Annexure 2-B

PARISHKAR COLLEGE OF GLOBAL EXCELLENCE (AUTONOMOUS)

SCHEME OF EXAMINATION COURSE STRUCTURE & SYLLABUS

AS PER UGC

ज्ञान-विज्ञान विमुक्तये

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

FOR

B.SC. HONOURS (PHYSICS)

(2022)

PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN B. Sc. Honours (Physics)

Semester	CORE COURSE (CP) (14)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2) (Skill Based)	Elective: Discipline Specific DSE (4)	Elective: Generic (GE) (4)	Credit
I	Mathematical Physics-I (6) Mechanics (6)	English Communication (4)	SEC-I (4)			20
II	Electricity& Magnetism(6) Waves and Optics(6)			DSE-1 (6)	GE-1 (6)	24
III	Mathematical Physics–II (6) Thermal Physics(6)			DSE-2 (6)	GE-2 (6)	24
IV	Mathematical Physics–III (6) Elements of Modern Physics(6) Analog Systems & Applications(6)		SEC-II (4)		GE-3 (6)	28
V	Quantum Mechanics and Applications(6) Solid State Physics(6)			DSE-3 (6)	GE-4 (6)	24
VI	Electromagnetic Theory(6) Statistical Mechanics(6) Digital Systems and Applications(6)	EVS (4)		DSE-4/ Project/ Internship (6)		28
Total Credits						**148**

PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM

in Bachelor of Science Honours (Physics)

- **AECC**- Ability Enhancement Compulsory Course
- **CC-** Core course
- **GE-** Generic Elective
- **SEC-** Skill Enhancement Course
- **DSE**-Discipline Specific Elective

Semester	Paper code	Course opted	Course name	Credits
I		Ability Enhancement Compulsory Course	English Communication	4
	CP/PHY/MP101	Core course-1	Mathematical Physics-I	4
	CP/PHY/MP102	Core Course-1 Practical/Tutorial	Mathematical Physics-I Lab	2
	CP/PHY/MEC103	Core course-2	Mechanics	4
	CP/PHY/MEC104	Core Course-2 Practical/Tutorial	Mechanics Lab	2
		Skill Enhancement Course-1	SEC-I	4
			Total	**20**
II	CP/PHY/EM201	Core course-3	Electricity and Magnetism	4
	CP/PHY/EM202	Core Course-3 Practical/Tutorial	Electricity and Magnetism Lab	2
	CP/PHY/WO203	Core course-4	Waves and Optics	4
	CP/PHY/WO204	Core Course-4 Practical/Tutorial	Waves and Optics Lab	2
		Discipline Specific Elective -1	DSE-1	4
		Discipline Specific Elective -1 Practical/Tutorial	DSE-1 Lab	2
		Generic Elective -1	GE-1	4
		Generic Elective -1 Practical/Tutorial	GE-1 Lab	2
			Total	**24**
III	CP/PHY/MP301	Core course-5	Mathematical Physics-II	4
	CP/PHY/MP302	Core Course-5 Practical/Tutorial	Mathematical Physics-II Lab	2
	CP/PHY/TP303	Core course-6	Thermal Physics	4

	CP/PHY/TP304	Core Course-6 Practical/Tutorial	Thermal Physics Lab	2
		Discipline Specific Elective -2	DSE-2	4
		Discipline Specific Elective- 2 Practical/Tutorial	DSE-2 Lab	2
		Generic Elective -2	GE-2	4
		Generic Elective -2 Practical/Tutorial	GE-2 Lab	2
			Total	**24**
IV	CP/PHY/MP401	Core course-7	Mathematical Physics III	4
	CP/PHY/MP402	Course-7 Practical/Tutorial	Mathematical Physics-III Lab	2
	CP/PHY/EMP403	Core course-8	Elements of Modern Physics	4
	CP/PHY/EMP404	Course-8 Practical/Tutorial	Elements of Modern Physics Lab	2
	CP/PHY/ASA405	Core course-9	Analog Systems and Applications	4
	CP/PHY/ASA406	Course- 9 Practical/Tutorial	Analog Systems & Applications Lab	2
		Skill Enhancement Course -4	SEC-II	4
		Generic Elective -3	GE-3	4
		Generic Elective -3 Practical	GE-3 Lab	2
			Total	**28**
V	CP/PHY/QMA501	Core course-10	Quantum Mechanics & Applications	4
	CP/PHY/QMA02	Core Course-10 Practical/Tutorial	Quantum Mechanics Lab	2
	CP/PHY/SSP503	Core course-11	Solid State Physics	4
	CP/PHY/SSP504	Core Course-11 Practical/Tutorial	Solid State Physics Lab	2
		Generic Elective -4	GE-4	4
		Generic Elective -4 Practical	GE-4 Lab	2
		Discipline Specific Elective -3	DSE-3	4
		Discipline Specific Elective -3 Practical/Tutorial	DSE-3 Lab	2
			Total	**24**

VI		Ability Enhancement Compulsory Course	EVS	4
	CP/PHY/EMT601	Core course-12	Electro-magnetic Theory	4
	CP/PHY/EMT602	Core Course-12 Practical/Tutorial	Electro-magnetic Theory Lab	2
	CP/PHY/SM603	Core course13	Statistical Mechanics	4
	CP/PHY/SM604	Core Course-13 Practical/Tutorial	Statistical Mechanics Lab	2
	CP/PHY/DSA505	Core course-14	Digital Systems and Applications	4
	CP/PHY/DSA506	Core Course-14 Practical/Tutorial	Digital Systems & Applications Lab	2
		Discipline Specific Elective-4/ Project/Internship	DSE-4/ Project/Internship	4
		Discipline Specific Elective -4/ Practical/Tutorial	DSE-4 Lab	2
			Total	**28**
Total Credits				**148**

