stretching
8. Determination of Young’s modulus by Koenig’s method
9. Determination of rigidity modulus by the static torsion method
10. Determination of Young’s modulus by uniform bending method
Third Semester B Sc Physics
Paper code: 16PHY301
Title of the paper: Waves, Acoustics and Optics
(Course duration 15 weeks with 3 hours of instruction per week)

Part – A

**Progressive waves:** Waves in one dimension. Differential equation of wave motion. Relation between amplitude and intensity. Expression for velocity of progressive waves in a medium, Newton’s formula, Laplace’s correction. Expression for frequency of vibration of a stretched string – harmonics, Longitudinal vibrations in a rod. Kundt’s tube experiment. Problems. 5 Hrs

**Analysis of complex waves:** The Fourier theorem, Fourier Series, Evaluation of Fourier Co-efficients, Fourier Analysis of the square wave, saw tooth wave. 3 Hrs

**Superposition of simple harmonic motion:** Lissajous’ figures- Composition of two simple harmonic waves of equal time period acting at right angles to one another with special cases. Equation for free vibrations, damped vibrations & Forced vibrations, solution in exponential form, Resonance, Expression for amplitude and phase at resonance. 5 Hrs

**Ultrasonics:** Introduction, Production of Ultrasonic waves by Piezo-electric oscillator. Methods of detection of Ultrasonic waves, Measurement of velocity of ultrasonic waves using Acoustic grating. Applications. 3 Hrs

**Interference:** Coherence, Conditions for interference, Interference by division of wave front, expression for fringe width – Theory of Fresnel's biprism, Interference by division of amplitude-Thin films of uniform thickness (reflection only). Interference by reflection-Newton's rings, Interference at a wedge. Michelson's interferometer – Measurement of \( \lambda \) and d\( \lambda \). Problems. 6 Hrs

Part – B


**Polarization:** Double refraction in uniaxial crystals. Huygen’s theory. Positive and negative crystal. Principal refractive indices. Huygen’s constructions of O and E wave fronts in a uniaxial crystal – (i) optic axis in the plane of incidence and parallel to the crystal surface at normal incidence, (ii) optic axis in the plane of incidence and perpendicular to the crystal surface at normal incidence. Retarding plates. Production and analysis of linearly, Circularly and elliptically polarized light. Optical activity, Fresnel's theory, Rotatory polarization. Babinet compensator-Construction and working. Interference of polarized light-Expression for resultant intensity, calculation of thickness of wedge shaped crystal plate (negative and positive), calculation of fringe width. Problems. 10 Hrs
Lens aberrations and Eye-Pieces: Introduction. Mention the types of aberrations, Chromatic Aberration, Achromatic combination of lenses, Condition for achromatism of two thin lenses (i) in contact and (ii) separated by a distance. Huygen's and Ramsden's eye pieces. Problems 4 Hrs


References:

11. R. Murugeshan Kiruthiga Sivaprasath: Optics and Spectroscopy.

Ill Semester B Sc Physics-Practical-3, Code: 16PHY302
(Course duration: 15 weeks with 3 Hours of Lab work per week)

Any Eight of the Following Experiments

1. Kundt’s tube experiment – velocity of sound in air at room temperature
2. Determination of speed of the transverse waves on a stretched string.
3. Determination of wavelength of sodium light using biprism
4. Newton’s rings – Determination of radius of curvature of a Plano convex lens
5. Air wedge – Determination of thickness of a thin paper/diameter of a thin wire.
6. Helmholtz resonator – Determination of frequency of a tuning fork
7. Diffraction grating – Determination of grating constant and wave length (minimum deviation method)
8. Diffraction at a straight wire – Determination of diameter of a wire
9. Determination of Cauchy’s constants using spectrometer
10. Polarization – Determination of unknown concentration of sugar solution by graphical method using a polarimeter
11. Determination of refractive indices of calcite and quartz crystal using spectrometer and sodium light.
Fourth Semester B Sc Physics
Paper code: 16PHY401
Title of the paper: Electricity and Magnetism
(Course duration 15 weeks with 3 hours of instruction per week)

Part – A

Electrostatics: Mechanical force and electric pressure on a charged surface. The path traced by a charged particle in an electric field. The attracted disc electrometer – construction, theory and applications. Problems. 4 hrs


