# FYUG(Physics) Course Curriculum Structure and syllabus for 1st Semester

| Year | Semester | Major (Credit) | Minor (Credit) | MDC (Credit) | AEC (Credit) | SEC*/ Dissertation (Credit) | Experiential Learning (Credit) | VAC (Credit) | Total Credits | Additional Summer Internship |
|---|---|---|---|---|---|---|---|---|---|---|
| I | I | Major – 1 (4)<br>(Level 100)<br><br>MJC45PHY101(T)25 : Mechanics (Credit: 03)<br><br>MJC45PHY101(P)25 : Mechanics (Credit: 01) | Minor – 1 (4)<br>(Level 100)<br><br>MNC45PHY101(T)25: Mechanics (Credit: 03)<br><br>MNC45PHY101(P)25: Mechanics (Credit: 01) | MDC - 1 (3)<br><br>MDC45PHY101 (T)25 Introduction to Physics: (Credit:03) | AEC – 1 (Communication Skills) (4) | SEC – 1 (3)<br><br>Computational Physics: SEC45PHY101a(T) 25 (Credit: 02)<br>+<br>SEC45PHY101a(P) 25 (Credit: 01)<br><br>**Or**<br><br>Electrical Circuits and Network Skills: SEC45PHY101b(T) 25 (Credit: 02)<br>+<br>SEC45PHY101b(P) 25 (Credit: 01) | | VAC – 1 (2) | 20 | Additional for Bachelor's Certificate (4) |

# Course title: Mechanics
# Credit: 04 (3+1)
# Theory: 45 Hours
# Practical: 30 Hours

## Course Objective

This course introduces the foundational theories, concepts, and principles of mechanics from a more advanced perspective. The topics covered include Newton's Laws of Motion, Rotational Dynamics, Gravitation and Central Force Motion, Non-inertial Systems, Special Theory of Relativity, etc. The students will be able to apply the concepts learnt to several real world problems.

## Course Learning Outcomes

Upon completion of this course, students are expected to

- Understand laws of motion and their applications to various dynamical situations.
- Learn the concept of inertial reference frames and Galilean transformations. Also, the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand translational and rotational dynamics of a system of particles.
- ApplyKepler's laws to describe the motion of planets and satellite in circular orbit.
- Explain the phenomenon of simple harmonic motion (SHM).
- Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.

In the practical component, the student shall perform experiments related to mechanics: compound pendulum, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity), fluid dynamics, estimation of random errors in the observations, etc.

# MJC45PHY101(T)25: Mechanics
# Credit: 03
# Theory: 45 Hours

**Unit 1**

**Fundamentals of Dynamics:** Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D).

**(5 Lectures)**

**Unit 2**

**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Work done by non-conservative forces. Law of conservation of Energy.

**(4 Lectures)**

**Unit 3**

**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, theorem of parallel and perpendicular axes. Determination of moment of inertia of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D). Kinetic energy of rotation. Motion involving both translation and rotation.

**(8 Lectures)**

**Unit 4**

**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. Two-body problem, its reduction to one- body problem and its solution. Reduction of angular momentum, kinetic energy and total energy. The energy equation and energy diagram. Kepler's Laws.

**(8 Lectures)**

**Unit 5**

**Oscillations:** Idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Compound pendulum. Damped oscillations. Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor.

**(6 Lectures)**

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

**(4 Lectures)**

**Unit 6**

**Special Theory of Relativity:** Michelson-Morley Experiment (only qualitative description) and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity, Length contraction, and Time dilation. Relativistic transformation of velocity, acceleration, frequency and wave number. Mass of relativistic particle, massless particles, mass-energy equivalence and relativistic Doppler effect (transverse and longitudinal).

**(10 Lectures)**

# MJC45PHY101(P)25: Mechanics
# Credit: 01
# Practical: 30 Hours

## Practical: 30 Hours

Demonstration cum laboratory sessions on the construction and use of Vernier callipers, screw gauge and travelling microscope, and necessary precautions during their use.

Sessions and exercises on the least count errors, their propagation and recording in final result up to correct significant digits, linearization of data and the use of slope and intercept to determine unknown quantities.

Session on the writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error and explanation of its sources, correct recording of the result of the experiment, and proper referencing of the material taken from other sources (books, websites, research papers, etc.)

At least 06 experiments from the following

1. Measurements of length (or diameter) using Vernier Calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the value of g using Bar Pendulum.
4. To determine the value of g using Kater's Pendulum.
5. To determine the height of a building using a Sextant.
6. To study the motion of the spring and calculate (a) Spring constant and, (b) g.
7. To determine the Moment of Inertia of a Flywheel.
8. To determine g and velocity for a freely falling body using Digital Timing Technique.
9. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
12. To determine the elastic Constants of a wire by Searle's method.

**References for Theory- Essential Readings:**


1. An Introduction to Mechanics (2/e), Daniel Kleppner & Robert Kolenkow, 2014, Cambridge University Press.
2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education.
3. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education.
4. Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.
5. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, Cengage Learning.

**Additional Readings:**

1. Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson

   Education.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3. University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4. Fundamentals of Physics, Resnick, Halliday & Walker 10/e, 2013, Wiley.
5. Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.
6. Physics for Scientists and Engineers, R. A. Serway, J. W. Jewett, Jr, 9/e, 2014, Cengage Learning.
7. Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.

**References for Laboratory Work:**

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11/e, 2011, Kitab Mahal.

# Course Title: Computational Physics
# Credit: 03 (2+1)
# Theory: 30 Hours
# Practical: 30 Hours

## Course Objectives:

This course is designed to introduce students to the fundamental concepts of computer programming using the Python language. It aims to develop computational thinking, logical reasoning, and problem-solving abilities by engaging students in writing simple programs, understanding program flow, and working with basic data structures. The course also seeks to build confidence in coding and lay a strong foundation for further study in programming or data science.

