Carmel College of Arts, Science & Commerce for Women, Nuvem Goa

Department of Physics

Programme: B. Sc. Physics (Honours)

Carmel College of Arts, Science & Commerce for Women, Nuvem Goa endeavours to achieve the following outcomes:

PO 1	**Attribute: KNOWLEDGE** Inculcate in our learners a quest for knowledge and an understanding of fundamental concepts and scientific principles related to various phenomena in daily life.
PO 2	**Attribute: CRITICAL THINKING** Acquire practical skills in handling scientific instruments and other experimental analysis, observational and problem-solving skills and draw logical inferences from scientific experiments.
PO 3	**Attribute: RESEARCH** Encourage student engagement for research skill development.
PO 4	**Attribute: SUSTAINABLE DEVELOPMENT** Have an interdisciplinary approach and provide solutions for sustainable development.
PO 5	**Attribute: COMMUNICATION SKILLS** Have good communication skills which help in expressing ideas and views clearly and effective.
PO 6	**Attribute: LIFE LONG LEARNING** Encourage a receptive mindset for lifelong learning
PO 7	**Attribute: SOCIETY** To groom an eco-conscious and ethical society

The department of physics, Carmel College of Arts, Science & Commerce for Women, Nuvem Goa endeavours to achieve the following outcomes:

Program Specific Outcomes (PSOs)	
PSO 1	**Academic Competence** Learn fundamentals of various branches of physics, which is beneficial for pursuing the higher education in physics and in many other applied branches of sciences. Students will be able to **develop**, **demonstrate**, **categorize**, **calculate** and **solve** scientific problems using concepts of physics.
PSO 2	**Personal and Professional Competence** **Propose** scientifically the outcomes to laboratory based experiments, **Analyse** experimental results and **interpret** graphs. **Develop** critical thinking and problem solving skills.
PSO 3	**Research Competence** **Apply** and **test** theoretically **discussed** concepts from classroom to experiments in the laboratory. **Calculate** the errors and the variations of the experimental results to the theoretical one and **discuss** the possible reason for the same.

F. Y. BSc – Semester I

Course Code: PYC101 **Couse Title: Section -1: MATHEMATICAL METHODS, MECHANICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand and apply the fundamentals of matrices, determinants, complex numbers and calculus.	2,3
CO 2	Understand the classical laws of motion and conservation laws.	1,2,3,4
CO 3	Discuss the concepts of momentum and its conservation	2,3,4,5
CO 4	Derive classical equations of motion in one and two dimensions for various systems.	5,6
In the laboratory component of the course, the student will be able to:		
CO 5	verify fundamental laws of physics learnt in lectures.	1,3,4
CO 6	use experimental apparatus, analysis techniques for experiments and software tools for experimental data analysis.	1,2,3

PO / CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	3	3	3	3	1	3	3	3
CO 2	3	2	2	1	2	1	1	2	2	2
CO 3	3	2	2	1	2	1	1	2	2	2
CO 4	2	2	2	1	2	2	1	3	2	3
CO 5	3	3	3	2	2	2	1	3	3	3
CO 6	2	2	2	2	2	2	1	2	2	3

Course Code: PYC101 **Couse Title: Section -2: ELECTRICAL CIRCUIT THEORY**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the concepts of basic circuit laws/theorems, mesh and Nodal analysis of circuits through circuit theorems.	1
CO 2	Apply the various theorems to simplify the complex circuits.	2
CO 3	State and use Kirchhoff current and voltage laws, Superposition, Thevenin's, Norton's and Maximum power transfer theorems to solve numerical problems	3
CO 4	Analyse the transient, steady state and resonating behaviour of circuits.	4
CO 5	understand different types of bridges and their uses.	1,2
In the laboratory component of the course, the student will be able to:		
CO 6	Test few theoretical concepts learnt in the class by performing experiments in the laboratory.	4,5

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	0	2	1	2	2	3	2	1
CO 2	3	3	0	0	1	2	0	3	2	0
CO 3	3	3	0	0	1	2	0	3	2	0
CO 4	3	2	1	2	1	1	1	3	2	1
CO 5	3	2	0	2	1	1	1	3	2	0
CO 6	3	3	2	1	1	2	1	3	3	3

SYLLABUS

SECTION 1: MATHEMATICAL METHODS AND MECHANICS (Theory: 2 Credits)

Mathematical methods **[15 Lectures]**

Matrices and determinants, Linear equations [**2]**
System of linear equations, matrices and determinants.

Elementary Vector Algebra **[2]**
Scalars and vectors, addition and subtraction of vectors, multiplication by a scalar, basis vectors and components, magnitude of a vector, unit vector, dot and cross product of vectors and their physical interpretation.

Complex numbers **[2]**
Complex numbers, notation of complex number, complex planes, physical meaning of complex quantities, exponential, logarithmic and trigonometric functions, hyperbolic functions. De'Moivre's Theorem, Roots of unity.

Limits and Continuity **[3]**
Definition, intervals and neighborhoods, algebra of limits, limits of trigonometric functions, exponential limits. Concept of continuity, left and right hand limits, graphical representation of continuity.

Differentiation **[3]**
Differentiation from first principles, derivative of polynomials, trigonometric, exponential, logarithmic functions and implicit functions. Rules of differentiation, Leibnitz theorem, higher order derivatives.

Integration **[3]**
Integration from first principles, integration as inverse of derivative, integration by inspection. Standard Integrals: (Algebraic, trignometric, exponential logarithmic), integration by parts, substitution methods, reduction formulae).

Mechanics **[15 Lectures]**

Motion of a particle in one dimension **[10]**
Discussion of the general problem of one dimensional motion. Dependence of force in general on position, velocity and time. Motion under a constant force with illustrations - Atwood'smachine, free fall near the surface of the earth. Motion along a rough inclined plane. The equation of motion, momentum and energy conservation theorems. Motion under a force which depends on time-general approach to the solution. Illustration using force of the type $F = F_o \sin(\omega t + \varphi)$. Motion under a conservative force dependent on position, potential energy. Motion under damping force depending on velocity - general dependence of resistive force on velocity. Motion in a medium with resistive force proportional to first power of velocity. Body falling under gravity in a resistive medium near the surface of the earth.

Motion in two dimensions : **[5]**
Equations of motion in plane polar coordinates. Momentum and energy theorems. Plane and vector angular momentum theorems.

Projectile motion in a non-resistive and resistive medium, (resistive force proportional to the first

power of velocity).

Text Books & References

1. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical methods for Physics and Engineering, Cambridge University Press (2006).
2. Robert Stainer and Philip Schmidt, Mathematics for Physics students, Schaum series, 2007.
3. K. R. Symon, Mechanics, Addison Wesley (1962).
4. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997).
5. C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer, Berkeley Physics Course, Volume I, Mechanics, McGraw-Hill (1973).
6. Eugine Hecht, College Physics, Schaum Outline Series, 2011.
7. P. V. Panat, Classical Mechanics, Narosa Publishing, (2013).
8. D. S. Mathur, Mechanics, S. Chand & Co. (1981).
9. Gupta, Kumar and Sharma, Classical Mechanics, Pragati Prakashan, Merut (2008).

MATHEMATICAL METHODS AND MECHANICS

Practical (any four) (1 credit)

Introduction to measurement techniques:

1. Range and least count of instruments, measurements using various instruments and error analysis (Vernier calipers, micrometer screw gauge, travelling microscope, spherometer, spectrometer) Graphical analysis of one-dimensional motion: Kinematics, plotting and interpretation of displacement, velocity and acceleration versus time graphs. Linear and nonlinear plots, determination of slopes and area under the curves for evaluation of physical quantities such as force, work and energy.
2. Motion in resistive medium (Experimentation/Simulation).
3. Atwood's machine.
4. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
5. Projectile Motion (Experimentation/Simulation).
6. Bar pendulum
7. Conical Pendulum
8. Torsional Pendulum
9. Graphical analysis of one-dimensional motion: Kinematics, plotting and interpretation of displacement, velocity and acceleration versus time graphs. Linear and nonlinear plots, determination of slopes and area under the curves for evaluation of physical quantities such as force, work and energy.
10. Motion in resistive medium (Experimentation/Simulation).
11. Atwood's machine.
12. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
13. Projectile Motion (Experimentation/Simulation).

14. Bar pendulum
15. Conical Pendulum
16. Torsional Pendulum

SECTION 2: ELECTRICAL CIRCUIT THEORY

(Theory 2 Credits)

Circuit Analysis **[7]**

Concept of constant current and constant voltage source, Maxwell's cyclic current method for circuit analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem (with proof) and their application to simple networks.

Inductance **[4]**

Self Inductance, self inductance of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, self inductance of co-axial cables, mutual inductance, coefficient of coupling, inductance in series and parallel.

Response of circuits containing L, C and R to DC **[6]**

Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit and in a series L-C-R circuit.

AC Circuits **[7]**

AC applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j operator and vector or phasor method applied to LR, CR and LCR circuits. Series and parallel resonance. Q factor and Bandwidth. Graphic representation of resonance (Variation of resistance, inductive reactance, capacitive reactance with frequency)

Mutually Coupled L-R circuits **[3]**

AC applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer.

AC Bridges **[3]**

General AC bridges, Maxwell's bridge, Maxwell's L/C bridge,De-Sauty's bridge. Wein's frequency bridge.

Text Books & References

1. J. Yarwood and J. H. Fewkes, Electricity and Magnetism. University Tutorial Press (1991).
2. D. N. Vasudeva, Fundamentals of Electricity and Magnetism, S. Chand and Company Ltd. New Delhi.(2012)
3. Brijlal and Subramaniam, Electicity and Magnetism, Ratan Prakashan, New Delhi. (1966).
4. Mahmood Nahvi, Joseph Edminister, Electrical Circuits, Schaum outline Series, (2002).
5. Thereja B.L. Text Book of Electrical Technology, S. Chand and Co Ltd. New Delhi (1990).
6. Sudhakar and Shammohan, Circuits and Networks Analysis and Synthesis, TMH, (2006).

SECTION 2: ELECTRICAL CIRCUIT THEORY

Practical (any four) (1 credit)

1. Verification of Thevenin's Theorem & Maximum Power transfer theorem
2. Verification of Norton's theorem & Maximum Power transfer theorem
3. Response of LR and CR circuits to AC - phasor diagrams.
4. Step Response of CR circuit / LR Circuit.
5. De Sauty's Bridge- comparison of capacitance and Maxwells L/C Bridge- determination of mutual inductance
6. LCR Series and parallel resonance –Resonant frequency, Q value and Bandwidth.

Course Code: PYG 101 **Course Title: BASIC PHYSICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand and apply the techniques of measurement of length, time and mass.	1,2
CO 2	Understand and apply concepts of elasticity, surface tension, fluid Statics and fluid dynamics.	1,2
CO 3	Understand acoustics with an emphasis on loudness, sound absorption, ultrasonic waves, Doppler Effect with their application to life sciences.	1,2,3
CO 4	Understand the requirements for Design of an auditorium for good hearing of music and speech.	2,4
CO 5	Discuss concepts of electrostatics and magnetism.	1,2,3
CO 6	Discuss basic electrical circuit components and electronics and their various applications.	1,2,3

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	2	2	2	2	3	1	1
CO 2	2	1	1	2	2	2	1	3	2	1
CO 3	2	2	1	2	2	2	2	3	1	1
CO 4	3	1	1	1	1	1	1	3	2	2
CO 5	2	2	2	1	1	1	1	2	2	2
CO 6	2	1	1	1	1	1	1	3	2	1

BASIC PHYSICS (Generic Elective) (4 credits Theory)

Measurement of Physical quantities, standards and units. [5]
Length: radius of proton to size to astronomical distances.
Mass: atomic mass unit to mass of earth.
Time: time for fast elementary particle to pass through nucleus to age of earth.
Units in electricity: volts, Amperes, ohms.
Units of Temperature: Celsius scale, Kelvin scale.
International systems and units: Units used to measure physical quantities and their inter-conversion.

