PROGRAMME AND COURSE STRUCTURE WITH CREDIT DISTRIBUTION

FOR

UG Degree Programmes with Single Major

IN

PHYSICS

(w.e.f. 2023-2024)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL
PIN 722155

STRUCTURE IN PHYSICS
(UG Degree Programmes with Single Major)
SEMESTER –I

Category of Course	Course Code	Course Title	Credit	Marks			No. of Hours		
				I.A.	ESE	Total	Lec.	Tu.	Lab.
1. Major (MJ) :: DSC	S/PHS/101/MJC-1	Mechanics and General Properties of Matter	**3 (Th.) + 1 (Lab.) = 4**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
2. Minor Stream	S/PHS/102/MN-1	Mechanics and General Properties of Matter	**3 (Th.) + 1 (Lab.) = 4**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
3. Multidisciplinary	S/PHS/103/MD-1	Fundamentals of Physics-I	**3**	**10**	**40**	**50**			
4. Skill Enhancement Courses	S/PHS/104/SEC-1	Basics of Computer and Python Programming	**2 (Th) + 1 (Lab) = 3**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
5. Ability Enhancement Course	ACS/105/AEC-1	Compulsory English: Literature and Communication	**2**	**10**	**40**	**50**			
6. Value Added Course	ACS/106/VAC-1	Environmental Studies	**4**	**10**	**40**	**50**			
Total Credit = 4+4+3+3+2+4 = 20				**Total Number of Courses = 6**					

SEMESTER –II

Category of Course	Course Code	Course Title	Credit	Marks			No. of Hours		
				I.A.	ESE	Total	Lec.	Tu.	Lab.
1. Major (MJ) :: DSC	S/PHS/201/MJC-2	Electricity and Magnetism	**3 (Th.) + 1 (Lab.) = 4**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
2. Minor Stream	S/PHS/202/MN-2	Electricity and Magnetism	**3 (Th.) + 1 (Lab.) = 4**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
3. Multidisciplinary	S/PHS/203/MD-2	Fundamentals of Physics-II	**3**	**10**	**40**	**50**			
4. Skill Enhancement Courses	S/PHS/204/SEC-2	Basic Instrumentation Skills	**2 (Th.) + 1 (Lab.) = 3**	**10**	**25 (Th.) 15 (Lab.)**	**50**			
5. Ability Enhancement Course	ACS/205/AEC-2	MIL-1	**2**	**10**	**40**	**50**			
6. Value Added Course	ACS/206/VAC-2	Any one of the followings: 1. Understanding India: Indian Philosophical Traditions and Value Systems 2. Health and Wellness 3. Basics of	**4**	**10**	**40**	**50**			

		Indian Constitution 4. Arts and Crafts of Bengal 5.Historical Tourism in West Bengal							
Total Credit = 4+4+3+3+2+4 = 20				**Total Number of Courses = 6**					

N.B. : S = Science, PHS = Physics, MJ = Major, MN = Minor, ACS = Arts Commerce Science, C = Core Course, AEC = Ability Enhancement Course, SEC = Skill Enhancement Course, DSC = Discipline Specific Core, DSE = Discipline Specific Elective, VAC = Value Added Course, MD = Multidisciplinary, I.A. = Internal Assessment, ESE = End-Semester Examination, Lec. = Lecture, Tu.= Tutorial, and Lab. = Laboratory

Bankura University Syllabus for Physics-2023-2027

PROGRAMME OUTCOME

The Undergraduate (UG) programme of Physics is composed of major, minor and interdisciplinary subjects. The syllabus is based on the National education policy which covers almost all the fields of Physics. The students will be enriched with plenty of knowledge after the completion of the course. The complete syllabus is compatible with the competitive examination for higher studies and research. In this programme there are various multidisciplinary courses. The students will acquire multidisciplinary skills which will be of tremendous value to them.

Sem-I

For DSC paper
(Major)
Credit-3+1

CoreT-1–Mechanics and General Properties of Matter (3 Credits)

1. Vector Calculus

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 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.

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems (Elementary idea only)

2. 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.

3. Work and Energy

Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Qualitative study of one-dimensional motion from potential energy curves. Stable and unstable equilibrium. Elastic potential energy/ instantaneous and average power. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

4. 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. Condition of pure rolling without sleeping. Ellipsoid of inertia.

5. Fluid Motion

Motion of ideal fluids. Streamlines and streamline flow. The continuity equation. Euler's equation for an incompressible fluid. Steady flow. Bernoulli's theorem and its applications. Toricelli's expression for the velocity of efflux of a liquid. Venturimeter. Kinematics of Moving Fluids, Poiseuille's Equation for flow of a liquid through Capillary, Bernoulli's theorem and the derivation of the Bernouli's equation. Principle of Pitot tube.