Alternating current: R.M.S. values. Response of LR, CR and LCR circuits to sinusoidal voltages (discussion using the ‘j’ operator). Series and parallel resonance-half-power frequencies, bandwidth and Q-factor. Expression for the average power in ac circuits containing resistance, inductance and capacitance with special cases-power factor, true power, and Wattless current (definitions). Skin effect (qualitative), comparison of AC and DC w r t characteristics and applications. Problems. 8 hrs

Applications of ac circuits - ac bridges –Anderson’s bridge, Maxwell’s bridge , de-Sauty’s bridge, Robinson’s bridge. 4 Hrs


Part – B


Magnetism: Dia, para and ferromagnetism. The electron theory of magnetism, Relation between magnetic field B, magnetization M and magnetic field intensity H. Magnetic susceptibility and magnetic permeability. Magnetic hysteresis, work done in taking unit volume of a magnetic material through a complete cycle of magnetization, area of hysteresis loop. Hysteresis loss, Weiss’s theory of ferromagnetism-curie temperature. problems 6 hrs

Electrical measurement: CRO – construction & working. Measurement of voltage, frequency and phase using a CRO. 2 hrs
**Electromagnetism**: Scalar and Vector fields. The gradient of a scalar field. The divergence and curl of a vector field. The physical significance of gradient, divergence and curl. Statement and theorems of Gauss and Stokes. Problems 4 hrs


**Reference books:**
2. K. K. Tewari: Electricity and magnetism.
8. A.B.Bhattacharya R.Bhattacharya, Under Graduate Physics, Volume II.

**III Semester B Sc Physics-Practical-4, Code: 16PHY402**
(Course duration: 15 weeks with 3 Hours of Lab work per week)

**Any Eight of the Following Experiments**
1. Anderson’s Bridge – Determination of the self-inductance of the coil
2. de-Sauty bridge – Verification of laws of combination of capacitances
3. Magnetic Hysterisis
4. $B_H$ using Helmholtz double coil galvanometer and potentiometer
5. Capacity of a condenser using a BG
6. LCR series circuit – Determination of L & Q factor
7. Voltage triangle – Measurement of phase difference
8. Low and High pass filters – Determination of the cut-off frequency
9. LCR parallel circuit – Determination of L & Q factor
10. To study the variation of XC with f and determination of C
12. CRO – determination of voltage and frequency
Fifth Semester B Sc Physics-Compulsory Paper
Paper code: 16PHY501
Title of the paper: Atomic Molecular and Nuclear Physics
(Course duration 15 weeks with 3 hours of instruction per week)

PART A

The Electron: Determination of e/m of an electron by Thomson's method. Determination of charge of an electron by Millikan's oil drop method. problems -2 Hrs


Effect of electric and magnetic fields: Experimental details, explanation of normal Zeeman effect on the basis of vector atom model, expression for the Zeeman shift, Stark effect theory.problems -3 Hrs

Molecular Spectra: Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules. Theory of pure rotation and vibration spectra. -4 Hrs

The Raman Effect: Experimental setup. Quantum theory, intensity and polarization of Raman lines. Applications. problems -2Hrs

Lasers: Basic Principle of Laser and conditions of laser. The He-Ne laser, Laser Applications. -3Hrs

PART B

Wave mechanics: Failure of classical mechanics in the microscopic domain, Wave function properties, interpretation, probability, normalization. De Broglie hypothesis. The Davisson and Germer experiment. Group and phase velocities, Heisenberg’s uncertainty principle (statement) with illustrations, setting up of time dependent and time independent Schrodinger equations. Born's interpretation of the wave function. Solution of the time dependent Schrodinger equation for a particle in a one dimensional box and it's Eigen values, Eigen functions. Energy Eigen values for the one dimensional simple harmonic oscillator. problems -9Hrs

The Nucleus: Neutron- discovery and properties. The proton-Neutron hypothesis. Nuclear forces and their characteristics, Yukawa’s theory (qualitative). -2 Hrs

Radioactive decay: Successive disintegration, radioactive equilibrium, radioactive series, range of alpha particle and its measurement. Theory of alpha decay (qualitative), Geiger-Nuttall law. Beta decay, Pauli's neutrino hypothesis, K-electron capture, internal conversion, radioactive sources (Ti$^{204}$, RaDE, Cs$^{137}$, Co$^{60}$etc.).Expression for absorption coefficient of beta particles in matter. Nuclear isomerism. -6 Hrs

Accelerators: Crockroft-Walton voltage multiplier, LINAC, Cyclotron. -3 Hrs
**Nuclear detectors:** Variation of ionization current with applied voltage in a gas counter, G. M. counter, principle of semiconductor detectors.