B.Sc. HONOURS PHYSICS

Core Papers (CP)

S.No.	Paper Code	Core Papers (CP) Name	Credits			Practical Paper Code
			L	T	P	
1.	CP/PHY/MP101	Mathematical Physics-I	4	0	2	CP/PHY/MP102
2.	CP/PHY/MEC103	Mechanics	4	0	2	CP/PHY/MEC104
3.	CP/PHY/EM201	Electricity and Magnetism	4	0	2	CP/PHY/EM202
4.	CP/PHY/WO203	Waves and Optics	4	0	2	CP/PHY/WO204
5.	CP/PHY/MP301	Mathematical Physics–II	4	0	2	CP/PHY/MP302
6.	CP/PHY/TP303	Thermal Physics	4	0	2	CP/PHY/TP304
7.	CP/PHY/MP401	Mathematical Physics-III	4	0	2	CP/PHY/MP402
8.	CP/PHY/EMP403	Elements of Modern Physics	4	0	2	CP/PHY/EMP404
9.	CP/PHY/ASA405	Analog Systems and Applications	4	0	2	CP/PHY/ASA406
10.	CP/PHY/QMA501	Quantum Mechanics and Applications	4	0	2	CP/PHY/QMA502
11.	CP/PHY/SSP503	Solid State Physics	4	0	2	CP/PHY/SSP504
12.	CP/PHY/EMT601	Electromagnetic Theory	4	0	2	CP/PHY/EMT602
13.	CP/PHY/SM603	Statistical Mechanics	4	0	2	CP/PHY/SM604
14.	CP/PHY/DSA605	Digital Systems and Applications	4	0	2	CP/PHY/DSA606

Discipline Specific Elective Papers DSE 1-4

S.No.	Paper Code	Discipline Specific Elective Papers (DSECP) Name	Credits		Practical Paper Code
			Tutorials	Practical	
DSE 1					
1.	DSE/2/PHY/NP	Nuclear and Particle Physics	4	2	DSE/2/PHY/NPL
DSE 2 (Choose any One)					
2.	DSE/3/PHY/ET	Experimental Techniques	4	2	DSE/3/PHY/ETL
3.	DSE/3/PHY/PDC	Physics of Devices and Communication	4	2	DSE/3/PHY/PDCL
4.	DSE/3/PHY/CD	Classical Dynamics	5	1	DSE/3/PHY/CDL
DSE 3 (Choose any One)					
5.	DSE/5/PHY/CS	Communication System	4	2	DSE/5/PHY/CSL
6.	DSE/5/PHY/NMA	Nano Materials and Applications	4	2	DSE/5/PHY/NMAL
DSE 4 (Choose any One)					
7.	DSE/6/PHY/PE	Physics of the Earth	4	2	DSE/6/PHY/PEL
8.	DSE/6/PHY/DSP	Digital Signal Processing	4	2	DSE/6/PHY/DSPL
OR					
Dissertation/Project/Internship					

Other Discipline (Four papers of any one discipline) - GE 1 to GE 4

S.No.	Paper Code	Other Discipline Specific Elective (DIS/GE) Name	Credits		Practical Paper Code
			Tutorials	Practical	
1.	GE/PHY1	Physics	4	2	GE/PHY2
2.	GE/PHY/MAT3	Mathematics	5	1	GE/PHY/MAT4
3.	GE/PHY/CHM5	Chemistry	4	2	GE/PHY/CHM6
4.	GE/PHY/ECO7	Economics	5	1	GE/PHY/ECO8
5.	GE/PHY/COM9	Computer Science	4	2	GE/PHY/COM10

Skill Enhancement Courses

S.No.	Paper Code	Skill Enhancement Courses (SEC) Name	Credits Tutorials
1.	SEC/PHY/WOK1	Physics Workshop Skills	4
2.	SEC/PHY/COM2	Computational Physics Skills	4
3.	SEC/PHY/ELC3	Electrical circuits and Network Skills	4
4.	SEC/PHY/INM4	Basic Instrumentation Skills	4
5.	SEC/PHY/REN5	Renewable Energy and Energy harvesting	4
6.	SEC/PHY/AOP8	Applied Optics	4

Generic Elective Papers (GE) (Minor-Physics) for other Departments/Disciplines: (Credit: 06 each)

S.No.	Paper Code	Generic Elective (GE) Name	Credits		Practical Paper Code
			T	P	
1.	GE/2/PHY/EM1	Electricity and Magnetism	4	2	GE/2/PHY/EM2
2.	GE/3/PHY/WAV/OPT3	Waves and Optics	4	2	GE/3/PHY/WAV/OPT4
3.	GE/4/PHY/SOS5	Solid State Physics	4	2	GE/4/PHY/SOS6
4.	GE/5/PHY/NUC7	Nuclear and Particle Physics	5	1	GE/5/PHY/NUC8

Department Overview

The Department aims at developing young talent for the Physical industry and academia. The curriculum is developed by highly Qualified faculty of **Parishkar** in such a way that the students are able to venture into allied fields also. The aim of the department through the programmes is to provide "a cut above" man-power to the ever growing demands of the industry and to prepare students for higher studies and research devoted to society. The interactive method of teaching at **Parishkar College of Global Excellence** is to bring about attitudinal changes to future professionals of the industry with an edge of creativity.