6. Elasticity

Stress and strain. Hooke's law. Elastic moduli and their interrelationship. Strain-energy in a stretched wire. Strain-energy associated with a pure strain. Torsion of a wire. Torsional oscillations. Loaded beams. Bending moment. Stresses induced by bending. The cantilever. Beam supported at its two ends and carrying a load at any point of the beam/ reciprocal theorem of light cantilever.

7. 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)/ energy and nature of orbits for particle motion under central force.

Reference Books

► An Introduction to Mechanics, D. Kleppner, R. J. Kolenkov,1973, McGraw-Hill.
► Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al.2007, Tata McGraw-Hill.
► 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. Young13/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.

Course Outcomes:

1. Develop the concepts of classical mechanics, vector, vector differentiation and integration.
2. Acquire knowledge about the elasticity of the material and the streamline and turbulent motion. Understand the relationship between elastic constants.
3. Understand how major concepts developed and changed over time.
4. Capable of analyzing and solving problems using oral and written reasoning skills based on the concepts of classical mechanics.

Ability to prepare and organize a presentation on the application of fundamental dynamics

CoreP-1–Mechanics and General Properties of Matter Lab (1 Credit)

List of practical (Minimum *Three* from the following experiments)

1. To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity.
2. Determination of the Young's modulus of a material in the form of a bar by the method of flexure.
3. Determination of the coefficient of viscosity of highly viscous liquid by Stoke's method.
4. To determine the value of **g** by using Bar Pendulum.
5. To determine the value of **g** by using Kater's Pendulum.

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, reprinted1985, Heinemann Educational Publishers.
► A Text Book of Practical Physics, I. Prakash & Ramakrishna,11th Edn,2011, Kitab Mahal.
► Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

Course Outcomes:

1. Students will learn to use the screw gauge, slide callipers, microscope, telescope.
2. They will know how to experimentally measure the Young's modulus, coefficient of viscosity of liquid, acceleration due to gravity, spring constant.

(Minor)
Credit-3+1

CoreT-1–Mechanics and General Properties of Matter (3 Credits)

1. Vector Calculus

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 Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. (Elementary idea only) Divergence and curl of a vector field. (Elementary idea only) Del and Laplacian operators. Vector identities.
Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems (Elementary idea only).

2. 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, Principle of conservation of momentum, Impulse.

3. Work and Energy

Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Qualitative study of one-dimensional motion from potential energy curves. Stable and unstable equilibrium. Elastic potential energy/ instantaneous and average power. Force as gradient of potential energy. Work & Potential energy, Law of conservation of Energy.

4. 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.

5. Fluid Motion

Motion of ideal fluids. Streamlines and streamline flow. The continuity equation. Euler's equation for an incompressible fluid. Steady flow. Bernoulli's theorem and its applications. Venturimeter. Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through Capillary, Bernoulli's theorem and the derivation of the Bernouli's equation.

6. Elasticity

Stress and strain. Hooke's law. Elastic moduli and their interrelationship. Strain-energy in a stretched wire. Strain energy associated with a pure strain. Torsion of a wire. Torsional oscillations. Loaded beams. Bending moment. Stresses induced by bending. The cantilever. Beam supported at its two ends and carrying a load at any point of the beam/ reciprocal theorem of light cantilever.

7. 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.

ReferenceBooks

- ► An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- ► Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
- ► Physics, Resnick, Halliday and Walker8/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 Young13/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.

Course Outcomes:

5. Develop the concepts of classical mechanics, vector, vector differentiation and integration.
1. Acquire knowledge about the elasticity of the material and the streamline and turbulent motion. Understand the relationship between elastic constants.
2. Understand how major concepts developed and changed over time.
3. Capable of analyzing and solving problems using oral and written reasoning skills based on the concepts of classical mechanics.

Ability to prepare and organize a presentation on the application of fundamental dynamics

CoreP-1–Mechanics and General Properties of Matter Lab (1 Credit)

List of practical (Minimum Three from the following experiments)

1. To study the Motion of Spring and calculate, (a) Spring constant, (b) **g** and(c) Modulus of rigidity.
2. To determination of the Young's modulus of a material in the form of a bar by the method of flexure.
3. Determination of the coefficient of viscosity of highly viscous liquid by Stoke's method.
4. To determine the value of **g by** using Bar Pendulum.
5. To determine the value of **g** by using Kater's Pendulum.