2 Hrs

**Book’s for Reference:**

7. Satya Prakash: Optics and Atomic Physics.
10. Irving Kaplan: Nuclear Physics.

**V Semester B Sc Physics-Practical-5, Code: 16PHY505**

(Compulsory paper experiments)

(Course duration: 15 weeks with 3 Hours of Lab work per week)

Any **Eight of the following experiments**

1. Ionization potential of Xenon
2. The e/m of an electron using a bar magnet
3. Estimation of mass of an electron
4. Determination of wavelength of Laser light
5. Verification of Inverse square law of gamma rays
6. Absorption coefficient of gamma rays
7. Cockcroft-Walton voltage multiplier
8. Determination of Planck’s constant using Photo cell
9. Characteristics of a GM tube
10. Study of Hydrogen Spectra using Gas discharge tube – Determination of Rydberg constant
Fifth Semester B Sc Physics-Elective Paper 1
Paper code: 16PHY502
Title of the paper: Nuclear and Condensed matter Physics
(Course duration 15 weeks with 3 hours of instruction per week)

PART – A

**Crystal Structure**: Space lattice, unit cell, lattice parameter, Bravais lattices, crystal planes, Miller indices, symmetry elements in a cubic lattice, calculation of co-ordination number and packing fraction for a cubic lattice, Structure of NaCl and diamond. **5Hrs**


**Liquid Crystals**: Properties, classification of liquid crystals– thermotropic liquid crystals, applications. **2Hrs**

**Imperfections in Solids**: point defect, Frenkel and Schotky defects, equilibrium concentration line defects – edge and screw dislocation. **4Hrs**

**Electrical Properties**: Classical theory, failures, quantum free electron theory of metals in three dimension, Hall effect, expression for Hall coefficient. **3 Hrs**

**Dielectric Properties**: Dielectric polarization, types of polarization, dielectric constant and displacement vector, methods of determining dielectric constant for solid and liquid. **2Hrs**

**Specific heat of Solids**: Dulong and Petite’s law and its limitation, Einstein’s theory of specific heat, Debye’s theory of specific heat. **3Hrs**

**Part B**

**Mass spectrometers**: Theory of Dempster’s and Brain bridge mass spectrograph **2Hrs**

**Nuclear Models**: Liquid drop model, semi empirical mass formula, shell model (qualitative) and magic number. **3 Hrs**

**Nuclear reactions**: Classification of nuclear reactions and conservation laws in nuclear reactions. Expression for q- value for nuclear reactions, threshold energy of endoergic reaction. Reaction induced by alpha particles, proton and deuteron. **3Hrs**
**Nuclear Fission and Fusion:** Nuclear fission chain reaction, four factor formula, power reactor-pressurized heavy water reactor, breeder reactors, nuclear fusion and thermo nuclear reaction, source of energy in stars, electric and magnetic confinement of plasma-TOKOMAK.  

4 Hrs

**Super conductivity:** Introduction, effect of magnetic field, critical temperature critical field, persistent current, Meissner effect, type I and type II superconductors applications, BCS theory (qualitative),

3 Hrs

**Elementary Particles:** Introduction, classification of elementary particles on the basis of interaction, particles and antiparticles fundamental interaction and conservation laws, quark model, types of quarks, constitution of hadrons, mesons, and beryons, Big Bang theory (qualitative).

5 Hrs

**Cosmic rays:** Discovery, primary and secondary cosmic rays -their composition, cosmic ray shower, origin of cosmic rays, radiation belts.