Equal importance is given to practical and theoretical aspects apart from experiential and digital modes of learning. Industrial projects form an integral part of the curriculum. Along with the syllabus, the **Parishkar College of Global Excellence** emphasizes on Value Addition Programs like Holistic Education, open elective programmes and Placement Training Programs, which include training students in group discussions, facing interviews and so on.

Program Outcomes

On successful completions of the B.Sc. Honours Programme students will be able to

- Understand and apply the fundamental principles, concepts and methods in key areas of science and multidisciplinary fields
- Demonstrate problem solving, analytical and logical skills to provide solutions for the scientific requirements.
- Develop the critical thinking with scientific temper.
- Communicate the subject effectively.
- Understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature.
- Understand the professional, ethical and social responsibilities.
- Enhance the research culture and uphold the scientific integrity and objectivity.
- Engage in continuous reflective learning in the context of technological and scientific advancements.
- Express proficiency in oral and written communications to appreciate innovation in research.
- Develop industry-focused skills to lead a successful career.

Program Highlights

Salient Features

- Approaching the subject from theoretical and practical points of view.
- Opportunity to attend seminars, workshops etc.
- Extra-curricular activities for peer interaction, growth of organizational skills and personality development.
- Well-equipped and spacious laboratories.
- Well qualified and experienced staff.
- Industrial collaboration/training.
- Placement opportunities.
- Good library and internet facilities.
- Industrial /Institutional projects.
- Guest lectures by experts from the field.

CORE COURSE (HONOURS IN PHYSICS)

SEMESTER-I

Syllabus

Name of Paper: MATHEMATICAL PHYSICS-I

Paper Code: CP/PHY/MP101 **Credits: 04**

Total Teaching Hours: 60

Course Objectives

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

Course learning outcome:

- Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.
- Learn the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.
- Learn the Dirac delta function its properties, which have applications in various branches of Physics, especially quantum mechanics.
- In the laboratory course, learn the fundamentals of the C and C++ programming languages and their applications in solving simple physical problems involving interpolations, differentiations, integrations, differential equations as well as finding the roots of equations.

Broad contents of the course:

- Calculus
- Vector Calculus
- Orthogonal Curvilinear Coordinates
- Dirac Delta function and its properties
- Introductory theory of probability

Skills to be learned

- Training in calculus will prepare the student to solve various mathematical problems.
- He / she shall develop an understanding of how to formulate a physics problem and solve given mathematical equation risen out of it.

Unit-I Teaching Hours 15

Calculus:

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitic ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).
First Order Differential Equations and Integrating Factor. Homogeneous equations with constant coefficients.
Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.
Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

Unit-II Teaching Hours: 15

Vector calculas: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.
Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Unit-III Teaching Hours: 15

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.
Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Unit-IV Teaching Hours: 15

Dirac Delta function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.
Introduction to probability: Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.
Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

Text Books and Reference Books:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning

- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, H.K. Dass
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

Practical Lab-Syllabus

Name of Paper: MATHEMATICAL PHYSICS-I (LAB)

Paper Code: CP/PHY/MP102 **Credits: 02**

Total Teaching Hours: 60

Course Objectives/Course Description

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical) in the Lab
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Course Outcome

Students will be learning the skills of problem solving and understand the concepts clearly.

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.

Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scans and prints, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D&2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs: using C/C++ language	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. sin θ, cos θ, tan θ, etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal a n d Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x$ For four initial conditions x (0) = 0, y (0) = -1, -2, -3, -4. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ The

	differential equation describing the motion of a pendulum is $\frac{d^2\upsilon}{dt^2} = -\sin(\upsilon)$ The pendulum is released from rest at an angular displacement α, i. e. $\upsilon(0) = \alpha$ and $\upsilon'(0) = 0$. Solve the equation for α = 0.1, 0.5 and 1.0 and plot ’ as a function of time in the range $0 \le t \le 8\pi$. Also plot the analytic solution valid for small $\upsilon(\sin\upsilon) = \upsilon$
Any other Experiments/Innovations related to Mathematical Physics can be added.	

Text Books and Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Schaum’s Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. , 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n., 2 0 0 7, Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006, Cambridge Univ. Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

Syllabus

Name of Paper: Mechanics

Paper Code: CP/PHY/MEC103 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description:

This course on mechanics enables the students to understand the fundamentals of Newtonian mechanics, theory of relativity, fluid dynamics, elasticity, and other applications.

Course learning outcome:

After going through the course, the student should be able to

- Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.
- Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.
- Understand the phenomena of collisions and idea about center of mass and laboratory frames and their correlation.
- Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.
- Understand simple principles of fluid flow and the equations governing fluid dynamics.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of Gravitation.
- Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
- Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-go-round experiences an outward pull.
- Describe special relativistic effects and their effects on the mass and energy of a moving object.
- Appreciate the nuances of Special Theory of Relativity (STR)
- In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum), rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.

Broad contents of the course:

- Fundamental of Dynamics
- Work and Energy
- Collisions
- Rotational Dynamics
- Elasticity
- Fluid Motion
- Gravitation and central force Motion
- Oscillation
- Non-inertial Systems
- Special Theory of Relativity

Skills to be learned

- Learn basics of the kinematics and dynamics linear and rotational motion.
- Learn the concepts of elastic in constant of solids and viscosity of fluids.
- Develop skills to understand and solve the equations of Newtonian Gravity and central force problem.
- Acquire basic knowledge of oscillation.
- Learn about inertial and non-inertial systems and essentials of special theory of relativity.

