NEP and Learning Outcome - based Curriculum Framework (LOCF)

For

B.Sc. Physics (Single Major)

(To be effective from the Academic Session 2024-25)

Department of Physics

Gurugram University, Gurugram

(A State Govt. University Established Under Haryana Act17 of 2017)

Scheme for B.Sc. Physics (Single Major)

Semester I

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A1	Mechanics	240/PHY/CC101	3	0	2	3	0	1	4	25	50	5	20	100
CC-A2	Waves and Oscillations	240/PHY/CC102	3	0	2	3	0	1	4	25	50	5	20	100
CC-A3	Mathematical Physics-I	240/PHY/CC103	4	0	0	4	0	0	4	30	70	0	0	0
Minor / Vocational Course(s)														
MIC-1														
Multidisciplinary Course(s)														
MDC-1														
Ability Enhancement Course (s)														
AEC-1														
Skill Enhancement Course(s)														
SEC-1														
Value-added Course(s)														
VAC-1														

Semester II

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A4	Electricity and Magnetism	240/PHY/ CC201	3	0	2	3	0	1	4	25	50	5	20	100
CC-A5	Elements of Modern Physics	240/PHY/ CC202	3	0	2	3	0	1	4	25	50	5	20	100
CC-A6	Electronics-I	240/PHY/ CC203	3	0	2	3	0	1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
MIC-2														
Multidisciplinary Course(s)														
MDC-2														
Ability Enhancement Course(s)														
AEC-2														
Skill Enhancement Course(s)														
SEC-2														
Value-added Course(s)														
VAC-2														

Semester III

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A7	Quantum-I	240/PHY/ CC301	3	0	2	3	0	1	4	25	50	5	20	100
CC-A8	Electromagnetic Theory	240/PHY/ CC302	3	0	2	3	0	1	4	25	50	5	20	100
CC-A9	Physics of Semiconductor Devices	240/PHY/ CC303	3	0	2	3	0	1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
MIC-3														
Multidisciplinary Course(s)														
MDC-3														
Ability Enhancement Course(s)														
AEC-3														

Semester IV

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A10	Quantum Mechanics -II	240/PHY/ CC401	3	0	2	3	0	1	4	25	50	5	20	100
CC-A11	Optics	240/PHY/ CC402	3	0	2	3	0	1	4	25	50	5	20	100
CC-A12	Mathematical Physics-II	240/PHY/ CC403	3	0	2	3	0	1	4	25	50	5	20	100
Minor/ vocational Course(s)														
MIC/VOC-4														
Ability Enhancement Course(s)														
AEC-4														
Value-added Course(s)														
VAC-3														

Semester V

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A13	Heat and Thermodynamics	240/PHY/ CC501	3	0	2	3	0	1	4	25	50	5	20	100
CC-A14	Solid State Physics	240/PHY/ CC502	3	0	2	3	0	1	4	25	50	5	20	100
CC-A15	Nuclear and Particle Physics	240/PHY/ CC503	3	0	2	3	0	1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
MIC-5														
Skill Enhancement Course(s)														
Internship	Internship								4					100

Semester VI

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A16	Classical Mechanics	240/PHY/ CC601	3	0	2	3	0	1	4	25	50	5	20	100
CC-A17	Atomic & Molecular Physics	240/PHY/ CC602	3	0	2	3	0	1	4	25	50	5	20	100
CC-A18	Statistical Mechanics	240/PHY/ CC603	3	0	0	3	0	0	3	25	50	0	0	75
Minor/ Vocational Course(s)														
MIC-6														
MIC-7														
Skill Enhancement Course(s)														
SEC-3														

1. ***The curriculum for semesters 7th, 8th, 9th and 10th will be provided in due course of time.***
2. ***The MDC, AEC, SEC, and VAC courses could be chosen from the university pool or from Departmental shortlisted Swayam-NPTEL Course list.***

Scheme of Programme for B.Sc. (Physics)

List of Core Courses (Semester Wise)

Semester I

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A1	Mechanics	240/PHY/CC101	3	0	2	3	0	1	4	25	50	5	20	100
CC-A2	Waves and Oscillations	240/PHY/CC102	3	0	2	3	0	1	4	25	50	5	20	100
CC-A3	Mathematical Physics-I	240/PHY/CC103	4	0	0	4	0	0	4	30	70	0	0	0