2 Hrs

**Books for reference:**

1. J.B Blackmore: Introduction to solid state physics
2. Kaplan Irving: Nuclear physics
4. Arthur Beiser: Perspectives of Modern physics
5. S.O. Pillai: Solid State physics
6. K.S. Kranes : Modern physics
7. B.L. Cohen : Concept of physics
8. S.N. Ghoshal : Nuclear physics
PART—A


Energy Storage: Sensible heat storage- liquids and solids, latent heat storage, Thermo chemical storage, Storage through charged batteries, fuel cells.


PART—B

Photo thermal Devices: Solar cooker, Solar dryer, Solar hot water systems- Principles and working.

Photovoltaic systems: Solar lantern, Water pumps and street lights – Principles and working.


Ocean energy: Energy from Sea waves, Ocean Thermal energy- Temperature gradient in sea and their use for power generation.

Biomass: Biochemical conversion, Biogas generation, geothermal energy.

References:
5. Green: Solar cells.
Fifth Semester B Sc Physics-Elective Paper 3

Title of the paper: Computation Physics and Programming in C
(Course duration 15 weeks with 3 hours of instruction per week)

PART –A

Introduction: Computer Algorithms, Definition and properties of Algorithms, writing pseudocodes, logical modules and algorithm development, flow charts, need for structured programming. 2Hrs

C Programming: Variable names, data types and their declarations, operators - Arithmetic, logical, relational, conditional and assignment. 3Hrs

Library functions: Input / Output statements – getchar, putchar, formatted output, file loading, errors handling. 4Hrs

Control Statements: if – else, for, do, while loops, nested loops, break, switch, continue, go to, switch. 7Hrs

Functions & program structure: Definition, Accessing, passing arguments, recursion, scope rules, external, static and Register variables, Block structure. 6Hrs.

PART -B

Introduction to Arrays & introduction to pointers 5Hrs

Graphics – Graphic commands and exercises to plot standard graphs and x – y plots 3Hrs

Numerical Methods and their applications in Physics Iterative methods for finding roots of equation: Bisection method and Newton – Raphson method. 4Hrs

Least square curve fitting – straight line fitting and non-linear curve fitting 3Hrs

Numerical integration – Trapezoidal rule Simpson’s 1/3rd rule and Gaussian integration 3Hrs

Applications: Writing programs to find solutions for simple problems in Physics 5Hrs

References:
2. V Rajaraman: Computer programming in C, Prentice hall of India Ltd, New Delhi
4. Yeshwanth Kanitkar: Let us C
5. Kereningham and Ritchie: C programming Language.
6. Schaum series: programming with C.
Sixth Semester B Sc Physics-Compulsory Paper
Paper code: 16PHY601
Title of the paper: Relativity, Astrophysics, Solid state and Electronics
(Course duration 15 weeks with 3 hours of instruction per week)

PART-A

Special theory of relativity: Michelson-Morley experiment- discussion of negative result. Postulates of special theory of relativity, Lorentz transformations (no derivation), simultaneity, Lorentz contraction, time dilation, illustration (meson decay and twin paradox). Relativistic transformation of velocity, relativistic addition of velocities. variation of mass with velocity, rest mass, massless particles. mass energy equivalence \( E = mc^2 \), the energy-momentum relation, the principle of equivalence. 8 Hrs

ASTROPHYSICS: Stars – Evolution of stars – main sequence, red giants, white dwarfs and neutron stars, Distance of a star – Stellar parallax and units of stellar distances, Definitions of arc sec and parsec (pc) astronomical unit (AU) and light year (ly) and equations relating AU ly and pc, Relation between apparent and absolute magnitude of a star, Spectral classification of stars, H-R diagram. Surface or effective temperature and colour of a star: Internal temperature of a star (derivation), Internal pressure of a star (no derivation), Expression for average temperature, core temperature and core pressure of a star, Sources of stellar energy. Expression for radii of white dwarfs and neutron star, Chandrashekar limit, black holes. 7 Hrs

Statistical Ideas in physics: The Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac energy distribution formulae (no derivation), A qualitative comparison of the three distribution formulae, Electron gas and Photon gas. 2 Hrs

Free Electron Theory: Classical theory, Expression for electrical conductivity-ohms law. Weidman-Franz law, quantum theory (qualitative ), FD distribution function, number of available energy states between \( E \) and \( E + dE \) (density of states), Expression for the Fermi energy and average energy. Effect of temperature on Fermi-energy. 5 Hrs