Unit-I Teaching Hours: 15

Fundamentals of dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.
Work and energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.
Collision: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

Unit-II Teaching Hours: 15

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.
Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Unit-III Teaching Hours: 15

Fluid motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube

Gravitation and central force motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Oscillations SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Unit-IV Teaching Hours: 15

Non inertial systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Special theory of relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler Effect. Relativistic Kinematics. Transformation of Energy and Momentum.

Reference Books:

- MP Saxsena, PR Singh, SS Rawat, College Book House.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. Additional Books for Reference
- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

Practical Lab-Syllabus

Name of Paper: MECHAINCS (LAB)

Paper Code: CP/PHY/MEC104 **Credits: 02**

Total Teaching Hours: 60

Course Objectives:

The mechanics related experiments included in this course enables the students to understand the theory better and develops the application skills in a practical situation.

Course Outcome

Better understanding of theory and development of practical application skills.

S.No.	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 study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
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 Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's 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.
10.	To determine the value of g using Bar Pendulum.
Any other Experiments/Innovations related to Mechanics can be added.	

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 Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

SEMESTER-II

Syllabus

Name of Paper: ELECTRICITY AND MAGNETISM

Paper Code: CP/PHY/EM201 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description:

This course on electricity and magnetism enables the students to understand the fundamentals of electrostatics, magnetostatics, electromagnetic induction and electromagnetic theory.

Course learning outcome:

After going through the course, the student should be able to

- Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Demonstrate a working understanding of capacitors.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Understand the dielectric properties, magnetic properties of materials and the phenomena of electromagnetic induction.
- Describe how magnetism is produced and list examples where its effects are observed.
- Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
- Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.

• In the laboratory course the student will get an opportunity to verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.

• Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits.

Broad contents of the course

• Electric Field and Electric Potential

• Conservative nature of Electrostatic Field

• Electrostatic energy of system of charges

• Dielectric Properties of Matter

• Magnetic Field

• Magnetic Properties of Matter

• Electromagnetic Induction

• Ballistic Galvanometer

Skills to be learned

• This course will help in understanding basic concepts of electricity and magnetism and their applications.

• Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.

Unit-I Teaching Hours: 22

Electric Field and Electric Potential Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.
Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.
Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor.
Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Unit-II Teaching Hours: 17

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole).
Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid.
Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.

Unit-III Teaching Hours: 10

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.
Electromagnetic Induction: Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Unit-IV Teaching Hours: 11

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance.
Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.
Network theorems: Ideal Constant-voltage and Constant-current Sources.
Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.
Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.

Text Books and Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

Practical Lab-Syllabus

Name of Paper: ELECTRICITY AND MAGNETISM LAB

Paper Code: CP/PHY/EM202 **Credits: 02**

Total Teaching Hours: 60

Course Objectives/Course Description

The experiments related to electricity and magnetism included in this course enables the students to understand the theory better and develops the application skills.

Course Outcome

On completion of this course, students will be able to measure resistances, voltages, current, charge and current density, magnetic field strength, self-inductance of a coil and mutual inductance of a pair of coils using appropriate instruments and experimental setup.

Experiment list

S.No.	Experiments
1.	Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2.	To study the characteristics of a series RC Circuit.
3.	To determine an unknown Low Resistance using Potentiometer.
4.	To determine an unknown Low Resistance using Carey Foster's Bridge.
5.	To compare capacitances using De'Sauty's bridge.
6.	Measurement of field strength B and its variation in a solenoid (determine dB/dx).
7.	To verify the Thevenin and Norton theorems.
8.	To verify the Superposition, and Maximum power transfer theorems.
9.	To determine self-inductance of a coil by Anderson's bridge.
10.	To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11.	To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
12.	Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer.
13.	Determine a high resistance by leakage method using Ballistic Galvanometer.
14.	To determine self-inductance of a coil by Rayleigh's method.
15.	To determine the mutual inductance of two coils by Absolute method.
Any other Experiments/Innovations related to electricity and magnetism can be added.	

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal 15
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Syllabus

Name of Paper: WAVES AND OPTICS

Paper Code: CP/PHY/WAV/OPT203 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description:

This course on Waves and Optics enables the students to understand the fundamentals of Waves and Optics theory.

Course learning outcome:

This course will enable the student to

- Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
- Apply basic knowledge of principles and theories about the behavior of light and the physical environment to conduct experiments.
- Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
- Use the principles of wave motion and superposition to explain the Physics of polarization, interference and diffraction.
- Understand the working of selected optical instruments like biprism, interferometer, diffraction grating, and holograms.
- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt firsthand.

• The motion of coupled oscillators, study of Lissajous figures and behavior of transverse, longitudinal waves can be learnt in this laboratory course.

Broad contents of the course

• Superposition of Two Collinear Harmonic Oscillations.

• Superposition of Two Perpendicular Harmonic Oscillations.

• Waves Motion – General.

• Velocity of Waves.

• Superposition of Two Harmonics Waves.

• Wave Optics.

• Interference.

• Michelson's Interferometer.

• Diffraction.

• Fraunhofer Diffraction.

• Fresnel Diffraction.

• Holography.

Skills to be learned

• He / she shall develop an understanding of various aspects of harmonic oscillations and waves specially.

(i) Superposition of collinear and perpendicular harmonic oscillations

(ii) Various types of mechanical waves and their superposition.

• This course in basics of optics will enable the student to understand various optical phenomena, principles, workings and applications optical instruments.