Semester II

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A4	Electricity and Magnetism	240/PHY/CC201	3	0	2	3	0	1	4	25	50	5	20	100
CC-A5	Elements of Modern Physics	240/PHY/CC202	3	0	2	3	0	1	4	25	50	5	20	100
CC-A6	Electronics-I	240/PHY/CC203	3	0	2	3	0	1	4	25	50	5	20	100

Semester III

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A7	Quantum-I	240/PHY/ CC301	3	0	2	3	0	1	4	25	50	5	20	100
CC-A8	Electromagnetic Theory	240/PHY/ CC302	3	0	2	3	0	1	4	25	50	5	20	100
CC-A9	Physics of Semiconductor Devices	240/PHY/ CC303	3	0	2	3	0	1	4	25	50	5	20	100

Semester IV

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A10	Quantum Mechanics -II	240/PHY/ CC401	3	0	2	3	0	1	4	25	50	5	20	100
CC-A11	Optics	240/PHY/ CC402	3	0	2	3	0	1	4	25	50	5	20	100
CC-A12	Mathematical Physics-II	240/PHY/ CC403	3	0	2	3	0	1	4	25	50	5	20	100

Semester V

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A16	Classical Mechanics	240/PHY/ CC601	3	0	2	3	0	1	4	25	50	5	20	100
CC-A17	Atomic & Molecular Physics	240/PHY/ CC602	3	0	2	3	0	1	4	25	50	5	20	100
CC-A18	Statistical Mechanics	240/PHY/ CC603	3	0	0	3	0	0	3	25	50	0	0	75

Semester VI

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A13	Heat and Thermodynamics	240/PHY/ CC501	3	0	2	3	0	1	4	25	50	5	20	100
CC-A14	Solid State Physics	240/PHY/ CC502	3	0	2	3	0	1	4	25	50	5	20	100
CC-A15	Nuclear and Particle Physics	240/PHY/ CC503	3	0	2	3	0	1	4	25	50	5	20	100

3. ***The curriculum for semesters 7^{th}, 8^{th}, 9^{th} and 10^{th} will be provided in due course of time.***
4. ***The MDC, AEC, SEC, and VAC courses could be chosen from the university pool or from Departmental shortlisted Swayam-NPTEL Course list.***

SEMESTER-I

Course ID - 240/PHY/CC101
MECHANICS

Marks (Theory): 50 **Credits :3 (45 Lectures)**
Marks (Internal Assessment): 25 **Time: 3 Hrs.**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20 % numerical problems in the relevant papers.

Course Objective: The objective of this course is to teach the students fundamentals of Newtonian Mechanics, rigid body dynamic, concept of inverse square force and the special theory of relativity.	**Course Outcome:** The student will be able to understand the concept and the applications of Newtonian mechanics. The origin and applications of special theory of relativity should be clear to students.

Unit - I

Time derivative of a vector, Motion in Plane Polar coordinates, Newton's Law, Dynamics of a system of particles, Principle of conservation of momentum, Impulse, Work and Kinetic Energy Theorem, Conservative Forces and examples (Gravitational and electrostatic), Non-Conservative Forces and examples (velocity-dependent forces e.g. frictional force, magnetic force). Potential Energy, Energy diagram, Stable, Unstable and Neutral Equilibrium, Force as gradient of the potential energy

Collisions: Elastic and Inelastic Collisions between two Spherical Bodies, Kinematics of $2 \rightarrow 2$ scattering in the Centre of Mass and Laboratory Frames.

Unit - II

Angular momentum of a particle and system of particles, Torque, Principle of conservation of Angular Momentum, Rotation about a fixed axis, Determination of Moment of Inertia of symmetric Rigid Bodies (rectangular, cylindrical and spherical) using Parallel and Perpendicular axes theorems, Kinetic energy of rotation, Motion involving both translation and rotation, Vector Nature of Angular Velocity and Angular Momentum, Gyroscope

Non-Inertial Systems: Non-inertial frames and fictitious forces, Uniformly rotating frame. Centrifugal force, Coriolis force and its applications.

Unit - III

Central forces, Law of conservation of Angular Momentum for Central Forces, Two-Body problem and its reduction to equivalent One-Body problem and its solution, Concept of effective potential energy and stability of orbits for central potentials, Discussion on Trajectories, Solution of Kepler's Problem, Kepler's Laws for planetary motion, Orbit for Artificial Satellites.