Properties of matter [12]
Elasticity: Hook's law, modulii of elasticity, Surface tension: Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Pressure difference across curved surfaces. Angle of contact. Capillarity. *Application of the phenomenon to life sciences.*

Fluid Statics and fluid dynamics**:** Pascal's Principle, Measurement of pressure. Various units of pressure and their inter-conversion, Concept of pressure energy. Bernoulli's theorem and its applications- Venturi meter and Pitot's tube. Viscosity, Viscosity estimation by Oswald's viscometer. Relevance to life sciences.

Acoustics [12]
Loudness, units of intensity and loudness, Weber Fechner law and sound absorbers.

Production and detection of Ultrasonic waves and its applications. Doppler effect. Calculation of of apparent frequency, (Normal incidence only), application to life sciences. Acoustics of Building Growth and decay of intensity, Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time (discussions only) , Acoustic requirements of a good auditorium,

Basics of Electrostatics and Electricity: [10]
Electric charge. Coulomb's law. Applications of electrostatics in life sciences. Basics of electricity: Current, voltage and resistance and their units, Ohm's law, Conductor, Semiconductor and Insulator.

Transducers: characteristics, classification of transducers-electrical, mechanical, optical. Applications in chemical and biological instruments.

Magnetism [5]
The magnetic field, The definition of B, magnetic dipoles, Units of magnetism, Electromagnetic induction, Faraday's law, Lenz's law.

Basic Electronics [16]
Voltage and current sources, Inductance coils, capacitors and transformers. Rectifiers and voltage regulators: Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes, Percentage regulation, Ripple factor and Rectification efficiency. ripple filters, Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation. Junction Transistor and its characteristics in CE mode, Current gain, Voltage gain, Light Emitting Diodes, Photoiodes and Phototransistors.

References:

1. Haliday, Resnik and Walker, Fundamentals of Physics, 10e, John Wiley and Sons.
2. Elements of Properties of Matter, by D. S. Mathur, S. Chand and Sons, (2013).
3. Text book of Sound by Khanna and Bedi.
4. H.S. Kalsi, Electronic Instrumentation,Tata McGraw Hill Publication.
5. A course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney, Dhanpat Rai & Sons.
6. V.K.Metha, Principles of Electronics, S.Chand & Company (2009).
7. A.P.Malvino, Electronic Principles –TMH 5^{th} edition

F. Y. BSc – Semester II

Course Code: PYC102 **Couse Title: Section -1: HEAT AND THERMODYNAMICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand concept of ideal gas, kinetic theory of gases and transport phenomena.	2,4
CO 2	Understand behaviour of real gases and develop an equation of state.	2,4,6
CO 3	Comprehend concepts of thermodynamics and the various laws of thermodynamics.	2,4
CO 4	Apply the laws of thermodynamics in various systems (Heat Engine, Carnot cycle and Refrigeration).	5
In the laboratory component of the course, the student will be able to:		
CO 5	verify fundamental laws of physics learnt in lectures.	1,3,4
CO 6	use experimental apparatus, analysis techniques for experiments and software tools for experimental data analysis.	1,2,3

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	2	2	2	0	3	2	1
CO 2	3	2	2	1	2	1	0	3	2	1
CO 3	3	3	2	2	2	2	1	3	2	2
CO 4	2	3	3	1	1	1	1	3	3	3
CO 5	3	2	2	1	2	1	1	3	3	3
CO 6	3	3	3	2	2	2	1	3	3	3

Couse Title: Section -2: PROPERTIES OF MATTER & ACOUSTICS		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand Elasticity of materials and develop theory for elastic behaviour of different materials by studying different systems.	1,2,3,4
CO 2	Understand surface tension and viscosity.	2
CO 3	Derive differential equation for harmonic oscillator.	6
CO 4	Familiarise with terms in acoustics like intensity, loudness, reverberation, etc, and study in detail ultrasonic waves and design of auditorium.	2,5,6
CO 5	Demonstrate a strong understanding of waves and derive various parameters of wave motion.	3,5,6
In the laboratory component of the course, the student will be able to:		
CO 6	use experimental apparatus, analysis techniques for experiments relating to elasticity, surface tension and wave motion.	1,2,3

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	1	1	1	1	3	2	3
CO 2	3	2	1	1	1	1	1	3	2	3
CO 3	3	2	2	1	1	1	1	3	2	2
CO 4	3	2	2	1	1	1	1	3	2	2
CO 5	3	2	1	1	1	1	1	3	3	2
CO 6	3	3	3	1	1	1	1	3	3	3

SECTION 1: HEAT AND THERMODYNAMICS I

(Theory 2 Credits)

Kinetic theory of gases **[8]**

Three states of matter, concept of ideal gas, postulates of Kinetic Theory of gases, expression of pressure of a gas, relation between rms velocity and temperature, Average kinetic energy of a gas molecule, heat and temperature, kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy and its application to specific heats of gases. Brownian motion and its features, Einstein's equation, Determination of Avogadro's number. Mean free path and derivation to calculate MFP, Transport phenomena, transport of momentum (viscosity).

Behavior of real gases **[7]**

Deviation from perfect gas behavior, Discussion of results of Andrew's experiments on CO2 and Amagat's experiment, critical constants, Van der Wall's equation of state, expression of Wan der Wall's constants, Reduced equation of state, Law of corresponding state, relation between Boyle temperature and critical temperature, critical coefficient.

Zeroth and First Law of Thermodynamics **[4]**

Basic concepts of thermodynamics: Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes, Zeroth law of thermodynamics and concept of temperature, Internal energy and First law of thermodynamics, Relation between pressure, volume and temperature in adiabatic process, Work done in isothermal and adiabatic processes, Path dependence of heat and work.

Second Law of Thermodynamics **[7]**

Process-reversible and irreversible, condition of reversibility, Second law of thermodynamics, Carnot's cycle, efficiency of Carnot's cycle, reversibility of Carnot's cycle, Carnot's theorem, coefficient of performance of a refrigerator, Thermodynamic scale of temperature, its identity with perfect gas scale, Clapeyron latent heat equation and its applications.

Entropy **[4]**

Entropy as a Thermodynamic variable, Entropy change in reversible and irreversible processes, Temperature–Entropy diagram of Carnot's Cycle, Entropy of a perfect gas, Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder, Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics).

Text Books & Reference Books:

1. Treatise on heat, M. N. Saha and B. N. Shrivastava, The Indian Press (1965).
2. Thermal Physics, S.C . Garg, R.M. Bansal and C. K. Ghosh, TMH (1993).
3. Thermodynamics J.K. Roberts and A.R Miller , E.L.B.S. (1960).
4. Text Book of Heat, G.R. Noakes, Mcmilan& Co(1960).
5. Thermodynamics, William C .Reynolds (1968).
6. Heat and Thermodynamics M.W. Zemansky and R.H. Ditman, McGraw Hill (1997).
7. Heat, Thermodynamics and Statistical Physics, BrijLal, N. Subrahmanyam and P. S. Hemne, S. Chand.

SECTION 1: HEAT AND THERMODYNAMICS I

Practical (any four) (1 credit)

1. Determination of Stefan's constant.
2. Resistance Thermometry (Cu wire and Pt 100).
3. Thermistor- NTC /PTC
4. Study of thermocouples for temperature measurement
5. Constant volume air thermometer.
6. Constant pressure air thermometer.
7. Calibration of Si diode as a temperature sensor.
8. Measurement of thermal conductivity of good conductors- by any method

SECTION 2: PROPERTIES OF MATTER AND ACOUSTICS (Theory 2 Credits)

Elasticity: **[10]**

Brief review of moment of Inertia. Modulii of elasticity, Strain energy, equivalence of shear to compression and extension at right angles to each other, Poisson's ratio and its limiting values, Relationship between the elastic constants. Torsion in a string-couple per unit twist, Torsional Pendulum. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Depression of a beam supported at the ends and loaded at the center. Theory of Loaded pillars, Critical load for pillars.

Surface Tension: **[4]**

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Pressure difference across curved surfaces. Angle of contact. Capillarity, experimental determination of surface tension and angle of contact.

Flow of liquids and Viscosity: **[3]**

Streamline flow, Turbulent flow, Critical velocity. Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube. Viscosity of gases – Mayer's formula.

Acoustics: **[10]**

Differential equation for harmonic oscillator, Velocity of longitudinal waves in fluids. Newton's formula for velocity of sound, vibrations in stretched strings. (transverse and longitudinal modes). Vibration in rods. Superposition of two simple harmonic motions, standing waves and beats, Helmholtz resonator.

Doppler effect. Intensity level - Bel and Decibel.

Production and detection of Ultrasonic waves and its applications.

Reverberation of sound **[3]**

Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time, Acoustic requirements of an auditorium.

Text Books and References:

1. Elements of Properties of Matter, by D. S. Mathur, S. Chand and Sons, (2013).
2. Lectures in elementary fluid dynamics, by J. M. McDonough (Lecture Notes available on Net, free download).
3. Fluid Mechanics by R K Bansal, Firewall Media, (2005).
4. Fluid Mechanics by Merle Potter, David Wiggert, Schaum Outline Series, (2008). Continuum Mechanics by George Mase, Schaum Outline Series. (1969).
5. Text book of Sound by Khanna and Bedi, Atma Ram, New Delhi, 1969.

SECTION 2: PROPERTIES OF MATTER AND ACOUSTICS

Practical (any four) (1 credit)

1. Bending of beams-single cantilever: determination of Young's modulus.
2. Bending of beams-double cantilever: determination of Young's modulus.
3. Velocity of sound by forming stationary waves by using C.R.O.
4. Young's modulus by transverse vibrations of rods /strips.
5. Capillarity: determination of Surface tension.
6. Viscosity of a liquid by Poiseuilles method.
7. Verification of Bernoulli's theorem.
8. To measure the velocity of flow using Pitot tube.
9. To determine the viscosity of fluid by viscometer.
10. Frequency of AC cycle using amplitude resonance
11. Kundt's tube experiment

Course Code: PYG 102 **Course Title: OPTICS and INSTRUMENTATION**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand laws of reflection and refraction on the basis for geometric optics.	1,2
CO 2	Understand theories of interference, diffraction and polarization of light.	1,2
CO 3	Be familiar with working of LASERS and X-Rays.	1,2
CO 4	Understand the physics behind instruments like microscopes, UV and IR Spectrophotometer and LCD and LED displays.	1,2
CO 5	Understand theory of molecular magnetic material.	1,2
CO 6	Understand the working principle of different medical imaging devices/instruments.	1,2

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	2	2	2	2	3	2	2
CO 2	3	2	2	2	2	2	2	3	2	2
CO 3	3	1	2	1	1	1	1	3	2	2
CO 4	3	2	2	2	2	2	2	3	2	2
CO 5	3	2	2	2	2	2	1	3	2	2
CO 6	3	1	1	2	2	2	2	3	2	2

OPTICS and INSTRUMENTATION (Generic Elective) (4 credits Theory)

Image Formation **[8]**

Luminous Intensity And Its Units, Reflection, Refraction. Introduction To Lenses, Optical Properties Of Lenses, Thin Lenses & Thick Lenses, Cardinal Points Of An Optical System, Aberrations; Spherical & Chromatic Aberrations In Lenses (Only Conceptual), Methods Of Minimizing Spherical & Chromatic Aberrations. Kellner's, Ramsden And Huygens Eyepiece- Construction And Image Formation With Optical Ray Diagrams.