Unit-I Teaching Hours: 11

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having
(1) Equal frequencies and (2) different frequencies (Beats).
Superposition of N collinear Harmonic Oscillations with
(1) Equal phase differences and (2) equal frequency differences.
Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.
Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Unit-II Teaching Hours: 15

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

Unit-III Teaching Hours: 14

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Unit-IV Teaching Hours: 20

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only)

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms

Text Books and Reference Books:

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

Practical Lab-Syllabus

Name of Paper: WAVES AND OPTICS LAB

Paper Code: CP/PHY/WAV/OPT204 **Credits: 02**

Total Teaching Hours: 60

Course Objectives/Course Description

- The experiments related to waves and optics included in this course provides a thorough understanding of the theory and expose the students to the method of detailed analysis and inferences.
- The experiments related to Waves and optics nets included in this course enables the students to understand the theory better and develops the application skills.

Course Outcome

- On completion of this course, students will be able to measure wavelength frequency and uses of Newtons Rings Biprism Grating.
- Better understanding of theory and development of practical application skills.

Experiment list

S.No.	Experiments
1.	To determine the frequency of an electric tuning fork by Melde's experiment and verify λ2 –T law.
2.	To investigate the motion of coupled oscillators.
3.	To study Lissajous Figures.
4.	Familiarization with: Schuster`s focusing; determination of angle of prism.
5.	To determine refractive index of the Material of a prism using sodium source.
6.	To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7.	To determine the wavelength of sodium source using Michelson's interferometer.
8.	To determine wavelength of sodium light using Fresnel Biprism.
9.	To determine wavelength of sodium light using Newton's Rings.
10.	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11.	To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12.	To determine dispersive power and resolving power of a plane diffraction grating.
Any other Experiments/Innovations related to waves and optics can be added.	

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Semester - II
PHYSICS-DSE (ELECTIVES)

Syllabus (DSE)

Name of Paper: NUCLEAR & PARTICLE PHYSICS

Paper Code: DSE/PHY/NPP15 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

This course is an elective paper which gives students an additional option get exposure to the fundamentals of nuclear and particle physics. Students will be introduced to the new ideas such as the properties and structure of nucleus, interaction of nuclear radiations with matter and the principle behind the working of radiation detectors, fundamental particles and their interactions, particle accelerators.

Course learning outcome:

• Learn the ground state properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.

• Know about the nuclear models and their roles in explaining the ground state properties of the nucleus –

(i) The liquid drop model, its justification as far as the nuclear properties are concerned, the semi-empirical mass formula.

(ii) The shell model, evidence of shell structure, magic numbers, predictions of ground state spin and parity, theoretical deduction of the shell structure, consistency of the shell structure with the Pauli Exclusion principles.

• Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays and the mechanisms of the emissions of these rays, outlines of Gamow's theory of alpha decay and Pauli's theory of beta decay with the neutrino hypothesis, the electron capture, the fine structure of alpha particle spectrum, the Geiger-Nuttall law, the radioactive series.

• Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, the reaction cross-sections, the types of nuclear reactions, direct and compound nuclear reactions, Rutherford scattering by Coulomb potential.

• Learn some basic aspects of interaction of nuclear radiation with matter- interaction of gamma ray by photoelectric effect, Compton scattering and pair production, energy loss due to ionization, Cerenkov radiation.

• Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.

• The students are expected to learn about the principles and basic constructions of particle accelerators such as the Van-de-Graff generator, cyclotron, betatron and synchrotron. They should know about the accelerator facilities in India.

• Gain knowledge on the basic aspects of particle Physics – the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons. The students should know about the quantum numbers of particles: energy, linear momentum, angular momentum, isospin, electric charge, colour charge, strangeness, lepton numbers, baryon number and the conservation laws associated with them.

Broad contents of the course:

• General properties of nuclei

• Nuclear models

• Radioactive decays

• Nuclear reactions

• Interaction of nuclear radiation with matter

• Detectors for nuclear interaction

• Particle accelerators

• Elementary particles and their properties

Skills to be learned

• Skills to describe and explain the properties of nuclei and derive them from various models of nuclear structure.

• To understand, explain and derive the various theoretical formulation of nuclear disintegration like α decay, β decay and σ decays.

• Develop basic understanding of nuclear reactions and decays with help of theoretical formulate and laboratory experiments.

• Skills to develop basic understanding of the interaction of various nuclear radiation with matter in low and high energy …….

• Ability to understand, construct and operate simple detector systems for nuclear radiation and training to work with various types of nuclear accelerators.

• Develop basic knowledge of elementary particles as fundamental constituent of matter, their properties and conservation laws during their interactions with matter.

UNIT-I Teaching Hours-15

Properties and Structure of Nucleus

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

UNIT-II Teaching Hours-15

Radioactivity and Nuclear Reactions

Radioactivity decay: (a) **Alpha decay:** basics of α-decay processes, theory of αemission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy.(b) **β-decay:** energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.(c) **Gamma decay:** Gamma rays emission & kinematics, internal conversion.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

UNIT-III Teaching Hours-15

Interaction of Nuclear Radiations with Matter and Detectors

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (BetheBlock formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility).

UNIT-IV Teaching Hours-15

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Reference Books:

- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991).
- Physics for Degree Studemts, C.L. Arora, P.S. Hemne, 2016, S. Chand & Company Pvt. Ltd.
- Nuclear & Particle Physics, Sardar Singh, S.S. Rawat, 2022, College Book House Publication.
- Nuclear & Particle Physics, Rajesh Jain, Narendra Jakhar, Sanjeev Kumar, Dalpat Meena, 2022, Jaipur Publishing House.