PART –B

Band Theory of Solids: Concept of energy bands in solids, intrinsic and extrinsic semiconductor. Derivation of expression for carrier concentration and electrical conductivity of intrinsic semiconductors, Expression for the energy gap of a semiconductor. 4 Hrs

Semiconductor Devices: P-N Junction diode, diode current equation, I V characteristics, static and dynamic resistance of a diode, testing of diode with an ohmmeter, zener diode breakdown and avalanche breakdown. regulated power supplies- shunt regulator using zener diode. Bridge rectifier. Expression for ripple factor and efficiency. Filters. 4 Hrs

Transistors: Type and configuration, Transistor action & characteristics for the CE configuration. DC and AC current gain, voltage divider bias, fixing operating point, drawing AC and DC load line, Effect of temperature on operating point, FET, its characteristics. 4 Hrs
Amplifiers & Oscillators: Single stage CE amplifier, AC load line. Expressions for voltage gain. Current gain, power gain, input resistance and output resistance (no derivation). The feedback concept-positive and negative feedback, Mention the Barkhausen criteria. Types of oscillators - Hartley oscillator.  

Logic circuits: Construction of AND, OR gates using diodes & NOT logic gates using Transistor Symbols and truth table for NOR, NAND and XOR logic gates.  


Books for Reference.

1. Resnick : Special theory of relativity  
2. A.P French : Special relativity  
4. C. Kittel : Introduction to solid state physics  
5. A. J. Dekkar : Solid State physics  
6. J.B. Blackmore : Introduction to solid state physics  
8. Modern Physics by Paul A Tipler  
10. Principles of Electronics by VK Mehta  
11. A text book of applied electronics by R S Sedha  

VI Semester B Sc Physics-Practical-7, Code: 16PHY605  
(Compulsory paper experiments)  
(Course duration: 15 weeks with 3 Hours of Lab work per week)  

Any eight of the following experiments

1. Determination of energy gap of a semiconductor using Meter Bridge.  
2. Determination Fermi energy of metal (copper)  
3. Determination of the value of Boltzmann Constant by studying diode forward Characteristics  
4. Characteristics of Transistor in CE mode.  
5. Bridge Rectifier- Without and with C and π section filters.  
6. Zener diode as shunt voltage regulator  
7. CE amplifier  
8. F E T Characteristics  
9. The logic gates AND, OR and NOT using transistors  
10. Amplitude modulator.  
11. Hartley oscillator
Sixth Semester B Sc Physics-Elective Paper 1
Paper code: 16PHY602
Title of the paper: Photonics
(Course duration 15 weeks with 3 hours of instruction per week)

Part A

Lasers: Basic principles, characteristics of laser, temporal and spatial coherence, line shape broadening, cavity configurations, pumping methods, modes of laser and properties, selection of modes-single mode operation. 3 hrs

Laser oscillator: Pumping schemes, amplification and gain, threshold condition for steady state oscillation, cavity resonance frequencies, optical resonator. 3 hrs

Types of laser and applications: Nd-YAG, CO₂ and dye lasers- construction and principles of working. Holography- introduction, construction and reproduction, application of Holography, Compact discs 5 hrs

Optoelectronics: Introduction, materials for optoeletronic devices, optoelectronic devices, fabrication of optoelectronic devices. 2 hrs

Laser diodes: Materials for laser diodes, energy band and carrier distribution in semiconductor, optical gain, conditions for lasing, quantum well lasers and surface emitting lasers. Efficiency of a laser diode. modulation of laser diodes. 5 hrs

Light Emitting Diodes (LEDs): Electroluminescence, materials used in LEDs, LED structures, characteristics of LEDs, efficiency of LEDs-internal, external and coupling efficiencies. 5 hrs

Part B

Photo detectors and Photovoltaics: Photo detection principle, important parameters of photodetectors, Photodiodes types-P-N photodiodes, p-i-n photodiodes, avalanche photodiodes, CCD and CMOS photodetectors-performance characteristics and fabrication. Solar cells- Construction and working , I-V characteristics, efficiency and fill factor (No derivation). 8 hrs

Optical fibers: Construction, optical fiber as a waveguide, ray propagation in the fiber-acceptance angle, numerical aperture, condition for propagation. modes of propagation, V-number. index profile, types of optical fibers-single mode step index fiber, multimode step index fiber, multimode graded index fiber, bit rate, dispersion and optical bandwidth, attenuation, absorption, scattering and radiation losses, attenuation
coefficient. Block diagram of optical fiber communication, construction of optical cables, cables structures, indoor and outdoor cables, under water cables, LED coupling to single mode fibres, fiber splicing, optical fiber connectors.