Interference: **[3]**

Interference by Division of Wave Front & Division Of Amplitude. One Example Of Each Kind.

Diffraction: **[5]**

Concept of Diffraction, Fresnel and Fraunhoffer Class of Diffraction. Concept Of Fraunhoffer Diffraction At Single Slit, Application Of Fraunhoffer Diffraction To Resolving Power Of Optical Instruments, Raleygh's Criterian For Resolution, Resolving Power Of Telescope And Microscope.

Polarization: **[5]**

Concept Of Polarization, Plane Of Polarization, Polarization By Reflection, Brewster's Law, Polarization By Refraction, Double Refraction. Nicol Prism, Simple Polarimeter.

Lasers: **[7]**

Stimulated And Spontaneous Emission, Population Inversion, Lasers, Properties Of Lasers, Different Kinds of Laser, Applications of Lasers In Medicine, And Science. Optical Fibers: Basic Principle and Applications.

X-Rays **[5]**

Coolidge Tube Generator, Continuous X-Ray Spectra and its Dependence on Voltage, Duane And Hunt's Law, Wave Nature Of X-Rays – Laue's Pattern, Diffraction Of X-Rays By Crystal, Bragg's Law, Bragg Single Crystal Spectrometer, Analysis Of Crystal Structure - Simple Cubic Crystal.

LCD And LED Displays:

Types of Liquid Crystals, Principle Of Liquid Crystal Displays, Applications, Led's, Led Displays And Their Advantages.

Instrumentation **[7]**

Simple Microscope, Compound Microscope, Phase Contrast Microscope, Electron Microscope, XRD, UV and IR Spectroscopy.

MEDICAL IMAGING PHYSICS: **[12]**

Molecular field: Diamagnetism, Paramagnetism and Ferromagnetism,
X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR) – NMR imaging – MRI Radiological imaging –Radiography –X-ray film – fluoroscopy –computed tomography scanner – principle function – display – generations –mammography. Ultrasound imaging – magnetic resonance imaging

Demonstration in class/ laboratory. Any four [8]

1. Luxmeter/Photometer.
2. Construction and image formation of Ramsden /Huygens eyepiece.
3. Interference patters using Fresnel's biprism, Lloyds mirror in Physics Laboratory.
4. Fresnel and Fraunhoffer class of Diffraction, Resolving power of telescope and microscope in Physics Laboratory.
5. Polarization using Polaroid, Double refraction. Nicol prism, simple polarimeter in Physics Laboratory.
6. Some properties of lasers in class.
7. Analysis of x-ray diffraction data for crystal structure determination

References

1. N Subrahmayam and N.Brijlal, Text Book of Optics, S. Chand & Company Ltd,(1991).
2. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
3. Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012).
4. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
5. R. S. Khandpur, Handbook of Biomedical Instrumentation, Second Edition. Front Cover. . Tata Mcgraw-hill Pub, 1992
6. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)

S. Y. BSc – Semester III

Course Code: PYC103 **Couse Title: Section -1: WAVES AND OSCILLATIONS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Formulate and solve the equations of motions for different physical systems that undergo SHM.	2,4,6
CO 2	Apply the principle of superposition for two harmonic motions having different and same frequency respectively	2,3,5
CO 3	Demonstrate knowledge of the fundamental assumptions related to the derivation of the wave equation.	1,3,5
CO 4	Derive and solve the equations for the damped oscillator and forced oscillator; understand the concept of resonance.	4,5,6
In the laboratory component of the course, the student will be able to:		
CO 5	experimentally verify theories learnt in lectures with different types of harmonic systems.	1,3,5
CO 6	demonstrate of undamped, damped, driven oscillations and phenomenon of resonance	2,3,4

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	2	2	2	2	1	3	2	2
CO 2	3	2	2	2	2	2	1	3	2	2
CO 3	3	2	2	1	2	1	1	2	2	2
CO 4	3	2	2	1	2	1	1	3	2	2
CO 5	3	2	2	2	2	1	1	2	3	3
CO 6	3	2	2	2	2	1	1	2	3	3

Couse Title: Section -2: ELECTRONICS		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand Principle of working and applications the basic electronic devices like Junction Diode, Zener diode, Thermistor, Transistor and Operational Amplifier.	1,2
CO 2	Understand the concepts of rectification, regulation, amplification, bias stability, Compensation and feedback.	1,2
CO 3	Apply concepts and design different electronic networks like rectifiers Voltage regulator, Amplifiers, and Oscillators.	3,4
CO 4	Design different electronic networks like Rectifiers, Voltage regulator, Amplifiers, and Oscillators.	6
In the laboratory component of the course, the student will be able to:		
CO 5	Get familiar with the basic electronic devices like Junction Diode, Zener diode, Thermistor, Transistor and Operational Amplifier.	1,2
CO 6	Design and construct networks on their own.	5,6

PO / CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	0	2	1	2	2	3	2	1
CO 2	3	3	0	2	1	2	2	3	3	1
CO 3	3	3	2	0	1	2	0	3	3	3
CO 4	3	3	0	0	1	0	0	3	1	2
CO 5	3	3	0	0	1	0	0	3	1	2
CO 6	3	3	3	1	1	2	0	3	3	3

SECTION 1: WAVES AND OSCILLATIONS

(Theory 2 Credits)

Waves and Oscillations: [10]

Periodic oscillations and potential well, differential equation for harmonic oscillator and its solutions (case of harmonic oscillations), kinetic and potential energy. Examples of simple harmonic oscillations: spring and mass system, simple and compound pendulum, Helmholtz resonator, bifilar oscillations.

Superposition of Waves: [8]

Wave equation and solutions, Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

Oscillatory Motion in a Resistive Medium: [12]

Damped harmonic oscillator, Damped forced harmonic oscillator. Displacement and velocity Resonance, Sharpness of resonance, Phase relationships, Energy consideration in a forced harmonic oscillator. Harmonic oscillator with an arbitrary applied force.

Text Books and References:

1. Takawale R. G. and Puranik P S. Introduction to Classical Mechanics, TMH, 1997
2. D. R. Khanna and R.S. Bedi, Text book of Sound,Atma Ram, New Delhi (1994).
3. N. K. Bajaj, Physics of Waves and Oscillations, TMH, 2006.
4. A P French, Waves and Oscillations, CBS Publishers, 2003
5. H. J. Pain, Physics of Vibrations and waves, 6^{th} Ed, Wiley, India, 2005
6. Brijlal and Subrahmanyam, Waves and Oscillations and Accoustics, S Chand & Co Ltd.(2009)
7. D. Chattopadhyay and P.C. Rakshit, Waves and Oscillations, Books and Allied Pvt Ltd (2009)
8. M Ghosh and B Bhattacharya, Oscillations and Accoustics, S Chand & Co Ltd. (1976).
9. S.P.Puri, Text book of Vibrations and Waves, Macmillan India ltd, 2nd edition, 2004

SECTION 1: WAVES AND OSCILLATIONS

Practical (any 4) (1 credit)

1. Bifilar oscillations Determination of η using Flat spiral spring.
2. Determination of η using Flat spiral spring.
3. Determination of Y using Flat spiral spring.
4. Y by vibrations of cantilever.
5. Superposition of two mutually perpendicular simple harmonic oscillations -Lissajous figures using CRO.
6. Helmholtz resonator.
7. Simulation of Waves
8. Resonance pendulum –study of amplitude resonance and determination of ‘g’
9. Double pendulum.

SECTION 2: ELECTRONICS (Theory 2 Credits)

Rectifiers and Regulators **[6]**

Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes without and with capacitive filters. Percentage regulation, Ripple factor and Rectification efficiency. Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation.

Transistors **[3]**

Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains α and β and their interrelation, Leakage current in transistors.

Basic Amplifier Characteristics **[3]**

Current gain, Voltage gain, Power gain, Input resistance, Output resistance, Conversion efficiency, Classes of amplifier operations, Decibel, Frequency response, Amplifier bandwidth.

CE amplifier: Class A **[4]**

Graphical analysis, Effect of adding A.C. load, Input and Output resistance, Conversion efficiency, Phase relationship between input and output.

Transistor Biasing **[4]**

Bias stability, Stability factor, Different methods of biasing, biasing compensation.

Feedback **[5]**

Positive and negative feedback, Voltage and current feedback, series and shunt feedback.
Effect on negative feedback on gain, frequency response, input and output resistance and distortion. Positive feedback, Barkhausen criterion for oscillations, Phase shift oscillator, Wein bridge oscillator, LC tank circuit, Hartley oscillator and Colpitts oscillator.

Linear IC's and Operation Amplifiers **[5]**

The Differential Amplifier, OP-Amp characteristics, Input and Output impedance, Input bias and offset currents, Input and output offset voltages. Differential and Common mode gains, CMRR, Slew rate, OP-Amp as inverting , Non Inverting amplifier and Difference amplifier.

Text Books and References

1. A.P.Malvino, Electronic Principles –TMH 5th edition (1996).
2. Allen Mottershed, Electronics Devices and Circuits an Introduction- 3rd edition PHI (1997).
3. Millman and Halkias, Intergrated electronics- TMH (1972).
4. Bhargava, Kulshrestha and Gupta, Basic Electronics and Linear Circuits-. TMH (1984).
5. Ramakant Gayakwad, Op-amp and Linear Intergrated Circuits, PHI (2002).

ELECTRONICS

Practical (any four) (1 credit)

1. Half wave and Full wave rectifier using Junction Diode, Load regulation characteristics.
2. Bridge rectifier with capacitor filter- Ripple factor using CRO.
3. Zener Diode Regulation.
4. Colpitts / Hartley oscillator
5. Wein's Bridge /Phase shift Oscillator.
6. Transistor characteristics- Input and Output (C E mode)
7. C.E. Amplifier. Fequency response with and without negative feedback. Calculation of Gain Bandwidth product.
8. C.E. Amplifier -Determination of Input and Output Impedance, Variation of Gain with load
9. OP-Amp: Inverting and Non-inverting amplifier.
10. Op-Amp : Differential amplifier & adder/subtractor

Course Code: PYS 101 **Course Title: Network Theory**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Apply the concepts of electrical circuit theorems and study & analyse the behaviour of DC and AC networks.	1,2
CO 2	State and use Kirchhoff current and voltage laws, Superposition, Thevenin's, Norton's and Maximum power transfer theorems to build equivalent circuits.	1,2
CO 3	Solve and analyse first and second order circuits having some excitation signal and be able to analyse the transient response (for series and parallel combination of RL, RC and RLC circuits).	2,3
CO 4	Calculate frequency response of filter, and various parameters of two port networks and analyse the transient, steady state and resonating behaviour of circuits.	4,5
CO 5	Analysis of various two port networks with their connection, interrelationships and interconnection of two port networks (with respect to impedance, admittance, hybrid and transmission parameters).	3,4,5
In the laboratory component of the course, the student will be able to:		
CO 6	To have hands on experience in circuit building using the various theorem and concepts studied during the course.	5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	0	2	1	2	2	3	2	1
CO 2	3	3	0	0	1	2	0	3	2	0
CO 3	3	3	0	0	1	2	0	3	2	0
CO 4	3	2	1	2	1	1	1	3	2	1
CO 5	3	2	0	2	1	1	1	3	2	0
CO 6	3	3	2	1	1	2	1	3	3	3

SYLLABUS
NETWORK ANALYSIS

Review of BASIC CONCEPTS: [5]

Voltage, Current, Power and Energy, Constant voltage and constant current source, The sine wave, RMS value and average value of a sine wave, The Resistance, Inductance and Capacitance, Kirchhoff's Voltage Law, Kirchhoff's Current Law, Principle of non-inductive resistance coils, Mutual inductance, Coefficient of coupling. Self Inductance of co-axial cables, Inductance in series and parallel. Capacitances in series and parallel.