Practical Lab-Syllabus (DSE)

Name of Paper: NUCLEAR AND PARTICLE PHYSICS (LAB)

Paper Code: DSE/PHY/NPP16 **Credits: 02**

Total Teaching Hours: 60

Course Objectives/Course Description

Students are expected to learn the topics such as binding energy, mass absorption coefficient for beta rays, mass attenuation coefficients for gamma rays, working of GM counter and NaI (Tl) detector.

Course Outcome

Better clarity of the theory through the respective experiments is expected. Hands on experience of working with detector spectrometers. Development of analytical and interpretation skills.

NUCLEAR PHYSICS LAB EXPERIMENT LIST:

S.No.	Experiments
1.	Computation of binding energy of nuclei.
2.	Mass absorption coefficient for beta particles in copper using GM counter.
3.	Range and end point energy of beta particles in aluminum.
4.	Mass attenuation coefficient of gamma rays in lead using GM counter.

5.	Resolution of NaI(Tl) detector spectrometer.
6.	Computation of energy loss for protons and alpha particles in aluminum and lead.
7.	Calibration of NaI (Tl) detector spectrometer.
Any other Experiments/Innovations related to nuclear and particle physics can be added.	

Text Books and Reference Books:

[1]. S. N. Goshal, Nuclear Physics, Chand and Co., New Delhi, 2005.

[2]. G. F. Knoll, Radiation Detection and Measurement, John Wiley and Sons, New York, 2000.

Syllabus (SEC)

Name of Paper: PHYSICS WORKSHOP SKILL

Paper Code: SEC/PHY/PWS1 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode.

Course learning outcome:

- After the successful completion of the course the student is expected to acquire skills/ hands on experience / working knowledge on various machine tools, lathes, shapers, drilling machines, cutting tools, welding sets and also in different gear systems, pulleys etc. He /she will also acquire skills in the usage of multimeters, soldering iron, oscilloscopes, power supplies and relays.

Broad contents of the course:

- Introduction to make simple length, height, time, area, volume measurements.
- Mechanical skills needed to the workshop practice.
- Electrical and electronics skills related to the measurement of various electrical and electronics quantities.
- Introduction to Prime Movers.

Skills to be learned

- Learn to use mechanical tools to make simple measurement of length, height, time, area and volume.
- Obtain hand on experience of workshop practice by doing casting, foundry, machining, welding and learn to use various machine tool like lathe shaper, milling and drilling machines etc. and working with wooden and metal blocks.
- Learn to use various instruments for making electrical and electronics measurements using multimeter, oscilloscopes, power supply, electronic switches and relays.

UNIT-I Teaching Hours-15

Introduction: Measuring units. Conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

UNIT-II Teaching Hours-15

Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

UNIT-III Teaching Hours-15

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, and diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, electronic switch using transistor and relay.

UNIT-IV Teaching Hours-05

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, lifting of heavy weight using lever. Braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn. 37
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

Syllabus (SEC)

Name of Paper: COMPUTATIONAL PHYSICS

Paper Code: SEC/PHY/CP2 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- Course will consist of hands on training on the Problem solving on Computers.

Course learning outcome:

- Learn the importance of computers in solving problems in Physics.
- Learn how to plan for writing the algorithm for solving a problem by drawing the flowchart of simple problems like roots of quadratic equations etc.
- Have a working knowledge about the Linux system, for example, the necessary commands.
- Learn, write and run FORTRAN programs in the Linux system. In particular, they should attempt the following exercises:

(i) Exercises on syntax on usage of FORTRAN.

(ii) Usage of GUI windows, Linux commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.

(iii) To print out all natural even/ odd numbers between given limits.

(iv) To find maximum, minimum and range of a given set of numbers.

- The students should also learn “Scientific Word Processing”, particularly, how to use the LaTeX software in writing articles and papers which include mathematical equations and diagrams. Similarly, students should learn the basics of Gnuplot.
- To have hands-on experience on computational tools, students are expected to do the following exercises:

(i) to compile a frequency distribution and evaluate mean, standard deviation etc,

(ii) to evaluate sum of finite series and the area under a curve,

(iii) to find the product of two matrices \

(iv) to find a set of prime numbers and Fibonacci series,

(v) to write program to open a file and generate data for plotting using Gnuplot,

(vi) plotting trajectory of a projectile projected horizontally,

(vii) plotting trajectory of a projectile projected making an angle with the horizontal direction,

(viii) creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen, saving it as an eps file and as a pdf file,

(ix) to find the roots of a quadratic equation,

(x) numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization,

(xi) Simulate the motion of a particle in a central force field and plot the output for visualization.

Broad contents of the course:

- Introduction
- Scientific Programming
- Control Statements
- Scientific word processing: Introduction to LATEX
- Visualization

Skills to be learned

- The students should learn the skills for writing a flow chart and then writing the corresponding program for a specific problem using the C/ C^{++}/FORTRAN language.
- The student should also acquire the proficiency in effectively using the GUI Windows, the LINUX operating system and also in using the LaTeX software for wring a text file.

UNIT-I Teaching Hours-15

Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of Linux as an Editor.

Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting

(1) lissajous figures and

(2) Trajectory of a projectile thrown at an angle with the horizontal.

UNIT-II Teaching Hours-15

Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program.

Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. FORTRAN Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of FORTRAN Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

UNIT-III Teaching Hours-15

Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming:

S.No.	Programming
1.	Exercises on syntax on usage of FORTRAN.
2.	Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3.	To print out all natural even/ odd numbers between given limits.
4.	To find maximum, minimum and range of a given set of numbers.
5.	Calculating Euler number using exp(x) series evaluated at x=1
Any other Experiments/Innovations related to computational physics can be added.	