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, reprinted1985, Heinemann Educational Publishers
► A Text Book of Practical Physics, I. Prakash & Ramakrishna,11thEdn, 2011, Kitab Mahal
► Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

Course Outcomes:

1. Students will learn to use the screw gauge, slide callipers, microscope, telescope.
2. They will know how to experimentally measure the Young's modulus, coefficient of viscosity of liquid, acceleration due to gravity, spring constant.

Multidisciplinary
(Credit-3)

Fundamentals of Physics-I (3 Credits)

1. Vector Analysis

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. 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).

2. Laws of Motion

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

3. Momentum and Energy

Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

4. Rotational Motion

Angular velocity and angular momentum. Torque. Conservation of angular momentum.

5. Gravitation

Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in aplane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.

6. Elasticity

Hooke's law–stress-strain diagram, Elastic moduli-relation between elastic constants, Poisson's ratio expression for Poisson's ratio in terms of elastic constants- work done in stretching and work done in twisting a wire – twisting couple on a cylinder –Determination of Rigidity modulus by static torsion- Torsional pendulum- Determination of Rigidity modulus and moment of inertia by Searles method.

7. Special Theory of Relativity

Postulate of special theory of relativity. Lorentz transformations. Simultaneity and order of events. Lorentz contraction. Time dilation, relativistic transformation of velocity, relativistic addition of velocities.

8. Sound

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Linearity & Superposition Principle.

Qualitative discussions on Damped oscillations, Forced vibrations and resonance. Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation; Absorption coefficient; Sabine's formula; measurement of reverberation time; Acoustic aspects of halls and auditoria.

9. Electrostatics

Electrostatic Field, electric flux, Gauss's law in electrostatics. Applications of Gauss's law-Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet and disc, 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, Polarization, Displacement vector. Parallel-plate capacitor completely filled with dielectric.

Reference Books

► UniversityPhysics. F.W. Sears, M.W. Zemansky and H.D. Young,13/e, 1986. Addison-Wesley
► Mechanics Berkeley Physics, vol-1: Charles Kittel, et.al. 2007, Tata McGraw-Hill.
► Physics –Resnick, Halliday & Walker 9/e, 2010, Wiley
► Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
► University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Course Outcomes:

1. Students will learn and develop the concepts of vector and basic knowledge of the vector differential operator Del and understand the operation on the scalar and vector field.
2. Students will Learn and realize about vector theorems like Divergence and Green theorem etc.
3. Students will develop the concepts on classical mechanics and enhance the basic knowledge of the non-inertial and inertial frame of reference, variable mass, rocket motion, special theory of relativity.
4. They will acquire knowledge about the elasticity of the material and the streamline and turbulent motion.
5. Enhance the capability to prepare and organize a presentation on the application of fundamental dynamics.
6. They can understand the relation between electrical charge, electrical field, electrical potential
7. They can understand and realize the superposition of SHM collinearly and perpendicularly and can study the Beat ant Lissajous figures.

Skill Enhancement Course (SEC-1)
(3 Credits: 2 Th. + 1 Lab)

T1-Basics of Computer and Python Programming (2 credit)

1. Introduction and Overview Computer architecture and organization, memory and Input/output devices.
2. 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
3. Errors and error Analysis; Truncation and round off errors, Absolute and relative errors, Floating point computations.
4. Introduction to programming in python: Introduction to programming, constants, variables and data types, dynamical typing, operator sand expressions, modules, I/O statements, iterables, compound statements, indentation in python, the if-elif-else block, for and while loops, nested compound statements, lists, tuples, dictionaries and strings, basic ideas of object-oriented programming.

4. Introduction to Computer Programming:

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).

5. Introduction of graph plotting:

Matplotlib as plotting device. Basics of plotting of function (i) x, (ii) x^2, (iii) x^3, (iv) trigonmetric functions, (v) Hyperbolic functions. Plot of 3D, Color map, Bar chart plots, circular plots, Plot from data file, saving the figures, subplots, multiple plot, Curve fitting, Least square fit, Goodness of fit, standard deviation.