CIRCUIT ANALYSIS AND NETWORK THEOREMS: [10]

Mesh analysis, Super Mesh analysis, Nodal analysis, Super Node analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer Theorem, Impedance matching. **RESPONSE OF RL, RC and RLC circuits to DC and AC [11]** Transient Response of RL, RC and RLC circuits. Sinusoidal response of RL, RC, RLC circuits, Impedance diagram, Phase angle, series and parallel complex impedance circuits. **POWER AND POWER FACTOR: [3]** Instantaneous power, Average power, Apparent power and Power factor, Reactive power, Power triangle.

COUPLED CIRCUITS: [3]

AC applied to mutually coupled L-R circuits. Reflected impedance, Transformers, Effect of loading the secondary of a transformer, Ideal transformer.

RESONANCE: [3]

Series resonance, quality factor (Q) and its effect on Bandwidth, parallel resonance, Q factor of parallel resonance.

TWO-PORT NETWORK: [7]

Two-port networks, open circuit impedance (Z) parameters, Short circuit admittance (Y) parameter, Hybrid (h) parameter, Interrelationship of different parameters, T & II networks, Lattice networks.

AC BRIDGES [3]

General AC bridges, Maxwell's bridge, Maxwell's L/C bridge, De-Sauty's bridge. Wein's frequency bridge.

Text Books & References ;

1. Sudhakar and Shammohan, Circuits and Networks Analysis and Synthesis, TMH, (2006).
2. J. Yarwood and J. H. Fewkes, Electricity and Magnetism. University Tutorial Press (1991).
3. D. N. Vasudeva,Fundamentals of Electricity and Magnetism.S. Chand and Company Ltd. New Delhi.(2012).
4. Brijlal and Subramaniam, Electicity and Magnetism, Ratan Prakashan, New Delhi. (1966).
5. Thereja B.L. Text Book of Electrical Technology, S. Chand and Co Ltd. New Delhi (1990).
6. Mahmood Nahvi, Joseph Edminister, Electrical Circuits, Schaum outline Series, (2002).

Practical: Minimum of 4 experiments.

1. Design of 1 mH inductor.
2. Study of High pass, Low Pass filters using passive components.
3. Band pass and Band stop filters using passive components.
4. Study of passive integrator and differentiator.
5. Thevenin's Theorem and Norton's Theorem.
6. Varification of Superposition Theorem.
7. Impedance Matching.
8. Response of LR, circuit to DC and AC.
9. Response of CR circuit to DC and AC.

S. Y. BSc – Semester IV

Course Code: PYC104 **Couse Title: Section -1: OPTICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the concepts of interference and wave fronts.	2,3
CO 2	Understand the working of Fabry-Perot and Michelson's interferometer and their applications.	2,4,5
CO 3	Explain diffraction phenomena.	2,3
CO 4	Understand the concept of Polarisation and optical activity with its applications	2,3,4
In the laboratory component of the course, the student will be able to:		
CO 5	Use different optical instruments and verify results of phenomena of light learnt in theory.	4,5

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	1	2	2	1	3	2	2
CO 2	3	1	1	1	2	2	1	3	2	2
CO 3	3	1	1	1	1	1	1	3	2	2
CO 4	3	2	2	1	2	2	1	3	2	2
CO 5	3	3	3	2	3	2	1	3	3	3

Couse Title: Section -2: Modern Physics		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the concept of Electric and Magnetic phenomena and its effects on charged particles.	1
CO 2	Demonstrate through various theoretical examples the need for concepts of modern physics over classical.	2,3
CO 3	Compare and contrast Modern Physics with Classical Physics and understand problems involving atomic spectra, blackbody radiation, the photoelectric effect, X-ray emission, the structure of the atom etc.	2,3
CO 4	Understand the working of different types of particle accelerators and mass spectrometers and their applications.	2,3
CO 5	Introduce and understand different types of Crystal structures and application of X-rays in determining these structures.	1,2,5
In the laboratory component of the course, the student will be able to:		
CO 6	Test few theoretical concepts learnt in the class by performing experiments in the laboratory.	5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	1	1	1	1	1	3	2	1
CO 2	3	3	2	1	1	2	1	3	2	0
CO 3	3	3	1	1	1	1	1	3	2	1
CO 4	3	3	1	1	1	1	1	3	2	1
CO 5	3	3	2	1	1	2	1	3	2	0
CO 6	3	3	2	1	1	2	1	3	3	3

SECTION 1: OPTICS

Interference **[9]**

Introduction: Interference by division of wave front & division of amplitude. Fresnel's biprism and Lloyd's mirror.

Formation of colors in thin film- reflected system, Transmitted system, wedge shaped film, Newton's Rings and its application to determine refractive index of liquids (Normal Incidence only).

Interferometry:- Michelson interferometer-its principle, working and its application to determine wavelength and difference between two wavelengths. Fabri Perot Interferometer.

Diffraction **[12]**

Concept of Diffraction, Fresnel and Fraunhoffer Diffraction. Division of cylindrical wave-front into half period strips, Fresnel's diffraction at straight edge and cylindrical wire. Fraunhoffer diffraction at single, double and N slits. Diffraction grating, width of principal maxima of plane diffraction grating. Resolving power of optical instruments- Rayleigh's criterion, Resolving power of telescope, Prism and grating.

Polarization **[9]**

Concept of polarization, Plane of polarization, Polarization by reflection, Brewster's law, Polarization by refraction, Double refraction, uniaxial and biaxial crystals, positive and negative crystals, Nichol's Prism, Circularly and Elliptically polarized light - Theory and analysis, Polaroid, Retardation plates - Quarter wave plate and Half wave plate, Optical activity, specific rotation, simple polarimeter, Laurent's half shade polarimeter.

Text Books and References

1. N Subrahmayam and N.Brijlal, Text Book of Optics, S. Chand & Company Ltd,(1991).
2. Optics, AjoyGhatak, Tata McGraw-Hill Publicashing Company Limited. (1977).
3. Ghatak And Tyagrajan, Contenprary Optics, Mc Millan (2003).
4. R. S Longhurst, Geometrical and Physical Optics, Orient Longman (1976 Indian edition).
5. Francis A Jenkins and Harvey E White, Fundamentals of Optics, (1976).
6. D N VasudevaA textbook of light for B. Sc. students (1962).
7. B.K. Mathur and T P Pandya,Principles of Optics, New Global Printing Press, Kanpur. (1980).

SECTION 1:OPTICS

Practical (any four) (1 credit)

1. Spectrometer: Determination of dispersive power of prism..
2. Cardinals points of two lenses.
3. Wedge shaped film – determination of wavelength
4. Fresnel Biprism
5. Newton's rings - determination of radius of curvature of lens
6. Single slit Diffraction using Na source
7. Diffraction Grating.
8. Resolving power of telescope using wire mesh.
9. Verification of Brewster's law.

SECTION 2: MODERN PHYSICS
(Theory 2 Credits)

Motion of charged particles in electric and magnetic fields **[6]**

Lorentz force , Motion in a uniform electric field, magnetic field, parallel and crossed fields. Electric discharge through gases, Determination of e/m for cathode rays, Charge and mass of an electron, Atomic masses, Energy and mass units.

Particle Accelerators **[3]**

Linear accelerator and Cyclotron.

Atomic Physics **[6]**

Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph. Review of Bohr's Hydrogen atom, Correction due to finite nuclear mass. Frank-Hertz experiment and atomic energy levels.

Properties of electromagnetic radiation **[7]**

Black Body Radiation, Kirchoff's radiation law, Stefan's law, Wien' law, Raleigh - Jean's law, Planck's law. Photoelectric effect and Compton Effect – observation, description, derivations of relevant equations and failure of classical physics to explain the same. Experimental verification of the Photoelectric and Compton effects.

Crystal Structure **[3]**

Crystal lattice,crystal planes and Miller indices, unit cells, typical crystal structures.

X-rays **[5]**

Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays – Laue's pattern, Diffraction of X-rays by crystal, Bragg's law, Bragg single crystal spectrometer, Analysis of crystal structure - simple cubic crystal.

Text Books and References;

1. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
2. S.B. Patel, Nuclear Physics, TMH (1991).
3. Irving Kaplan, Nuclear Physics, Narosa Publishing House,(1997).
4. F.K. Richtmyer, E.H. Kennord, J.N. Cooper Introduction to Modern Physics, McGraw Hill (1997).
5. H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall (1973).
6. J.B.Rajam, Atomic Physics, S.Chand and Co. Ltd.(1950).

7. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
8. K.Thyagarajan and A.Ghatak, Optical Electronics, Cambridge University Press (1997).
9. B.B.Laud, LASERs and Non-linear optics, Wiley Eastern (1991)

SECTION 2: MODERN PHYSICS
Practical (any four) 1 credit

1. Frank Hertz Experiment.
2. Characteristics of photo cell.
3. Measurement of K/e using transistor.
4. Photocell (verification of Photoelectric effect).
5. To determine the Planck's constant using LEDs of at least 4 different colours.
6. Measurement of emissivity of hot bodies (various types of surfaces).
7. X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy and assigning transitions.
8. Calculation of lattice constant by of Copper – x-ray diffraction pattern is given and student calculates, d-spacing, miller indices and lattice constant.

Course Code: PYS 105 **Couse Title: ELECTRICAL AND ELECTRONIC INSTRUMENTATION**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the working of A.C. and D.C. indicating instruments.	2,3
CO 2	Design of different types of A.C and D.C. bridges.	4,6
CO 3	Understand working of powers supplies and it's design.	4,5
CO 4	Understand working of oscilloscopes.	2,4
CO 5	Understand different types of instrumentation amplifiers and signal analyzers.	2,4
In the laboratory component of the course, the student will be able to:		
CO 6	Design, construct, and test different circuit learnt in the theory lectures.	2,3,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	3	2	2	2	1	3	2	2
CO 2	3	3	2	1	1	1	1	3	2	2
CO 3	3	3	1	1	1	1	1	3	2	2
CO 4	3	3	1	1	1	1	1	3	2	2
CO 5	3	2	1	1	1	1	1	3	2	2
CO 6	3	3	3	1	1	1	1	3	3	3

PYS105: ELECTRICAL AND ELECTRONIC INSTRUMENTATION
(3 credits theory and one credit practical)

D.C Indicating Instruments: (6)
PMMC Galvanometer (D'Arsonval movement) - Principle, construction and working, current sensitivity, voltage sensitivity and megohm sensitivity, advantages and disadvantages, conversion of Galvanometer into Ammeter, Voltmeter and Ohmmeter (series and shunt type), Aryton shunt, Loading effect of voltmeter. **A.C Indicating Instruments: (6)** Electrodynamometer-principle, construction and working, merits and demerits, Rectifier type Instruments, thermocouple Instrument (Ammeter), electrostatic voltmeter-principle, construction and working, watt-hour meter.