14 hrs

References

3. Sapna Katiar, Optical fiber communication, S K Kataria and Sons, New Delhi-110002.
Title of the paper: Analog and Digital Electronics
(Course duration 15 weeks with 3 hours of instruction per week)

PART - A

**Network Theorems**: Thevenin’s theorem, Norton's Theorem, application to the analysis of DC circuits problems

Special purpose diodes: LED and Photodiode-characteristics, tunnel diode, varactor diode and schottky diode (qualitative)


**Operational amplifiers**: Basic differential amplifier, Op-amp and its characteristics, inverting ,non inverting amplifiers, concept of virtual ground, Applications of OP-AMP integrator, Differentiator, Comparator, Schmitt Trigger, with expressions for output (derivations). Problems

**Oscillators**: Phase-shift and Colpitt’s oscillators, Crystal oscillator (qualitative). Expression for frequency and condition for oscillation (no derivation).

PART- B

**Use of Binary number** in logic circuits, Boolean Algebra - laws- Simplification of Boolean Functions - De Morgan's theorem

**Combinational & sequential circuits**: Half adder, Full adder using basic gates & EXOR gates, RS and JK flip flop (clocked version)

**Digital equipment and Electronic instruments**: Digital building blocks, clock and time base, Digital display, comparators, Digital voltmeter, digital clock, Multimeter, construction as voltmeter and as ammeter. Sensitivity, CRO- construction and application

**Logic gates** – RTL, TTL and CMOS gates: their characteristics

**Integrated Circuits** – classification, fabrication of monolithic IC. Fabrication of diodes, transistors, resistors and capacitors. IC symbols, scale of integration and IC fixed 5V voltage regulator

**Analog to Digital Converters** –counter comparator ADC, successive approximation type ADC

**Digital to Analog Converters** – Weighted resistor DAC, Resistor ladder DAC
Books for reference:

1. Malvino: Electronic principles, Fifth edition
2. Malvino and Leach: Digital principles and applications,
3. V.K. Mehta: Principals of Electronics
4. Basic Electronics by R. S. Sedha, S. Chand publication
5. Bapat YN: Electronic circuits and Systems, TMH,
6. Alan Motttershead: Electronic devices and circuits,
7. R P Jain.: Modern Digital Electronics
Sixth Semester B Sc Physics-Elective Paper 3
Paper code: 16PHY604
Title of the paper: Communication Systems
(Course duration 15 weeks with 3 hours of instruction per week)

PART A

2Hrs

Electro Acoustic transducers:
Microphone types:- Carbon, Moving coil, Condenser and Ribbon microphones, sensitivity, directivity, phasing and testing.
Loud Speakers: Direct radiator dynamic type, expression for efficiency, radiated output power, Horn Loud speaker, cut-off frequency, measurement of acoustic power and pressure response of a speaker.
6Hrs

Modulation: Introduction to Modulation, Frequency Modulation(FM), expression for frequency modulated wave for a single sinusoidal modulating signal, FET method to produce FM (reactance modulator), Bandwidth of FM.
Demodulation: Detection of FM signal using foster seely discrimination
Pulse modulation techniques: Sampling theorem, Nyquist criterion, channel capacity, PAM, PWM, PPM, PCM and Delta modulation
8Hrs

Digital modulation techniques: Advantageous of digital modulation. Introduction to ASK, FSK, PSK, QPSK, 8PSK and 16PSK (qualitative analysis only)
Multiplexing: Types of Multiplexing-FDM, TDM, SDM
6Hrs

PART B

Amplifiers used in communication: Introduction to amplifiers, AF, IF and RF amplifiers, Power amplifiers, Classes of Power amplifiers (Introductory aspects)
Transmission lines: Introduction, Parallel wire line, Reflection coefficient, Transmission coefficient, SWR, Co-axial cables.
8Hrs

Other Communication systems: Principles of ground wave, sky wave propagation, microwave communication.
Satellite communication: Types of orbits, Power budget, block diagram of transponder, simplex and duplex systems, facsimile transmission, basics of cellular communication.
8Hrs

Antennas:
Types of antenna: Elementary ideas of Resonant antenna, High frequency antenna, Yagi antenna, Microwave antenna-geometry and properties of parabolic antenna, Wideband and special purpose.
antenna-Horn, Discone, Helical and Dielectric antenna, Current and Voltage distribution in antenna, expression for energy radiated by a short doublet (dipole), Impedance matching

References.