P1- Basics of Computer and Python Programming (1 credit)

(Any five from the followings)

1. Write a program to calculate the multiplication and sum of two numbers.
2. Write a program to print the sum of the current number and the previous number
3. Write a program to add the even numbers from 1-100.
4. Write a program to add the odd numbers from 1-100.
5. Write a program to calculate the area of a circle/square/triangle.
6. Write a program to sort the number in ascending and descending order.
7. Write a program to find the largest of a given list of numbers
8. Write a program to check if the first and last number of a list is the same or not.
9. Write a program to display numbers divisible by 5 from a list.
10. Print the following pattern

    1
    2 2
    3 3 3
    4 4 4 4
    5 5 5 5 5

11. Write a program to print a 3x3 matrix.
12. Plot the graph of a sine, cos, and tan curves.
13. Plot the graph of f(x) vs x or x^2 or x^3
14. Plot the graph of e^x, e^{-x}, and log(x).
15. Plot the graph of $ax + b/x^2$, where a and b are positive constants.
16. Plot the graph from a data file.
17. Calculation of resistance from Ohms law by using least square fitting.

Reference books

► Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.

► Learning with Python-how to think like a computer scientist, J. Elkner, C. Meyer, and A. Downey, 2015, Dreamtech Press.

► Introduction to computation and programming using Python, J. Guttag, 2013, Prentice Hall India.

► Effective Computation in Physics-Field guide to research with Python, A. Scopatzand K.D. Huff, 2015, O'Rielly

► A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.

► Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, 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, DarrenWalker,1st Edn., 2015, Scientific International Pvt. Ltd

Course Outcomes:

1. There is a scope to know the computer architecture.
2. There is a scope to study the Python programming language.
3. The students will be able to learn how can solve any physical problem in Python.
4. There is a scope to learn the graph plotting.

Sem II

For DSC paper
(Major)
Credit: 3+1

Core T-2–Electricity and Magnetism (3 Credits)

1. Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss's 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. Concept of electrical monopole, dipole, quadrupole, multipole. Potential and Electric Field due to monopole, dipole, quadrupole and multipole expansion. Force and Torque on a dipole. Dipole-dipole interaction energy. Electrostatic energy of a 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, Cylindrical and Spherical capacitors. Capacitance of an isolated conductor. Uniqueness theorem (statement). Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

2. 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.

3. 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) infinite straight wire, (2) Infinite planar surface current, and (3) Solenoid. Properties of B: curl and divergence. Axial vector property of B and its consequences. 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.

4. Electromagnetic Induction and Magnetic Properties of Matter

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. Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Origin of Dia-magnetism, Para-magnetism and Ferro -Magnetism. B-H curve and hysteresis.

5. 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.

6. 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.

Reference Books

► Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw Hill.
► Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
► Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
► FeynmanLecturesVol.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.

Course Outcomes:

The course will help the students to understand the basic concepts of electrostatics including electric field, potential, electrostatic energy, electric dipole etc. They should be able to understand Laplace's equation, Poisson's equation, method of images and their application to simple electrostatic problems. The students will also acquire knowledge about dielectric properties of matter and application of laws of electrostatics for dielectric materials. This course will provide the students with basic knowledge of magnetostatics i.e. magnetic effect of current and related laws of physics. On completion of the course students will learn about electromagnetic induction, magnetic properties of matter, operation of different ac electrical circuits, network theorem, etc.

Core P-2–Electricity and Magnetism Lab (1 Credit)

List of Practical (Minimum three from the following experiments should be done)

1. To verify the Thevenin, Norton and Maximum power transfer theorems.
2. 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) Bandwidth.
3. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
4. Determination of the boiling point of a suitable liquid using a platinum resistance

thermometer.

5. Construction of one Ohm coil.

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,11thEd., 2011, Kitab Mahal

► Advanced level Physics Practicals, Michael Nelson and J. 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.

Course Outcomes:

On performing the laboratory experiments students should have a rudimentary grasp on how experimental equipment related to electricity and magnetism can be used. They will have a better insight by experimentally verifying some of the laws/theorems of electricity and magnetism.

(Minor)
Credit: 3+1

Core T-2–Electricity and Magnetism (3 Credits)

1. Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss's 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 (statement only). 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. Parallel-plate capacitor. Capacitance of an isolated conductor.

2. 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.

3. 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) infinite straight wire and (3) Solenoid. 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.

4. 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. 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.

5. 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.

6. Network theorems

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem. Applications to simple dc circuits.

Reference Books

► Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw Hill.
► Electricity and Magnetism, Edward M. Purcell,1986 McGraw-Hill Education
► Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
► Feynman LecturesVol.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.

Course Outcomes:

The course will help the students to understand the basic concepts of electrostatics including electric field, potential, electrostatic energy, electric dipole etc. They should be able to understand Laplace's equation, Poisson's equation, method of images and their application to simple electrostatic problems. The students will also acquire knowledge about dielectric properties of matter and application of laws of electrostatics for dielectric materials. This course will provide the students with basic knowledge of magnetostatics i.e. magnetic effect of current and related laws of physics. On completion of the course students will learn about electromagnetic induction, magnetic properties of matter, operation of different ac electrical circuits, network theorem, etc.