D.C and A.C Bridges: (6)
Wheat stone bridge-determination of resistance, Kelvin double bridge-determination of resistance, Maxwell's L/C bridge-determination of self inductance, Wien's bridge-determination of frequency, Schering bridge-determination of capacitance.

Power Supplies: (9)
Unregulated D.C power supplies(using full wave, bridge rectifier with C and L-C filter), transistor series and shunt voltage regulators, OP-AMP series and shunt voltage regulators, voltage regulators using IC 78xx series and ICLM317, Switching regulator(step down type).

Oscilloscopes: (9)
Block diagram of basic oscilloscope, CRT, deflection sensitivity, electrostatic deflection, electrostatic focusing (explanation only –no mathematical treatment), vertical amplifier, delay line circuit, sweep generator, measurement of voltage, period, frequency and phase difference, sampling oscilloscope, Digital storage oscilloscope – block diagram and working principle.

Instrumentation Amplifiers and Signal Analyzers: (9)
Instrumentation amplifier, Electronic voltmeters - d.c voltmeter with direct coupled amplifier, a.c voltmeter using rectifiers, ramp type digital voltmeter, digital multimeter, function generator, wave analyzers- audio range wave analyzer, heterodyne wave analyzer.

Books:
1. W. D. Cooper and A. D. Helfrik Electronic Instrumentation and Measurement Techniques - PHI Publication
2. H.S. Kalsi, Electronic Instrumentation,Tata McGraw Hill Publication
3. A course in Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney, Dhanpat Rai & Sons
4. Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory - PHI Publication
5. Ramakant Gayakwad, Op-amps and Linear Integrated Circuits, Pentice Hall, 2000.

Practical: Minimum of 4 practical
1. Use of Analog and Digital Multimeter for components testing and measurements(voltage, current and resistance)
2. Design and construction of multi range Voltmeter
3. Design and construction of series type Ohmmeter
4. Study of Maxwell's L/C bridge for determination of inductance
5. Study of Schering bridge for determination of capacitance

6. Design and construction of Wien bridge oscillator using OP-AMP
7. Design and construction of Instrumentation amplifier using OP-AMP
8. Series voltage regulator using transistor/OP-AMP.
9. Shunt voltage regulator using transistor/OP-AMP.
10. Design and construction of Function Generator using IC XR2206.
11. Measurement of frequency and phase on a CRO using Lissajous figures
12. Study of SMPS.

T. Y. BSc – Semester V

Course Code: PYC 105 **Course Title: Section 1: CLASSICAL MECHANICS** **Section 2: THERMAL PHYSICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Gain a good understanding of the concepts of Classical and Thermal Physics	1,2,3
CO 2	On comprehending the concepts will be at ease to apply the same to everyday life situations	1,2,3
CO 3	Know the mathematical methods needed for the scientific inquiry needed to model the advanced theories and provide deductions	3,4,5
CO 4	Understand the concepts of probability theory and apply this knowledge in solving problems.	3,4,5
CO 5	Understand the different statistical distribution theory and apply this to the suitable problems.	3,4,5
In the laboratory component of the course, the student will be able to:		
CO 6	Get familiar with the different new setups and systems and verify the concepts learnt in theory.	3,4,5

PO / CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	1	1	2	2	1	3	2	1
CO 2	2	2	2	2	2	2	1	3	2	1
CO 3	3	3	2	2	2	2	1	3	2	1
CO 4	3	3	2	2	1	1	1	3	2	1
CO 5	3	3	2	2	1	1	1	3	2	1
CO 6	3	3	3	2	2	2	2	3	3	3

CLASSICAL MECHANICS and THERMAL PHYSICS
(Theory 4 credits)

Classical Mechanics:

Motion of a system of particles **[7]**

Center of mass coordinates, applications of conservation laws for linear momentum, angular momentum and energy - rockets, conveyor belts and planets, critique of conservation of laws. The collision problems, the two body problem, reduction to equivalent one body problem.
(Ref: [1,2,3]).

Motion under a central force **[10]**

General features of motion, qualitative discussions of orbits under inverse square law force field. Nature of orbits, elliptical orbits, Kepler's problem, hyperbolic orbits, classical scattering, definition of scattering cross section, impact parameter and scattering angle, Rutherford's scattering cross section. (Ref: [1,2]).

Moving coordinate systems **[7]**

Inertial and non- inertial coordinate frames, rotating coordinate systems, laws of motion on the rotating earth, Coriolis force, Foucault's pendulum, and Larmor's theorem. (Ref: [2,4]).

Rigid bodies **[6]**

Rotation about an axis, moment of inertia tensor, Euler's equations of motion of a rigid body, torque free motion, qualitative discussion of motion of a symmetric top.
(Ref: [1,2,4]).

Thermal Physics:

Power cycles. **[3]**

Internal Combustion Engines – The Otto cycle and its efficiency, Diesel cycle and its efficiency.
(Ref: [6,7]).

Production of low temperature. **[13]**

Cooling by evaporation. Vapour compression machines. Refrigerators based on Vapour absorption. Cooling by sudden adiabatic expansion of compressed gases. Efficiency and performance of refrigerating machines. Enthalpy and heat flow. Joule Kelvin effect. Expression for Joule Kelvin coefficient and inversion temperature. Application to Van der Waals' gas. Principles of regenerative and cascade cooling. Liquifaction of hydrogen and helium. Production of temperatures below 4^{o} K. Properties of He I and He II. Cooling by Adiabatic Demagnetisation of paramagnetic substances. (Ref: [4,6,7,8]).

Probability **[7]**

Random Events, Probability, Probability and Frequency, Some basic rules of Probability theory, Continuous random variables, Mean value of discrete and continuous variables, Variance: Dispersion, Probability Distribution, Binomial distribution: Mean value and fluctuation, Stirling's Approximation, Poisson Distribution: Mean value and Standard deviation, Gaussian Distribution: Standard deviation. (Ref: [9,10]).

Statistical Distributions: **[7]**

Concept of Phase space, Probability of distribution and most probable distribution. Maxwell Boltzmann Statistics. Molecular speeds: mean, most probable and rms speeds. Experimental verification of Maxwell Boltzmann distribution law (Zartman ko experiment). Bose Einstein and Fermi Dirac statistics (qualitative study). (Ref: [4,6,11]).

References

1. K. R. Symon, Mechanics, Addison Wesley (1971).
2. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997)
3. Gupta, Kumar and Sharma, Classical Mechanics, Pragati Prakashan.
4. A.V. Namjoshi, J.A. Rao, Classical Mechanics Thermal and Statistical Physics (T.Y. B.Sc Vol. III), Sheth Publishers Pvt. Ltd.
5. C.L. Arora & P.S. Hemne, Physics for Degree Students, S. Chand
6. Brij Lal & Subrahmaniam, Heat Thermodynamics and Statistical Physics, S. Chand Publications.
7. M.N. Saha and B.N. Shrivastava,Treatise on heat, The Indian Press(1965).
8. M.W. Zemansky and R.H. Ditman, Heat and Thermodynamics, McGraw Hill (1997).
9. B.B. Laud Introduction to Statistical Mechanics, New Age International (2008).
10. N. Joshi, S.G. Chitale, G. Venkat, S.R. Rege, Statistical Techniques,
11. Perspectives of modern physics – Arthur Beiser, McGraw hill (1995).

Course Code: PYC 106 **Course Title : ANALOG AND DIGITAL ELECTRONICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the working of transistor as a switch and apply this knowledge to explain the principle of operation of multivibrators and Schmitt trigger.	1,2,3
CO 2	Understand the working of Op-amp as in Active diode circuits, integrator, differentiator, multivibrators, comparators, waveform generator, IC voltage regulators, and IC-555 timer and applications.	2,3,4
CO 3	Understand the working principle and operation of Field Effect Transistors (FET) and MOSFETS in amplifiers, oscillators and VVR dependent devices.	2,3,4,5
CO 4	Understand binary logic, working of logic gates and fundamentals of TTL and CMOS logic devices	1,2,3,5
CO 5	Understand working of digital circuits like adders, subtracters, multiplexers, demultiplexers, flip flops, counters and digital clock and other combinational and sequential circuits	1,2,3,4,5,6
In the laboratory component of the course, the student will be able to:		
CO 6	Design, construct and test different circuits learnt in the theory lectures.	2,3,5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	1	1	1	2	1	3	3	1
CO 2	3	2	1	1	1	2	1	3	3	1
CO 3	3	2	1	1	1	2	1	3	3	1
CO 4	3	3	3	0	0	2	0	3	3	2
CO 5	3	3	3	1	0	2	2	3	3	3
CO 6	3	3	3	2	0	3	0	3	3	3

ANALOG AND DIGITAL ELECTRONICS
(Theory 4 credits)

Analog Electronics:

Transistors Multivibrators. **[6]**

Transistor as a switch, switching times, Multivibrators – Astable, Monostable, Bistable and Schmitt Trigger.

Field Effect Transistors. **[11]**

Basic structure of the JFET, Principles of operation, Characteristic curves and parameters, Common source amplifiers, Common gate amplifier (only qualitative discussion), The MOSFET Depletion Mode and Enhancement mode, Dual-Gate MOSFET. FET Phase shift oscillator, FET as VVR and its applications in Attenuator, AGC and Voltmeter circuits.

Applications of OP-AMP. **[6]**

Active diode circuits, Intergrator, Differentiator, Comparator, Window comparator, Schmitt Trigger, Waveform generator –Square wave, Triangular and Ramp Generator and monostable.

Voltage Regulation: **[3]**

Fixed voltage regulation using IC-78 & 79 series, adjustable voltage regulators using IC LM-317.

Timers: **[4]**

IC-555 Timer : basic concept, block diagram, Monostable, Astable and Voltage controlled oscillator (VCO).

Digital Electronics:

Number system Logic. **[15]**

Binary number system, Binary to Decimal and Decimal to Binary conversion, Basic logic gates, OR, AND, NOR, NAND, and EX-OR, Bubbled OR and Bubbled AND gates. De Morgan's Law's, Boolean Algebra, NAND and NOR gates as universal building blocks in logic circuits, Sum of Products methods and Product of Sum methods of representation of logical functions. Binary addition and Subtraction, Half adder and Full adder, Multiplexer and Demultiplexer. Encoders and decoders

Logic families – DTL, TTL Standard TTL NAND gate, Schottky TTL, ECL OR and NOR gate, MOS (inverter, NAND and NOR gates) and CMOS (inverter, NAND and NOR gates).

Flip Flops and Counters. **[15]**

Basic RS FF, Clocked RS FF, JK FF, D-type and T-type FF, Master Slave Concept, 3 bit Shift register (shift left, shift right), Applications of FF's in counters, 3 bit count up/count down binary ripple counter, Mod 3, Mod 5, Mod 7 Counters, BCD Decade Counter, Cascade BCD Decade counters, Principle of digital clock.