UNIT-IV Teaching Hours-15

Scientific word processing: Introduction to Latex: TeX/Latex word processor, preparing a basic Latex file, Document classes, preparing an input file for Latex, Compiling Latex File, Latex tags for creating different environments, Defining Latex commands and environments, changing the type style, Symbols from other languages.

Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, generating table of contents, bibliography and citation, making an index and glossary, List making environments, Fonts, Picture environment and colours, errors.

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. Importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.

Hands on exercises:

S.No.	Exercises
1.	To compile a frequency distribution and evaluate mean, standard deviation etc.
2.	To evaluate sum of finite series and the area under a curve.
3.	To find the product of two matrices.
4.	To find a set of prime numbers and Fibonacci series.
5.	To write program to open a file and generate data for plotting using Gnuplot.
6.	Plotting trajectory of a projectile projected horizontally.
7.	Plotting trajectory of a projectile projected making an angle with the horizontally.
8.	Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9.	To find the roots of a quadratic equation.
10.	Motion of a projectile using simulation and plot the output for visualization.
11.	Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12.	Motion of particle in a central force field and plot the output for visualization.
Any other Experiments/Innovations related to computational physics can be added.	

Reference Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n . , 2 0 0 7 , Wiley India Edition.

Syllabus (SEC)

Name of Paper: ELECTRICAL CIRCUITS AND NETWORK SKILLS

Paper Code: SEC/PHY/ECNS3 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

Course learning outcome:

• After the completion of the course the student will acquire necessary skills/ hands on experience /working knowledge on multimeters, voltmeters,ammeters, electric circuit elements, dc power sources, ac/dc generators, inductors, capacitors, transformers, single phase and three phase motors, interfacing dc/ac motors to control and measure, relays and basics of electrical wiring.

Broad contents of the course:

• Basic principles of electricity, electrical circuits and electrical drawings.
• Physics of generators, transformers, electric motors.
• Solid state devices and their uses.
• Electrical wiring and measures for electrical protection.

Skills to be learned

• Skills to understand various types of DC and AC circuits and making electrical drawings with symbols for various systems.
• Skills to understand and operate generators, transformers and electric motors.
• Develop knowledge of solid state devices and their uses.
• Skills to do electrical wiring with assured electrical protection devices.

UNIT-I **Teaching Hours-15**

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.
Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits and Theorems (Maximum power, superposition, reciprocity, Thevenin, Miller and Norton Theorem). Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

UNIT-II Teaching Hours-15

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

UNIT-III Teaching Hours-15

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

UNIT-IV Teaching Hours-15

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

Syllabus (SEC)

Name of Paper: BASIC INSTRUMENTATION SKILLS

Paper Code: SEC/PHY/BIS4 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

This course is to get exposure with various aspects of instruments and their usage through hands-on mode.

Course learning outcome:

After the successful completion of the course the student is expected to have the necessary working knowledge on accuracy, precision, resolution, range and errors/uncertainty in measurements. He/she will acquire hands on skills in the usage of oscilloscopes, multimeters, multivibrators, rectifiers, amplifiers, oscillators and high voltage probes. He also would have gained knowledge on the working and operations of LCR Bridge, generators, digital meters and counters.

Broad contents of the course:

- Basics of measurement
- Electronic voltmeters/multimeters
- Cathode ray oscilloscope
- Impedance Bridges and Q meters.
- Digital instruments, Digital multimeters

Skills to be learned

- Develop skills to use basic electrical instruments like multimeter, electronic voltmeter, cathode ray, and oscilloscope.
- Acquire efficiency in making signal generators and analysis of obtained signals.
- Learn to understand and use various types of digital instruments.
- Develop knowledge of making measurements with Impedance Bridges and Q meters.

UNIT-I **Teaching Hours-15**

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a Multimeter and their significance.

Electronic Voltmeter: Advantage over conventional Multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.

AC millivolt meter: Type of AC millivolt meters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivolt meter, specifications and their significance.

UNIT-II Teaching Hours-15

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

UNIT-III Teaching Hours-15

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators. Pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters: Block diagram of bridge. Working principles of basic (balancing type) RLC bridge. Specifications of RLC Bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

UNIT-IV Teaching Hours-15

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items:

S.No.	Test items
1.	Use of an oscilloscope.
2.	CRO as a versatile measuring device.
3.	Circuit tracing of Laboratory electronic equipment.
4.	Use of Digital multimeter/VTVM for measuring voltages
5.	Circuit tracing of Laboratory electronic equipment.
6.	Winding a coil / transformer.
7.	Study the layout of receiver circuit. 8. Trouble shooting a circuit.
8.	Balancing of bridges.
Any other Experiments/Innovations related to basic instrumentation skills can be added.	

Laboratory Exercises:

S.No.	Exercises
1.	To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2.	To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3.	To measure Q of a coil and its dependence on frequency, using a Q- meter.
4.	Measurement of voltage, frequency, time period and phase angle using CRO.

5.	Measurement of time period, frequency, average period using universal counter/ frequency counter.
6.	Measurement of rise, fall and delay times using a CRO.
7.	Measurement of distortion of a RF signal generator using distortion factor meter.
8.	Measurement of R, L and C using a LCR bridge/ universal bridge.
Open Ended Experiments:	
1.	Using a Dual Trace Oscilloscope
2.	Converting the range of a given measuring instrument (voltmeter, ammeter)
Any other Experiments/Innovations related to basic instrumentation skills can be added.	

Reference Books:

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Syllabus (SEC)

Name of Paper: APPLIED OPTICS

Paper Code: SEC/PHY/AO6 **Credits: 04**

Total Teaching Hours: 60

Course Objectives/Course Description

This course is to get exposure with various aspects of instruments and their usage through hands-on mode.