Unit - IV

Inertial and Non-Inertial Frames, Invariance of Newton's Laws of motion under Galilean transformations, Postulates of Special Theory of Relativity, Lorentz Transformations, simultaneity, Length Contraction, Time Dilation, Proper Length and Proper Time, Life Time of a Relativistic Particle (for example Muon Decay Time and Decay Length), Relativistic Transformation of Velocity and Acceleration, Variation of Mass with Velocity, Mass-Energy Equivalence.

References:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, McGraw-Hill.
2. Mechanics, Berkeley Physics, Vol.1, C. Kittel, W. Knight, et.al., Tata McGraw-Hill.
3. Fundamentals of Physics, R. Resnick, D. Halliday and J. Walker, Wiley Publications.
4. Mechanics, D.S. Mathur, S. Chand and Company Limited.
5. Feynman Lecture Series, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, Pearson Education.

MECHANICS (LAB)

Marks (External): 20 **Credits: 1 (30 Hrs.)**
Marks (Internal Assessment): 05 **Time: 3 Hrs.**

1. Each student should perform at least five experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. Measurements of Length (or Diameter) using Vernier Caliper, Screw Gauge and Travelling Microscope.
2. To Study the Random Error in observations.
3. To determine the Height of a Building using a Sextant.
4. To determine the vertical distance between two given points using Sextant.

5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.

References:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. BSc Practical Physics, Harnam Singh, S. Chand Publications, 2020.
3. BSc Practical Physics, Geeta Sanon, R. Chand Publications, 2020.
4. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 1511, Kitab Mahal.

Course ID - 240/PHY/CC102

WAVES AND OSCILLATIONS

Marks (Theory): 50 **Credits :3 (45 Lectures)**
Marks (Internal Assessment): 25 **Time: 3 Hrs.**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The objective of this course is to introduce the basics of oscillatory motion, wave motion, transmission linens, ultrasonic and their applications.	**Course Outcome:** After completion of this course, students will be familiar with the concept of wave and oscillations.

UNIT – I

Simple Harmonic Motion (SHM): Oscillatory motion, Oscillations of a Spring-Mass System; Simple harmonic oscillator: Equation of motion, solution, characteristics and energy stored; Examples of Physical Systems Executing SHM: Simple Pendulum, Compound Pendulum, LC-

Circuit; Principle of Superposition; Superposition of Two Collinear Harmonic Oscillations of Same/Different Frequencies; Beats; Superposition of Two Perpendicular Simple Harmonic Oscillations of Same/Different Frequencies and Lissajous Figures.

UNIT – II

Damped Oscillations and Forced Oscillation: Equation of Motion of a Damped Oscillator and its Solutions; Heavy Damping; Critical Damping; Weak Damping and its Characteristics: Logarithmic Decrement, Relaxation Time, Quality Factor; Forced Oscillator: Differential Equation and its Solution, Resonance, Power Absorbed; Quality Factor.

UNIT – III

Coupled Oscillations: Coupled Oscillator comprising Two Oscillators and its Solution; Normal Coordinates; Degrees of Freedom and Normal Modes of Vibration, Energy relations in Coupled Oscillations, Many Coupled Oscillators.

UNIT – IV

Waves: Waves in One Dimension; Superposition of waves; Stationary Waves; Waves on a Stretched String with Fixed Ends; Phase Velocity and Group Velocity; The Doppler Effect.

References:

1. Vibrations and Waves by A. P. French. (CBS Pub. and Dist., 1987).
2. Wave and Oscillation by W. F. Smith (OUP USA, 2010).
3. The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988).
4. The Physics of Vibrations and Waves by H. J. Pain (Wiley, 2006).
5. An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973).

WAVES AND OSCILLATIONS (LAB)

Marks (External): 20 **Credits: 1 (30 Hrs.)**
Marks (Internal Assessment): 05 **Time: 3 Hrs.**

1. Each student should perform at least five experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. Estimate limits on angular displacement for SHM by measuring the time period at different angular displacements and compare it with the expected value of time period for SHM using Bar Pendulum.
2. To determine the value of acceleration due to gravity (g) using bar pendulum.
3. To study the damped oscillations using bar pendulum.
4. To study the effect of area of the damper on damped oscillations. Also plot amplitude as a function of time and determine the damping coefficient and Q factor for different dampers.
5. To determine the value of acceleration due to gravity using Kater's pendulum for
   (a) $T1 \approx T2$ and (b) $T1 \neq T2$
   and discuss the relative merits of both cases by estimation of error in the two cases.
6. Understand the applications of CRO by measuring voltage and time period of a periodic waveform using CRO.
7. To study the superposition of two perpendicular simple harmonic oscillations using CRO (Lissajous figures).
8. To calculate g, spring constant and mass of a spring using static and dynamic methods.
9. To calculate spring constant of series and parallel combination of two springs.
10. To determine the frequency of an electrically maintained tuning fork by Melde‘s experiment and to verify λ^2 –T Law.

References:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3. Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4. A Text Book of Practical Physics, Vol I and II, Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5. An Introduction to Error Analysis: The study of uncertainties in Physical Measurements, J. R. Taylor, 1997, University Science Books List of experiments.

Course ID - 240/PHY/CC103

MATHEMATICAL PHYSICS-I

Marks (Theory): 70 **Credits: 4 (60 Lectures)**
Marks (Internal Assessment): 30 **Time: 3 Hrs.**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of seven short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The present course introduces about the vector calculus, differential equation and Curvilinear Coordinates and their applications. It also develops an understanding of Special mathematical functions required for advanced physics problems.	**Course Outcome:** After completing this course, students would be able to deal with mathematics that appears in other papers such as Classical Mechanics, Quantum Mechanics, Nuclear Physics, Condensed Matter Physics, etc.

Unit - I

Calculus: Limit, continuity and differentiability of a function, geometrical significance of derivative, successive differentiation, Leibnitz theorem, partial derivatives, total differential, Approximations: Binomial & Taylor Series.

Unit - II

Ordinary Differential Equations: First order differential equations of degree one and those reducible to this form, Homogeneous differential equations of second order with constant coefficients, Wronskian and linearly independent functions. Complete Solution, complimentary function, particular integral and general solution.

Unit - III

Vector Calculus: Scalar and vector function, del operator, gradient of a scalar field, Divergence and curl of a vector field, Laplacian operator, Line, surface and volume integrals of vector fields. Flux of a vector field. Gauss divergence theorem, Green's and Stokes' Theorems and their applications.

Unit - IV

Curvilinear Coordinates: Orthogonal Curvilinear Coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and cylindrical Coordinate systems, transformation of Cartesian coordinates into spherical and cylindrical coordinates

References:

1. Mathematical Methods for Physicists, G. B. Arfken, H. J. Weber, F. E. Harris,2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A.Coddington, 2009, PHI learning
3. Mathematical Physics, Goswami, 1st edition, Cengage Learning
4. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
5. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

Course ID - 240/PHY/MI101

BASIC INSTRUMENTATION SKILLS (LAB)

Marks (External): 35 **Credits: 2(60 Hrs.)**
Marks (Internal Assessment): 1**5** **Time: 3 Hrs.**

1. Each student should perform at-least eight experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. To find the least count of vernier caliper and screw gauge.
2. To find the resistance of a resistor using color coding and multimeter.
3. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
4. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
5. To measure Q of a coil and its dependence on frequency, using a Q- meter.
6. To observe sine wave, square wave, triangular wave and ramp waveforms on the C.R.O. and to measure amplitude and frequency of the waveforms.
7. Measurement of time period, frequency, average period using universal counter/ frequency counter.
8. Measurement of rise, fall and delay times using an Oscilloscope.

9. Measurement of R, L and C using a LCR bridge/ universal bridge.
10. To study the variation in current and voltage in a series LCR circuit and hence determine the resonant frequency of the circuit
11. To study the variation in current and voltage in a parallel LCR circuit and hence determine the resonant frequency of the circuit
12. To study the effect of voltmeter resistance on voltage measurement.

References:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co. Performance and design of AC machines - M G Say ELBS Edn.
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. Logic circuit design, Shimon P. Vingron, 2012, Springer.
3. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
4. Electronic Devices and circuits, S. Salivahanan & N. S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.

SEMESTER II

Course ID - 240/PHY/CC201

ELECTRICITY AND MAGNETISM

Marks (Theory): 50 **Credits :3 (45 Lectures)**
Marks (Internal Assessment): 25 **Time: 3 Hrs.**

Note: The paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of seven short answer type questions, each of two marks. The rest of the eight questions are to be set uniformly, with two questions from each unit selected. A student is required to attempt five questions, selecting one from each unit along with compulsory question no 1. The question paper shall contain 20% numerical problems in the relevant papers.