Books and References:

1. A.P. Malvino, Electronic Principles: TMH.(2007).
2. Allen Mottershed, Electronics Devices and Circuits An Introduction: PHI (1997).
3. Millman and Halkias, Electronic Devices and Circuits, Mc Graw Hill (1967).
4. Millman and Halkias, Intergrated Electronics, TMH (1971).
5. V.K.Metha, Principles of Electronics, S.Chand & Company (2009).
6. Malvino and Leach, Digital Principles and Applications, TMH (1986).
7. R. P. Jain, Modern Digital Electronics, TMH (2003).
8. Ramakant Gayakwad, Introduction to operational amplifier, PHI.

PYC106
ANALOG AND DIGITAL ELECTRONICS
(Practical 2 credits)

Minimum of total 8 experiments, but at least 3 experiments from each section

Analog Electronics

1. Study and analysis of transistorised Multivibrators- Astable, Monostable.
2. Study and analysis of transistorised Multivibrators- Bistable, Schmitt trigger.
3. F.E.T Characteristics & F.E.T Common Source Amplifier.
4. Op-Amp as a differential (Instrumentation) amplifier and its application in temperature measurement.
5. Op-Amp as a square wave generator & integrator
6. Regulated power supply using IC LM 317 with external pass transistor.
7. Study of IC 555 as Astable & VCO / Monostable multivibrator.

Digital Electronics

8. Analog / Digital Multiplexer.
9. Verification of De Morgan Laws and Boolean Identities. (Construction using Gates).
10. Binary addition- Half adder and Full adder using logic gates.
11. NAND and NOR gates as universal building blocks.
12. Study of JK flip flop with JK FF IC's (Ripple counter and Decade counter).

Course Code: PYC 107 **Course Title:MATHEMATICAL PHYSICS & ELECTROMAGNETIC THEORY I**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand vector calculus and differential equations and their applications.	2,3
CO 2	Understand special functions like Legendre's equation, Legendre polynomials, beta and gamma functions.	2,3,5
CO 3	Understand the basic laws of electrostatics and electric fields in matter.	2,3,4
CO 4	Solve electrostatic field equations in rectangular and spherical symmetry in vacuum and dielectric media, acquires in depth knowledge microscopic theory of dielectrics, and Electrostatic energy	3,4,5
In the laboratory component of the course, the student will be able to:		
CO 5	use capacitors to measure dielectric constant and susceptibility of liquid, verify Curie -Weiss law and use ballistic galvanometer for the measurement of high and low resistance and capacitance.	4,5,6
CO 6	Solve the differential vector identities, differential equations and Fourier series applications.	4,5

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	2	2	2	2	1	3	2	3
CO 2	3	2	2	2	2	2	1	3	2	3
CO 3	3	2	2	2	2	2	1	3	2	3
CO 4	3	2	2	2	2	2	1	3	2	3
CO 5	3	2	2	2	2	2	1	3	3	3
CO 6	3	2	2	2	2	2	1	3	3	3

MATHEMATICAL PHYSICS & ELECTROMAGNETIC THEORY I
(Theory 4 credits)

MATHEMATICAL PHYSICS

Vector Analysis[15]

Vectors and scalar fields, differentiation and integration of scalar and vector fields, directional derivative, gradient, the del operator, divergence and curl, Laplacian operator, Integration of Vector Functions - Line, Surface and Volume Integrals, Gauss Divergence Theorem (without proof), Greens Theorem, Stokes Theorem (without proof), Differential vector Identities, Expression for Laplacian operator in Cartesian, spherical and cylindrical coordinates. Dirac delta function and its application. (Ref: [1,2,3,4,5]).

Differential equations [10]

Partial differentiation - definition of the partial derivative, Total differential, Chain rule, Exact and inexact differentials, Useful theorems of partial differentiation, Change of variables, Partial differential equations and separable solutions, Problems (Schaum Series).
(Ref: [1,2,3,4])

Some special functions in Mathematical Physics [5]

Introduction to Legendre's equation, Legendre polynomials and Fourier series, Introduction to beta and gamma functions. (Ref: [1,2,3,4])

ELECTROMAGNETIC THEORY I

Electrostatics [6]

Coulomb's Law, Electric Field and electrostatic potential, Continuous Charge distribution, field lines, flux and Gauss' law with applications, the electric dipole- field and potential. (Ref: [5]).

Techniques to solve electrostatic problems [8]

The electrostatic potential, Poisson's equation, Laplace's equation in one independent variable, solutions to Laplace's equation in spherical co-ordinates (zonal harmonics), conducting sphere in a uniform electric field, method of electrostatic images, point charge in front of grounded conducting plane.
(Ref: [5]).

Electric Fields in matter [6]

Polarization, Fields outside a dielectric medium, electric field inside a dielectric, Gauss's law in a dielectric, the electric displacement vector, electric susceptibility and dielectric constant. Boundary conditions on the field vectors, Dielectric sphere in a uniform electric field. (Ref: [5]).

Microscopic Theory of Dielectrics [5]

Molecular field in a dielectric, induced dipoles, A simple model, polar molecules, Langevin-Debye formula, permanent polarization, ferroelectricity. (Ref: [5]).

Work and Energy in electrostatics [5]

Work and Potential energy of discrete and continuous charge distributions, Energy density of an electric field.

Books and References

1. Charlie Harper, Introduction to Mathematical Physics, PHI, (1976)
2. H.K. Dass & R. Verma, Mathematical Physics, S. Chand.
3. Mary L Boas, Mathematical methods in physical sciences, John Wiley and sons (1983)
4. Arfken & Weber, Mathematical Methods for Physicists, Elsevier.
5. Reitz and Milford, Foundations of Electromagnetic Theory, Addision- Wesley Publishing Company.(2008)
6. David Griffiths, Introduction to Electrodynamics , Prentice Hall of India Ltd, New Delhi (1995)
7. Mahajan and Rangawala, Electricity and Magnetism, Tata McGraw-Hill Publishing Company Ltd., 1988
8. Chatopadhaya and Rakshit, Electricity and Magnetism, New Central Book Agency, (2013)

MATHEMATICAL PHYSICS & ELECTROMAGNETIC THEORY I

(Practical 2 credits)

Students must perform minimum 5 experiments from electromagnetic theory and minimum of 3 tutorials from mathematical physics.

Electromagnetic Theory I

1. Measurement of Dielectric constant of solids by using parallel plate capacitor.
2. Measurement of dielectric constant & susceptibility of liquid using two co-axial metal tubes
3. Absolute capacity by ballistic galvanometer.
4. Verification of Curie -Weiss law using a disc capacitor.
5. Equipotential lines & electric field
6. Variation of A.C. Resistance of a coil with frequency.
7. Dielectric constant K and Electric Susceptibility χ_e using series resonance method.
8. Determination of high resistance by leakage using ballistic galvanometer
9. Resistance of ballistic galvanometer by shunting.

Mathematics Physics tutorials

10. Proof of differential vector identities.
11. First order differential equation.
12. Second order differential equation.
13. Partial differential equations
14. Application of Fourier Series to solution of ODF
15. Application of Fourier Series to solution of PDE

Course Code: PYD 101 **Course Title: QUANTUM MECHANICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Familiarize with the facets of the historical development of quantum mechanics that reveal the wave properties of matter.	1,2
CO 2	Understand the concept of wave function and it's applications.	2,3,4
CO 3	Understand the Heisenberg uncertainty principle and it's applications.	2,3,4,5
CO 4	Justify validity of quantum postulates.	4,5,6
CO 5	Solve and give concise physical interpretations of the Schrödinger equation for simple systems	3,4,5,6
CO 6	Apply quantum theory to various complicated systems.	3,4,5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	2	2	2	2	1	3	2	1
CO 2	3	3	2	2	2	2	1	3	2	1
CO 3	3	3	2	2	2	2	1	3	2	1
CO 4	3	3	2	2	2	2	1	3	2	1
CO 5	3	3	2	2	2	2	1	3	2	1
CO 6	3	3	2	2	2	2	1	3	2	1

QUANTUM MECHANICS

(Theory 4 credits)

Waves and particles **[7+2T]**

De Broglie's hypothesis, Review of the Bohr's postulate about stationary states in the light of De Broglie's hypothesis, The concept of quantum (particle) nature of radiation.
Demonstration of wave nature of particles-Davisson Germer experiment, electron diffraction experiment of G.P.Thomson, Dual nature of radiation/matter. Complimentary in Duality.
(Ref: [1,2,3]).

The Wave Function **[5+2T]**

Representation of a De Broglie wave, Velocity of De Broglie wave, Construction of a wave group, Wave packet and its motion in one dimension., Group velocity and particle velocity, Max Born's interpretation of the wave function, probability concept, Acceptable wave function, Normalization of wave function.
(Ref: [1,2,3]).

Heisenberg's Uncertainty Principle **[5+2T]**

Limitation of wave mechanics to predict the physical state of a particle/system accurately. Heisenberg Uncertainty principle. Illustration by thought experiments (γ - ray microscope, single slit diffraction and double slit experiment), Applications of Heisenberg Uncertainty principle.
(Ref: [1,2,3]).

Schroedinger's Wave Equation **[12+4T]**

Wave equation for De Broglie waves and Schroedinger's time dependent wave equation, Concept of stationary states. Schroedinger's time independent equation. Postulates of Quantum mechanics, Definition of operators & their necessity, Expectation values, Extraction of information from solutions in terms of expectation values of physical variables/observable. Eigen value equation, Commutation relations.
(Ref: [1,2,3]).

Applications of Schrödinger's Time Independent Wave Equation **[16+5T]**

Free particle, Infinite square well potential: Energy eigen functions and eigen values,
One dimensional finite square step potential of height Vo: Comparison of classical and quantum mechanical results for particle energy E>Vo and E<Vo, Rectangular potential barrier and penetration through it, tunnel effect, Qualitative discussion of alpha decay, tunnel diode & scanning tunneling microscope. Simple Harmonic Oscillator – Energy eigen values and eigen functions (Operator method), Calculation of $\langle x \rangle$ and $\langle p_x \rangle$, $\langle x^2 \rangle$ and $\langle p_x^2 \rangle$. Particle in a three dimensional box, Concept of degeneracy.
(Ref: [1,2,3]).

Books and References

1. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1995).
2. Arthur Beiser, Perspectives of Modern Physics, 5th Edition, McGraw Hill (1995).
3. P.S. Bangui & others, New Course in Physics, Sheth Publishers.
4. F.K. Richtmayer, E.H.Kennard, J.N. Cooper, Introduction to Modern Physics (1969).
5. H. Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, HRW (1972).

Ghatak and Lokanathan, Quantum Mechanics, Theory and Applications, Mc Millan (2004).

Course Code: PYD 103 **Course Title: Solid State Physics**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	**Define** different types of materials and their properties.	1
CO 2	**Explain** mechanical properties of solid matter, and **relate** these to bond type. **Explain** how diffraction of electromagnetic waves on solid matter can be used to obtain lattice structure**. Explain** simple theories for conduction of heat and electrical current in metals.	2
CO 3	**Understand** and **solve** to derive classical and quantum mechanical expressions for different types of magnetic materials.	2,3
CO 4	**Classify** solid state matter according to their band gaps and study their properties.	4
CO 5	**Compare** and **justify** theory for different types of magnetic, electric and dielectric materials.	5
In the laboratory component of the course, the student will be able to:		
CO 6	**Test** few theoretical concepts learnt in the class by performing experiments in the laboratory.	5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	1	1	1	1	1	3	2	1
CO 2	3	3	2	1	1	2	1	3	2	0
CO 3	3	3	1	1	1	1	1	3	2	1
CO 4	3	3	1	1	1	1	1	3	2	1
CO 5	3	3	2	1	1	2	1	3	2	0
CO 6	3	3	2	1	1	2	1	3	3	3

SOLID STATE PHYSICS
(Theory 3 credit course)

Crystal Structure: **[10]**

Solids - Amorphous and Crystalline Materials, Lattice Translation Vectors, Basis, Unit Cell, Miller Indices, Reciprocal Lattice, Types of Lattices, Brillouin zones, Diffraction of X-rays by Crystals, Bragg's Law. (Ref: [1,3,4,5]).