Core P-2–Electricity and Magnetism Lab (1 Credit)

List of Practical (Minimum three from the following experiments should be done)

1. To verify the Thevenin, Norton and Maximum power transfer theorems.
2. 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) Bandwidth.
3. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
4. Determination of the boiling point of a suitable liquid using a platinum resistance thermometer.
5. Construction of one Ohm coil.

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,11thEd., 2011, Kitab Mahal

► 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,CengageLearning.

► A Laboratory Manual of Physics forunder graduate classes, D.P. Khandelwal, 1985, Vani Pub.

Course Outcomes:

On performing the laboratory experiments students should have a rudimentary grasp on how experimental equipment related to electricity and magnetism can be used. They will have a better insight by experimentally verifying some of the laws/theorems of electricity and magnetism.

Multidisciplinary

(Credit-3)

Fundamentals of Physics-II (3 Credits)

1. Magentic field and Electromagnetic induction

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. Electromagnetic Induction, Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, Mutual inductance of two coils. Energy stored in magnetic field.

2. Magnetic properties of materials

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

3.Kinetic Theory of Gases

Mean free path (zeroth order), Law of equipartition of energy (no derivation) and its applications to specific heat of gases, mono-atomic, diatomic and triatomic gases.

4. Laws of Thermodynamics

Thermodynamic description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various thermodynamic processes, Applications of First Law: General relation between C_p and C_v, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law of thermodynamics and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

5. Introduction of Modern Physics

Structure of matter, Concept of molecule, atom, nuclei and quark. Thompson atom model, Rutherford atom model, Bohr's atom model and concept of energy levels, ionization and

excitation potentials. X-rays, production (Coolidge tube), continuous and characteristic-X-rays, soft and hard X-rays, and applications. Photo electric effect, Compton scattering and pair production. Elementary of black body radiation and wave particle duality.

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 LaneReese,2003, Thomson Brooks/Cole.
- ► D.J. Griffiths, IntroductiontoElectrodynamics,3rdEdn,1998, Benjamin Cummings
- ► Thermal Physics, S. Garg, R. Bansal and C.Ghosh, 1993, Tata McGraw-Hill.
- ► A Treatise on Heat, Meghnad Saha, and B.N. Srivastava,1969, Indian Press.
- ► Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- ► Heat and Thermodynamics, M.W. Zemasky and R. Dittman, 1981, McGrawHill
- ► Thermodynamics, Kinetic theory & Statistical Thermodynamics, F.W. Searsand
- ► G.L. Salinger.1988, Narosa
- ► University Physics, Ronald LaneReese,2003, Thomson Brooks/Cole.
- ► Thermal Physics, A. Kumar and S.P.Taneja, 2014,R.chand Publications.

Course Outcomes:

After completion of the course the students should understand the basic concepts about magnetic effect of current, basic concepts about different types of magnetic materials and electromagnetic induction. This course further enables the students to acquire knowledge about basic concepts of kinetic theory of gases. They will also gain knowledge about laws of thermodynamics and their application to different thermodynamic processes. This course will further help the students to acquire knowledge on basic modern physics such as structure of matter, atomic model, production of x-rays, theory of photo electric effect, Compton scattering, pair production and black body radiation.

Skill Enhancement Course (SEC-2)

(3 Credits: 2 Th. + 1 Lab)

T2-Basic Instrumentation Skills (2 credit)

1. Basic of Measurement, Instruments accuracy, precision, sensitivity, resolution range, etc. Errors in measurements and loading effects. Multi-meter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multi-meter and their significance.

2. Electronic Voltmeter Advantage over conventional multi-meter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multi-meter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

3. 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.

4. Digital Instruments, Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. Digital Multi-meter Block diagram and working of a digital multi-meter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time-base stability, accuracy and resolution.

P2-Basic Instrumentation Skills (1 credit)

List of Practical (Minimum three from the following experiments should be done)

1. To observe the loading effect of a multi-meter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multi-meter for measuring low/high frequency voltage and currents.
3. Measurement of a low resistance using a Carry-Foster bridge
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of a current through low resistance using a potentiometer.
6. Measurement of rise, fall and delay times using a CRO.
7. Converting the range of a given measuring instrument (voltmeter, ammeter)

Course Outcomes:

Through this course, the students will develop the ideas about the basics of measurements. They learn the uses of various instruments like electronic voltmeter, cathode ray oscilloscope (CRO), Signal Generators and Analysis Instruments, Impedance Bridges & Q-Meters and some digital instruments.