Course Objective: The course on electricity and magnetism deals with Coulomb's law, the electric field, potential formulation of electrostatic, capacitors, magnetism, and magnetic materials, along with the application of these concepts. The physical context and derivation of Maxwell equations is covered.	**Course Outcome:** The student will be able to understand Gauss's Divergence theorem, Stokes's theorem in dielectrics, and the electrical and magnetic properties of materials. The origin and applications of Maxwell's equations should be clear to students.

UNIT-I

Electrostatics: Electric field, Electric field lines, Electric flux, Divergence and curl of electrostatic field, Gauss' Law with applications, Conservative nature of Electrostatic Field, Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Electrostatic energy of system of charges, Energy per unit volume in electrostatic field, Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Surface charge and force on a conductor, Laplace's and Poisson equations, Laplace equation in three dimension, The Uniqueness Theorems.

UNIT-II

The method of images: Point charge in the presence of grounded conducting sphere, Solution of Laplace equation by separation of variables for Cartesian and spherical coordinates, Multipole expansion of potential due to arbitrary charge distribution.

Dielectric Properties: Dielectric medium, Polarization, Bound charges in a polarized dielectric and their physical interpretation, Electric displacement, Gauss's theorem in dielectrics, Linear Dielectrics, Susceptibility, Permittivity & Dielectric constants, Boundary value problems with dielectrics.

UNIT-III

Magnetism: Lorentz force law, Magnetic forces, Magnetostatics: Biot-Savart's law and its applications (1) straight conductor (2) circular coil (3) solenoid carrying current, Divergence

and curl of the magnetic field, Ampère's circuital law and its applications for simple current configurations, Magnetic vector potential.
Electromagnetic Induction: Faraday's experiments on induction, Faraday's Law, Induced Electric field, Self and Mutual inductance, Energy in magnetic fields.

UNIT-IV

Magnetic Properties of Matter: Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H, M, Para-, Dia- and Ferromagnetism, B-H curve and hysteresis
Maxwell's Equations: Electrodynamics before Maxwell. Maxwell's fixing of Ampere's law, Maxwell's equations in vacuum and linear dielectrics

References:

1. D.J. Griffith, Introduction to Electrodynamics, Pearson Publication
2. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
3. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

ELECTRICITY AND MAGNETISM (LAB)

Marks (External): 20 **Credits: 1 (30 Hrs.)**
Marks (Internal Assessment): 05 **Time: 3 Hrs.**

1. Each student should perform at least five experiments.
2. The students are required to calculate the error involved in a particular experiment.
3. List of experiments may vary.

List of Experiments:

1. To determine an unknown Low Resistance using Potentiometer.
2. To determine an unknown Low Resistance using Carey Foster's Bridge.

3. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
4. To determine self-inductance of a coil by Rayleigh's method.
5. e/m measurement by Thomson method
6. To determine the mutual inductance of two coils
7. B-H curves for soft and hard ferromagnetic materials.
8. Measurement of self-inductance of a coil by Owen's Bridge

References:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. BSc Practical Physics, Geeta Sanon, R.Chand Publications, 2020.
3. BSc Practical Physics, Harnam Singh, S. Chand Publications, 2020.
4. A Text Book of Practical Physics, I.Prakash &Ramakrishna, 11th Ed., 1511,Kitab Mahal
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
6. Engineering Practical Physics, S.Panigrahi and B.Mallick, 1515, Cengage Learning.

Course ID - 240/PHY/CC202

ELEMENTS OF MODERN PHYSICS

Max. Marks: 50 **Credit: 3**
Internal Assessment: 25 **Time: 3 Hours**

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory.

Course Outcomes:

After successful completion of the course on Modern Physics, a student will be able to:

- *Understand the quantum theory of light and wave-particle duality.*

- *Describe Heisenberg uncertainty principle and linear superposition principle.*
- *Solve the Schrödinger equation for simple systems and interpret wave functions in terms of probabilities and normalization.*
- *Distinguish between different types of radioactive decays.*

Unit-I

Blackbody Radiation (observations and models), Plank's proposition and quantum theory of light, Photoelectric effect, X-rays, X-ray production, Compton scattering, Pair Production, De Broglie Waves, Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and the relation between them. Two-Slit experiment with electrons, Probability, Wave amplitude and wave functions, Rutherford Model, Hydrogen spectra and Bohr model of atom, Explanation of Hydrogen spectra, Nuclear mass effect on spectra of Atoms.