Free electron theory of metals: **[5]**

Drude's Free electron model, Fermi Dirac distribution, thermionic emission, Contact potential. (Ref: [2,4,5]).

Band theory of metals: **[7]**

Electrons in periodic lattice, Kronig Penny Model (Qualitative Approach) Effective mass of electron, Concept of hole. Classification of materials based on band structure. Effect of magnetic field on electrons, Hall effect. (Ref: [2,4,5]).

Magnetic Properties of Matter: **[9]**

Diamagnetic, Paramagnetic, Ferrimagnetic and Ferromagnetic Materials. Classical Langevin Theory of diamagnetic and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. (Ref: [1,4,5]).

Dielectric Properties of Materials: **[7]**

Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, Tranverse optic modes. (Ref: [1,2,3,4]).

Ferroelectric Properties of Materials: **[7]**

Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop. (Ref: [1,2]).

Books and References:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Solid State Physics, A. J. Dekker, McMillan, 1969
3. Solid State Physics, S.O. Pillai, Mc-Graw Hill.
4. Solid State Physics, Gupta, Kumar & Sharma,
5. New Course in Physics, Gogawale & Lele, Vol. I. Sheth Publishers
6. Millman & Halkias, Electronic Devices and Circuits, Mc-Graw Hill.
7. Principles of Electronic Materials and Devices, S.O. Kasap,
8. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, PHI

9. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
10. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
11. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
12. Solid State Physics, Rita John, 2014, McGraw Hill
13. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
14. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

SOLID STATE PHYSICS

Practical (any four) 1 credit

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. Measurement of magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. Variation of Dielectric Constant of a dielectric Materials with frequency
5. To study the P E Hysteresis loop of a Ferroelectric Crystal.
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
7. To measure the resistivity of a semiconductor (Si/Ge) with temperature by any method (room temperature to 150^{o}C) and to determine its band gap.
8. To determine the Hall coefficient of a semiconductor sample.
9. Energy band gap using PN junction.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

T. Y. BSc – Semester VI

Course Code: PYC 108 **Course Title: ATOMIC AND MOLECULAR PHYSICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Show and relate the gradual development of the Atomic theory from single hydrogen atom to many electron atoms.	1,2
CO 2	Classify elements in periodic table with understanding from the cause of electron configuration.	1,2
CO 3	Understand and solve of orbital and spin magnetic moment, angular momentum, spin-orbit coupling.	2,3
CO 4	Examine the behaviour of atoms in a magnetic field and relate with proper mathematical equations.	4,5
CO 5	Be able to solve Schrodinger's equation for the Hydrogen atom- and interpret solutions in terms of three quantum numbers.	5
In the laboratory component of the course, the student will be able to:		
CO 6	Develop mathematical treatment for the Bohr atom, Zeeman effect and Raman spectra. Test few theoretical concepts learnt in the class by performing spectroscopic experiments in the laboratory.	5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	1	1	1	1	1	3	2	1
CO 2	3	3	2	1	1	2	1	3	2	0
CO 3	3	3	1	1	1	1	1	3	2	1
CO 4	3	3	1	1	1	1	1	3	2	1
CO 5	3	3	2	1	1	2	1	3	2	0
CO 6	3	3	2	1	1	2	1	3	3	3

ATOMIC AND MOLECULAR PHYSICS

Hydrogen Atom **[6]**

Schrodinger's equation for the H-atom, separation of variables, Quantum numbers-n, l, m_l, spin, magnetic moment, J and m_J, Angular momentum, Magnetic moment and Bohr magneton.
(Ref: [1,2,3]).

Many Electron Atoms **[10]**

Pauli exclusion principle and classification of elements in periodic table. Symmetric and Antisymmetric wave functions, Electron configuration, Hund's rule, Spin orbit interaction, Vector atom model, Total angular momentum, L-S coupling, J-J coupling.
(Ref: [1]).

Atomic Spectra **[8]**

Spectroscopic notation, Selection rules (derivation from transition probabilities), Alkali metal type spectra, Principal, Sharp, Diffused and Fundamental series, fine structure in alkali spectra.
(Ref: [1]).

Atoms in a Magnetic Field **[8]**

Effects of magnetic field on an atom, The Stern-Gerlach experiment, Larmor Precession, The Normal Zeeman effect, Lande 'g' factor, Zeeman pattern in a weak field (Anomalous Zeeman effect). (Ref: [1,4]).

X-ray Spectra **[6]**

Characteristic spectrum, Moseley's law, Explanation of X-ray spectra on the basis of quantum mechanics, Energy levels and characteristic X-ray lines, X-ray absorption spectra, Fluorescence and Auger effect. (Ref: [4]).

Spectra of Diatomic Molecules **[14]**

Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibration-Rotation spectra, Fortrat Parabolas and explanation of band structure on its basis, Electronic spectra
(Ref: [5,7,10]).

Raman Effect **[8]**

Raman Effect: Classical and Quantum mechanical explanation, Pure rotational Raman spectra, Vibrational Raman spectra, Rotational fine structure, Experimental set up for Raman spectroscopy.
(Ref: [10])

Books and References:

1. Arthur Beiser, Perspectives of Modern Physics, 5th Edition, McGraw Hill (1995)

2. F.K. Richtmayer, E.H.Kennard, J.N. Cooper, Introduction to Modern Physics (1969)
3. H.E.White H.Semat and J.R.Albright, Introduction to Atomic Physics, McGraw Hill Book Company (2003)
4. H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall (1972)
5. Barrow, Introduction to Molecular Physics, McGraw Hill (1962)
6. Anne P. Thorne, Spectrophysics, Chapman and Hall(1974)
7. Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012)
8. P.T. Matthews, Introduction to Quantum Mechanics, TMH (1974)
9. Ghatak and Lokanathan, Quantum Mechanics, Theory and Applications, Mc Milan (1967)
10. G. Arhuldas, Molecular Structure & Spectroscopy, PHI.

ATOMIC AND MOLECULAR PHYSICS
(Practical 2 credits)

Minimum of 8 experiments

1. To determine the wavelength of H-alpha emission line of Hydrogen atom. Hydrogen source / Rydberg Constant
2. Balmer series & Emission spectra
3. Determination of specific rotation of optically active substances.
4. To determine the value of e/m by helical method.
5. Absorption spectrum of a liquid $KMnO_4$ or KI
6. To determine the charge of an electron using Millikan oil drop apparatus
7. Resolving fine structure of Sodium D lines using Diffraction (reflection/ transmission) grating
8. Determination of Cauchy's constants of a given Flint glass prism using fine structure of Na D lines
9. To determine refractive index of liquid by hollow prism
10. To determine the absorption lines in the rotational spectrum of Iodine vapour.
11. Analysis of Rotational / Vibrational spectra to find bond length and bond strength
12. Zeeman effect
13. GM counter

Course Code: PYC 109 **Course Title: SOLID STATE DEVICES AND INSTRUMENTATION**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand the working and application of different types of diodes including photodiodes and light emitting diodes, photoconductive cell photovoltaic cell, solar cell and LCD.	1,2
CO 2	Understand the working Industrial Devices like Silicon controlled rectifier, Silicon controlled switch, Gate turn off switch, Light activated SCR, Shockley diode, Diac, Triac, Unijunction transistor (UJT).	2,3
CO 3	Learn about the principle of working of Phototransistor, Solid State Image scanners (CCD's), Basic LED TV and instruments like DC and AC ammeter/ voltmeter, Ohmmeter, Digital voltmeter, multimeter, frequency meter, CRO.	2,3,4
CO 4	Understand the working and application Sensors like strain gauges, resistance thermometer, Thermistor, capacitor, inductor, piezoelectric, and Hall Effect.	3,4,5
CO 5	Understand functioning and design of signal generators.	2,3,4,5,6
In the laboratory component of the course, the student will be able to:		
CO 6	Observe Current –Voltage characteristics and applications of few two and three terminal devices is carried out	4,5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	1	1	0	2	2	3	2	2
CO 2	3	3	0	0	0	2	1	3	2	2
CO 3	3	3	0	2	1	1	1	3	3	1
CO 4	3	3	0	1	1	1	1	3	3	2
CO 5	3	3	3	2	1	2	2	3	3	3
CO 6	3	3	3	2	1	2	1	3	3	3

SOLID STATE DEVICES AND INSTRUMENTATION
(Theory 4 credits)

Solid State Devices:

Two Terminal Devices **[10]**

Power diodes, Tunnel diodes, Varicap diodes, Schottky Barrier diode, Semiconductor photoconductive cell, Photovoltaic cell, Photodiode, Light emitting diodes (LED), Liquid Crystal display (LCD), Solar cells and Photocouplers. (Ref: [1,3]).

Industrial Devices **[15]**

Silicon controlled rectifier (SCR), SCR characteristics, rating, construction and terminal identification, SCR applications, Silicon controlled switch (SCS), Gate turn off switch (GTO), Light activated SCR (LASCR), Shockley diode, Diac, Triac, Typical Diac-Triac Phase control circuit, Unijunction transistor (UJT), Phototransistor. (Ref: [1,3]).

Image Capture Devices **[5]**

Solid State Image scanners (CCD's), Basic LED TV. (Ref: [2]).

INSTRUMENTATION:

Measuring Instruments **[12]**

Errors in measurement, Basic PMMC, Analog DC ammeter, Multirange ammeter, Universal shunt, DC & AC voltmeter, Multirange voltmeter, Extending voltmeter range, Transistor voltmeter, Ohmmeter – Series and shunt type, Multimeter, Digital voltmeter, Resolution and sensitivity of digital meters, multimeter, frequency meter, Q meter. (Ref: [6,7,8]).

Oscilloscope **[4]**

CRT, CRO block diagram (simple CRO), vertical and horizontal deflection system, Vertical amplifier, sweep generator, Delay line. (Ref: [6,7,8]).

Transducers **[10]**

Introduction, Electrical transducer, selecting a transducer, Resistive transducers, Strain gauges, resistance wire gauge, types of strain gauges, foil strain gauge, semiconductor strain gauge, Resistance thermometer, Thermistor, Inductor transducer, LVDT, Capacitive transducer, Piezo electric transducer and Hall effect transducers. (Ref: [6,7,8]).

Signal Generator **[4]**

Standard signal generator, AF sine and square wave generator, Function generator.
(Ref: [6,7]).

Books and References

Solid State Devices:

1. Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11t Ed. PHI (2009)

2. R.R. Gulati Monochrome and Colour TV, 2nd Ed., New Age International, 2005.
3. Allen Mottershed, Electronic Devices and Circuits An Introduction: PHI (1997).
4. Malvino, Electronic Principles, TMH (2007).
5. J. Millman and C. Halkias, Electronic Devices and Circuits , Mc Graw Hill (1972).
6. H. S. Kalsi, Electronic Instrumentation: TMH (2004).
7. William David Cooper, Electronic Instrunentation and Measurement Techniques, PHI (2003).
8. A. K. Sawhney A course in Electrical and Electronic Measurement, Dhanpat Rai and Co.(2001).