Course learning outcome:

This course will enable the student to get

- Familiar with optical phenomena and technology.
- Qualitative understanding of basic lasing mechanism, types of Lasers, characteristics of Laser Light, types of Lasers, and its applications in developing LED, Holography.

• The idea of propagation of electromagnetic wave in a nonlinear media – Fibre optics as an example will enable the student to practice thinking in a logical process, which is essential in science.

• Experiments in this course will allow the students to discuss in peer groups to develop their cooperative skills and reinforce their understanding of concepts.

Broad contents of the course:

• Sources and Detectors
• Fourier Optics
• Holography
• Photonics: Fibre Optics

Skills to be learned

This course will help in understanding about the lasers and detectors, Holography, Optical fibre and their applications.

UNIT-I Teaching Hours-15

Sources and Detectors: Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Experiments on Lasers:

S.No.	Experiments
a.	Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
b.	To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
c.	To find the polarization angle of laser light using polarizer and analyzer.
d.	Thermal expansion of quartz using laser.
Any other Experiments/Innovations related to applied optics can be added.	

Experiments on Semiconductor Sources and Detectors:

S.No.	Experiments
a.	V-I characteristics of LED.
b.	Study the characteristics of solid state laser.
c.	Study the characteristics of LDR.
d.	Photovoltaic Cell.
e.	Characteristics of IR sensor.
Any other Experiments/Innovations related to applied optics can be added.	

UNIT-II Teaching Hours-15

Fourier Optics: Concept of Spatial frequency filtering, Fourier transforming property of a thin lens.

Experiments on Fourier Optics:

S.No.	Experiments
	a. Fourier optic and image processing
1.	Optical image addition/subtraction
2.	Optical image differentiation
3.	Fourier optical filtering
4.	Construction of an optical 4f system
	b. Fourier Transform Spectroscopy
1.	Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science.
	Experiment:
1.	To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.
Any other Experiments/Innovations related to applied optics can be added.	

UNIT-III Teaching Hours-15

Holography: Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

Experiments on Holography and interferometry:

S.No	Experiments
1.	Recording and reconstructing holograms
2.	Constructing a Michelson interferometer or a Fabry Perot interferometer.
3.	Measuring the refractive index of air
4.	Constructing a Sagnac interferometer
5.	Constructing a Mach-Zehnder interferometer
6.	White light Hologram.
Any other Experiments/Innovations related to applied optics can be added.	

UNIT-IV Teaching Hours-15

Photonics: Fiber Optics: Optical fibers and their properties, Principal of light propagation through a fiber, The numerical aperture, Attenuation in optical fiber and attenuation limit, Single mode and multimode fibers, Fiber optic sensors: Fiber Bragg Grating.

Experiments on Photonics: Fiber Optics

S.No.	Experiments
1.	To measure the numerical aperture of an optical fiber
2.	To study the variation of the bending loss in a multimode fiber
3.	To determine the mode field diameter (MFD) of fundamental mode in a single-mode fiber by measurements of its far field Gaussian pattern
4.	To measure the near field intensity profile of a fiber and study its refractive index profile
5.	To determine the power loss at a splice between two multimode fiber.
Any other Experiments/Innovations related to applied optics can be added.	

Reference Books:

- Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill. 47
- LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
- Fiber optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
- Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
- Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Pr

Generic Elective (For Select Physics) GE-1
Semester - II

Syllabus (GE-1)

Name of Paper: ELECTRICITY AND MAGNETISM

Paper Code: GE/2/PHY/EM1 **Credits: 04**

Total Teaching Hours: 60

Course learning outcome:

After going through the course, the student should be able to

- Demonstrate Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Demonstrate a working understanding of capacitors.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Describe how magnetism is produced and list examples where its effects are observed.
- Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
- Apply various network theorems such as Superposition Theorem, Thevenin Theorem, Norton Theorem, Reciprocity Theorem, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.
- In the laboratory course the student will get an opportunity to verify all the above mentioned theorems elaborated above, using simple electric circuits.

Broad contents of the course:

- Vector Analysis
- Electrostatistics

- Magnetism
- Electromagnetic Induction
- Maxwell's Equation and EM Wave propagation.

Skills to be learned

- This course will help in understanding basic concepts of electricity and magnetism and their applications.
- Basic course in electrostatics will equips the student with required prerequisites to understand electrodynamics phenomena.

UNIT-I Teaching Hours-10

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

UNIT-II Teaching Hours-15

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

UNIT-III Teaching Hours-15

Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro-magnetic materials.

UNIT-IV Teaching Hours-20

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.
Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
- Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

Practical Lab-Syllabus (GE-1)

Name of Paper: ELECTRICITY AND MAGNETISM

Paper Code: GE/2/PHY/EM2 **Credits: 02**

Total Teaching Hours: 60

Experiments:

S.No.	Exercises
1.	To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) Checking electrical fuses.
2.	Ballistic Galvanometer: (i) Measurement of charge and current sensitivity (ii) Measurement of CDR (iii) Determine a high resistance by Leakage Method (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3.	To compare capacitances using De'Sauty's bridge.
4.	Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5.	To study the Characteristics of a Series RC Circuit.
6.	To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7.	To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8.	To determine a Low Resistance by Carey Foster's Bridge.
9.	To verify the Thevenin and Norton theorems
10.	To verify the Superposition, and Maximum Power Transfer Theorems.
Any other Experiments/Innovations related to electricity and magnetism can be added.	

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & 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
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.