Unit-II

Position measurement- gamma-ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables, Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle application to virtual particles and range of interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Unit-III

Solution of Schrodinger equation for one-dimensional problems: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

Unit-IV

Nuclear Decay: Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta-decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma-ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

References/Books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, M. A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, T. A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course, Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

ELEMENTS OF MODERN PHYSICS (LAB)

Marks (Internal): 5 **Credits: 1**

Marks (End Semester exam): 20 **Time: 3 Hours**

Students assigned the Elements of Modern Physics laboratory work will perform at least 5 experiments of the following sections:

1. Demonstration of energy quantization using the Franck-Hertz Experiment.
2. To determine the wavelength of laser light using Michelson interferometer experiment.
3. To determine the value of Planck's constant using photocell/LED.
4. To determine the e/m ratio of an electron using Magnetron.
5. To study Hall Effect and to determine Hall coefficient.
6. To verify the existence of different harmonics and measure their relative amplitudes in a complex wave using CRO (square, clipped sine wave, triangular wave, etc.).
7. To determine the ionization potential of mercury.
8. To determine the half-life of Indium.
9. Statistics using G. M. Counter.
10. Thickness of Al Sheet using G. M. Counter.

Course ID - 240/PHY/CC203

ELECTRONICS-I

Max. Marks: 50 **Credit: 3**
Internal Assessment: 25 **Time: 3 Hours**

UNIT-I

Ideal constant-voltage and constant-current Sources, Kirchhoff's Current Law & Kirchhoff's Voltage Law, Mesh & Node Analysis, Thevenin theorem, Norton theorem, Star Delta Transformation, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem, Applications to DC circuits.

UNIT-II

Concept of feedback in amplifier, Type of feedback, Small signal amplifiers, Analysis of stage amplifier by Graphical and Equivalent Circuit methods, Requirement of multistage amplifiers, Gain of multistage amplifier, Coupling of two stages, Frequency response of RC-coupled amplifiers, Distortion in amplifier, Classification of amplifiers, Power amplifier, Push-pull amplifier, Voltage gain in feedback amplifier, Negative feedback and its advantages, Classification of oscillators, LC and RC oscillators.

UNIT-III

Graphical Analysis of the CE Configuration, Two-port Devices and the Hybrid Model, Transistor Hybrid Model, Conversion Formulas for the Parameters of the Three Transistor Configurations, Analysis of a Transistor Amplifier Circuit Using h Parameters, The Emitter Follower, Comparison of Transistor Amplifier Configurations, Linear Analysis of a Transistor Circuit, Cascading Transistor Amplifiers, Simplified Common-emitter Hybrid Model, The Common-emitter Amplifier with an Emitter Resistance.

UNIT-IV

Integrated Circuits (IC): Fabrication and Characteristics: Integrated circuit Technology, Basic monolithic IC, Epitaxial Growth, Masking and Etching, Diffusion of impurities, Transistors for Monolithic circuits, Monolithic diodes, Integrated resistors, Integrated capacitors and inductors, Large scale and medium scale integration (LSI and MSI), Metal Semiconductor contacts

Reference Books:

1. Basic Electronics and Linear Circuits, N. N. Bhargava et. al., 2nd Edition, McGraw Hill Education, India
2. A textbook in Electrical Technology, B. L. Theraja, S. Chand & Co.
3. Circuit and Networks, 2nd Edition, A Sudhakar and Shyammohan S Palli, Tata McGraw-Hill.
4. Integrated Electronics by Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education, India.

Electronics-I (LAB)

Marks (Internal): 5 **Credits: 1**

Marks (End Semester exam): 20 **Time: 3 Hours**

Students assigned the Elements of Electronics-I laboratory work will perform at least 5 experiments of the following sections:

List of Experiments:

1. Verify Thevenin and Norton Network Theorem
2. To verify the Superposition, and Maximum power transfer theorems.
3. Study frequency response of R-C Coupled Amplifier
4. Study characteristics of a Push-Pull Amplifier
5. Study a LC/RC Oscillator using transistors
6. Study of Analog Communication System.
7. Study of NPN transistor as Amplifier.
8. Study of PNP transistor as Amplifier.
9. Study of Tunnel Diode characteristics.
10. Study of h-parameter of a transistor.