PYC109

SOLID STATE DEVICES AND INSTRUMENTATION

(Practical 2 credits)

Minimum of 8 experiments

1. Light emitting diode V-I characteristics, determination of Planck's constant & Energy gap
2. Photodiode /Photo-transistor: Characteristics, Variation of conductivity with Intensity and spectral response,
   Application as a switch
3. UJT characteristics and its use in relaxation oscillator.
4. SCR characteristics and gate-controlled ac half wave rectifier.
5. DIAC& TRIAC Characteristics, Gate triggering application.
6. Design and Construction of analog two range voltmeter & ohmmeter.
7. Solar cell characteristics (V-I at different wavelengths), spectral response, maximum power point
8. Determination of transition capacitance of Varactor diode as function of reverse bias voltage and use as
   a variable/tuning capacitor in any one application. (Type CD91 or Bel 90 or equivalent).
9. Crystal Oscillator: Determination of velocity of ultrasonic waves in a liquid medium, different liquids/ same liquid
   at different temperatures.
10. Study of strain Gauges to determine Young's Modulus.
11. Study of LVDT - calibration and its use in any one application.
12. Signal Generator XR 2206

Course Code: PYC 110 **Course Title: ELECTROMAGNETIC THEORY II & THEORY OF RELATIVITY**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Understand magnetic potential magnetic dipoles and properties of magnetic material.	2,3
CO 2	Understand and formulate theory for magnetism.	3,6
CO 3	Obtain Maxwell's equation and use it for obtain Ampere's Law and other applications.	3,4,5,6
CO 4	Understand special theory of relativity	2,3,4,5,6
In the laboratory component of the course, the student will be able to:		
CO 5	Test various concepts learnt in the theory lectures.	4,5
CO 6	Solve problems related using concept of special theory of relativity	3,4,5

PO / CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	2	2	2	2	1	3	2	1
CO 2	3	3	3	2	2	2	1	3	2	1
CO 3	3	3	3	2	2	2	1	3	2	2
CO 4	3	3	2	2	2	2	1	3	3	2
CO 5	3	3	2	2	2	2	1	3	3	3
CO 6	3	3	2	2	2	2	1	3	3	3

ELECTROMAGNETIC THEORY II & THEORY OF RELATIVITY
(Theory 4 credits)

Steady currents and their magnetic fields **[8]**

Steady currents, current density, Biot-savart's law and its applications, Ampere's circuital law, magnetic vector potential, magnetic field of a distant circuit, magnetic dipoles, dipole moment and the field of a point magnetic dipole, magnetic scalar potential. (Ref: [1]).

Magnetic Field in material media **[12]**

Magnetization, magnetic field produced by magnetized material, magnetic pole density, sources of the magnetic field, magnetic intensity H (Auxiliary magnetic field), The field equations, magnetic susceptibility and permeability, Hysteresis, Boundary conditions on **B** and **H** vectors, current circuits containing magnetic media, Magnetic circuits, Magnetic circuits containing permanent magnets. (Ref: [1]).

Microscopic Theory of Magnetism **[6]**

Molecular field inside matter, Origin of Diamagnetism, Origin of Paramagnetism, theory of Ferromagnetism, Ferromagnetic domains, ferrites. (Ref: [1]).

Magnetic Energy **[5]**

Magnetic energy of coupled circuits, Energy density in the magnetic field, Hysteresis Loss. (Ref: [1]).

Maxwell's Equations **[6]**

Faraday's Law of electromagnetic induction, Generalization of Ampere's Law- Displacement current, Maxwell's equations and their empirical basis, Electromagnetic energy-Poyntings theorem. (Ref: [1]).

Experimental Background of the Theory of Special Relativity **[7]**

Galilean Transformations, Newtonian Relativity, Michelson Morley Experiment, Attempts to preserve the concept of a preferred Ether frame, (Lorentz-Fitzgerald Hypothesis), Einstein's Postulates of Special Relativity. (Ref: [6,7])

Relativistic Kinematics **[6]**

Relativity of Simultaneity , Derivation of the Lorentz Transformations and derivation of its consequences such as Length Contraction and Time dilation, Relativistic Addition of velocities, Aberration and Doppler Effect. (Ref: [6,7])

Relativistic Dynamics **[10]**

Dynamics and relativity, Need to redefine momentum, Relativistic Momentum, Relativistic Force law, and dynamics of a single particle, Longitudinal and transverse mass, Equivalence of mass and energy $E= Mc^2$, Lorentz transformation of Momentum, Energy, Mass and Force, Twin Paradox (qualitative approach). (Ref: [6,7])

Books and Reference Books: -

1. Reitz and Milford, Foundations of Electromagnetic Theory, Addision- Wesley Publishing Company (2008).
2. David Griffiths, Introduction to Electrodynamics , Prentice Hall of India Ltd, New Delhi (1995).
3. Mahajan and Rangawala, Electricity and Magnetism, TMH, , (1988).
4. Chatopadhaya and Rakshit, Electricity and Magnetism, New Central Book Agency, (2013).
5. P. Lorrain, D. Corson, Electromagnetic Fields and Waves, 1988.
6. Robert Resnik, Introduction to Special Relativity Wiley(1968).
7. N.C. Garach, Understanding Relativity, Vol. I, Sheth Publishers

ELECTROMAGNETIC THEORY II & THEORY OF RELATIVITY
(Practical 2 credits)

Students must perform minimum 6 experiments and 2 tutorials.

Experiments

1. Measurement of Core losses and copper losses in a transformer
2. Measurement of Hysteresis loss using CRO.
3. Hysteresis by magnetometer
4. To study Hall effect, measurement of hall coefficient and its application as a transducer
5. Self inductance: Rayleigh's method
6. Mutual inductance by ballistic galvanometer.
7. Mutually coupled tuned series LCR circuits
8. Magnetic circuit – determination of flux and reluctance
9. Helmholtz coil & measurement of Faraday's number
10. Magnetic susceptibility of paramagnetic substances by Guoy's Balance

Tutorials

11. Problems on length contraction/ time dilation
12. Problems on relativistic velocity addition
13. Twin Paradox
14. Pole –Barn Paradox

Course Code: PYD 106 **Course Title: NUCLEAR PHYSICS**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Demonstrate a knowledge of fundamental aspects of the structure of the nucleus.	1,2
CO 2	Explain the phenomenon of radioactive decay, nuclear reactions.	2
CO 3	Have knowledge of the different nuclear models.	2,3,4,5
CO 4	Explain the nuclear reaction at the reactor and the functioning of the nuclear reactor.	2,3
CO 5	Cite the contribution of Indian science community towards the building of nuclear science in our country and abroad.	1,2
CO 6	Explain theories behind different detectors used for detecting the neutral nuclear radiations.	5,6

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	2	1	2	1	2	2	3	2	1
CO 2	3	2	2	1	1	2	1	3	2	1
CO 3	3	3	1	1	1	1	1	3	2	1
CO 4	3	3	1	1	1	1	1	3	2	1
CO 5	3	3	2	1	1	2	1	3	2	1
CO 6	3	3	2	1	1	2	1	3	3	1

NUCLEAR PHYSICS
(Theory 4 credits)

Nuclear Properties **[5]**

Constituents of nucleus, Isotope, Isotone & Isobar, Radii & Density of nucleus, Definition of a.m.u, Mass of nuclei, Mass defect, Packing fraction, Binding energy, Stability of nuclei, Magnetic and electrical dipole moments.

Nuclear forces **[5]**

Main characteristics of nuclear forces; Deuteron problem that reveals tensor/ non-central nature of nuclear force, meson theory of nuclear forces, estimation of mass of meson using Heisenberg's Uncertainity Principle; Yukawa potential.

Radioactivity **[10]**

Law of radioactive decay; Derivation of expression for exponential decay, half & mean life, statistical nature of radioactive phenomenon, Problems, Successive radioactive transformation (A→B→C type); ideal, transient and secular equilibrium; radioactive series; Radioactive-carbon dating, Applications, Problems

Nuclear Reactions [8]

Artificial transmutation, Definition, Compound nucleus, Types of nuclear reactions, Conservation laws, Energetics of nuclear reactions, Q value, Threshold energy of endoergic reactions, cross sections of nuclear reactions, Discovery of neutron, Determination of neutron mass, Problems

Radioactive Decay **[12]**

Alpha decay: Velocity and energy of alpha particles; Alpha disintegration energy; Geiger-Nuttal law, alpha spectra and fine structure; short range and long range alpha particles; Gamow theory of alpha decay (qualitative treatment);

Beta decay: Types of beta decay; energies of beta decay; the continuous beta particle spectrum; difficulties in understanding the spectrum; Pauli's neutrino hypothesis; Fermi's theory of beta decay (qualitative treatment); K capture

Gamma decay: Origin of the decay; internal conversion and nuclear isomerism.

Nuclear Models **[10]**

Liquid drop model; compound nucleus theory; analogy between liquid drop and the nucleus; Wiezsacker's semi empirical mass formula; mass parabolas; prediction of stability against decay for members of an isobaric family; spontaneous and induced fission; Bohr-Wheeler theory of nuclear fission and condition for spontaneous fission on the basis of Z/A; Estimation of energy released from binding energy curve and from energy – mass equivalence.

Nuclear Shell Model: Experimental evidence for magic numbers; evidences that led to shell model, main assumptions of the single particle shell model; Jensen-Mayer scheme (no derivation); predictions of the shell model- Spin and Parity

Nuclear energy [7]

Neutron induced fission; chain reaction; mass yield in an asymmetrical fission; neutron cycle in a thermal nuclear reactor (the four factor formula) Structure of nuclear reactor and it's working; principle of a breeder reactor; Nuclear Program in India- Nuclear Energy , Nuclear test (Pokhran- I & II), Nuclear submarine

Detection of nuclear radiation [3]

Ionization chamber; proportional chamber; Geiger Muller counter; Photographic emulsions; Semiconductor detectors

Text Books / References:

1. Irving Kaplan, Nuclear Physics, Narosa Publishing House
2. Atomic and Nuclear Physics, A.B.Gupta and Dipak Ghosh, Books and Allied (P) Ltd
3. Arthur Beiser, Perspectives of Modern Physics, 5th Edition, McGraw Hill (1995)
4. F.K. Richtmyer, E.H. Kennord, J.N. Cooper, Introduction to Modern Physics, (6th Ed.) McGraw Hill (1997).
5. S.B. Patel, Nuclear Physics, TMH ().
6. Nuclear Physics , K. Ilangovan, MJP publisher.

Course Code: PYD 109 **Course Title: PROJECT**		
On completion of the course, the students will be able to:		**Cognitive level**
CO 1	Identify a research project based on a relevant physics topic.	1,4,6
CO 2	Conduct the necessary literature review.	1,4
CO 3	Write a synopsis of the project proposal	1,2,3
CO 4	Create and construct the project.	6
CO 5	Obtain and analyse the experimental data.	3,4,5
CO 6	Organise and write a project report.	2,3,5

PO / **CO**	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PSO1***	***PSO2***	***PSO3***
CO 1	3	3	3	2	3	3	2	3	3	3
CO 2	3	3	3	2	3	3	2	3	3	3
CO 3	3	3	3	2	3	3	2	3	3	3
CO 4	3	3	3	2	3	3	2	3	3	3
CO 5	3	3	3	2	3	3	2	3	3	3
CO 6	3	3	3	2	3	3	2	3	3	3