5. Fundamentals of Acoustics-Lawrence Edward Kinsler and Austin Rogers Frey, J. Wiley and Sons
6. Acoustics – Willam W Seto, Schaum series

Note: **electronics students are not eligible to opt this papers**
VI Semester B Sc Physics-Practical-8, Code: 16PHY606  
(Combination of Compulsory and Elective papers)  
(Course duration: 15 weeks with 3 Hours of Lab work per week)

Any **seven** of the following experiments  
(Four experiment from compulsory part and Three from elective Part)

**Compulsory part**

1. Negative feed-back amplifier.  
2. A study of Amplitude Modulation and Amplitude Demodulation  
3. A study of Characteristics of FET  
4. Thevenin’s Theorem-verification

**Elective part**

**Elective -1 (PHOTONICS)**  
1. Measurement of efficiency and output power of LED  
2. Characteristics of Diode Laser –Measurement of output power, LI curves  
3. Verification of inverse square law for light intensity using a photo-diode.  

**Elective -2 (ANALOG AND DIGITAL ELECTRONICS)**  
1. Phase shift Oscillator  
2. Colpitt’s oscillator  
3. Full Adder  
4. Study of op-amp characteristics.

**Elective -3 (COMMUNICATION SYSTEMS)**  
1. Diode detector  
2. Digital multiplexing using IC555 & IC 7400 (Observe multiplexing on CRO)  
3. PAM and PWM using IC 555  
4. Study of TDM using IC4016.  
5. Study of de multiplexer using IC 555 & IC 7400.  
6. A study of IF amplifier –Frequency response  
7. ASK and FSK modulator

**Project work** equivalent to two experiments is compulsory. A report must be submitted for internal evaluation and IA marks(Max10). The work must emphasize significant ideas & concepts and should address the questions –why it is important, where it is applied, what are its key features & limitations?

A list of suggestive ideas for project work is appended at the end.
Any seven of the following experiments
(Four expt from compulsory part and Three from elective Part)

Compulsory part
1. Triode Characteristics
2. Phase measurement in LCR circuit using CRO.
3. Verification Maximum power transfer theorem.
4. The logic gates- AND, OR, NOT and NAND using IC 7400

Elective part

Elective -1 (NUCLEAR AND CONDENSED MATTER PHYSICS)
1. Determination of Dielectric constant of liquid
2. Study of X-ray photograph- determination of interplanar distance
3. Study of Hall effect
5. Study of Solar cell-IV characteristics, FF & efficiency

Elective -2 (: RENEWABLE ENERGY PHYSICS)
1. Estimation of the performance of a direct methanol fuel cell at three different temperatures.
2. Determine the optimum solar energy collector(rubber, aluminum, and copper).
3. Determination of efficiency of photovoltaic cell.
4. Determine the effect of angle between the bright light source and the solar cell on the current.

Elective -3 (COMPUTATIONAL PHYSICS AND PROGRAMMING IN C)
1. Programming Exercises -Matrix multiplication
2. Programming Exercises to calculate Standard deviation, Transpose of a matrix
3. Programming Exercises-To write a program for least square fitting a function for given data points.
4. Programming Exercises – To write a function sub program to calculate Sin X or Cos X using series expansion.
5. Programming Exercises –
6. To find the roots of polynomial using Newton –Raphson method.
7. To integrate a given function using trapezoidal and Simpsons rule.

Project work equivalent to two experiments is compulsory. A report must be submitted for internal evaluation IA marks(Max10). The work must emphasize significant ideas & concepts and should address the questions – why it is important, where it is applied, what are its key features & limitations.

A list of Suggestive ideas for project work is appended at the end.