## Course learning outcomes:

By the end of this course, students will be able to understand the basic structure and syntax of Python programming, including the use of variables and fundamental data types such as strings, integers, floats, and booleans. They will be able to apply arithmetic and logical operations to solve simple problems and write Python programs using control structures like conditional statements (if, else, elif) and loops (for, while). Students will also learn to work with essential data structures such as lists, tuples, and dictionaries, and use both built-in and user-defined functions to create modular and reusable code. They will gain proficiency in handling input and output operations, debugging common errors, and developing algorithmic thinking.

# Course Code: SEC45PHY101a(T)25
# Credit: 02
# Theory: 30 Hours

**Unit 1: Introduction**

Basics of Programming Languages, Interpreter and Compiler, Algorithms and Flowcharts, History and features of Python, Python 3 vs. Python 2, Installing Python and IDEs (Anaconda, PyCharm, Jupyter Notebook etc.)

**Basics of Python:** Python Keywords, Identifiers and Variables, Data Types, Backslash Character Constants.

**Operators and Expressions:** Arithmetic Operators, Relational Operators, Logical/Boolean Operators, Assignment Operators, interactive mode and Script mode, Order of Operations, Comments in Python, Common Errors, Managing Input and Output Operations, Frequently used Formatting Specifiers.

(**7 lectures)**

**Unit 2: Control Structures**

**Decision making and Branching:** Conditional statements (Simple if, if-else, else-if ladder, nested-if statements), Boolean values.

**Decision making and Looping:** The while loop statement, The for loop statement, The range () function, Jumps in Loops, Skipping a part of a Loop, The else Clauses on Loops.

**Functions:** Types of Functions, Nesting of Functions, Boolean Function, Recursion Function, Default Arguments, Lambda function.

**(7 lectures)**

**Unit 3: Data Structures**

**List:** Definition, The in operator, Traversing in a List, Nested List, List Operations, List Slices, List Functions, List Methods, Copying Lists, Sorting Lists, Two-Dimensional Lists, Multidimensional Lists.

**Dictionaries:** Definition, Creating a Dictionary, Adding, Modifying, and Retrieving Values, The Dictionary Methods.

**Sets :** Accessing Sets with common functions**,** Subset and Superset in Sets, Relational operators in Sets, Set Operations.

**Tuples :** Definition, Tuple Assignment, Tuples as Return Values, The Basic Tuple operations, Relationship between Lists and Tuples, Relationships between Dictionaries and Tuples.

(**7 lectures)**

**Unit 4: File Handling**

Introduction, Text files and Binary files, Absolute and Relative filename, Opening a File, Writing Data, Some commonly used methods for File handling
Writing and Reading Numeric Data. Data visualization with matplotlib.

**(4 lectures)**

**Unit 5: Applications to Computational Physics**

What is computational physics? Oscillatory Motion (SHM), Damped pendulum dynamics, Basics of Fractals, Random Numbers in Computer Simulation, Applications of Monte Carlo Method.

(**5 lectures)**

## Course Code: SEC45PHY101a(P)25
## Credit: 01
## Practical: 30 Hours

1. Write Python programs for the following with and without recursive functions:
   A. To convert decimal numbers to binary numbers.
   B. Write a Python program to reverse the digits of an integer
   C. To find the Greatest common divisor (GCD) of two numbers
2. Write a Python program to verify a given number is prime or not.
3. Write a Python program to generate prime numbers between any two given numbers.
4. Write a Python program to organize a given set of numbers in ascending and descending orders.
5. Write a Python program to generate Fibonacci series.
6. Write a Python program to find out the Prime numbers from a sequence of Fibonacci series.
7. Write a Python program to check a given number is an Armstrong number or not.
8. Write a Python program to check a given year is a Leap year or not.
9. Write a Python program to print Pascal Triangle.

10. Write a Python program to solve the Tower of Hanoi.

**References:**


1. M. Shubhakanta Singh, *Programming with Python and its applications to Physical Systems*, Taylor and Francis, 2024.
2. Allen B. Downey, *Think Python*, Green Tea Press, 2014.
3. Hans Peter Langtangen, *A Primer on Scientific Programming with Python*, Springer, 2012.
4. S. Hilborn, R.C., *Chaos and Nonlinear Dynamics, An Introduction for Scientists and Engineers*, Ed. 2, Oxford University Press, USA, 2004.
5. Pang, Tao, *Introduction to Computational Physics, Ed. 2.*, Cambridge University Press, NY, 2006,
6. Landau, Rubin H., *Computational Physics: Problem solving with Computers,* John Wiley and Sons, Inc.,1997.

# Course Title: Electrical circuits and Network Skills

## Credit: 03 (2+1)

## Theory: 30 Hours

## Practical: 30 Hours

### Course Objectives

To develop an understanding of basic principles of electricity and its household applications. To impart basic knowledge of solid state devices and their applications, understanding of electrical wiring and installation.

### Course Leaning Outcomes

At the end of this course, students will be able to

- Demonstrate good comprehension of basic principles of electricity including ideas about voltage, current and resistance.
- Develop the capacity to analyze and evaluate schematics of power efficient electrical circuits while demonstrating insight into tracking of interconnections within elements while identifying current flow and voltage drop.
- Gain knowledge about generators, transformers and electric motors. The knowledge would include interfacing aspects and consumer defined control of speed and power.
- Acquire capacity to work theoretically and practically with solid-state devices. Delve into practical aspects related to electrical wiring like various types of conductors and cables, wiring-Star and delta connections, voltage drop and losses.
- Measure current, voltage, power in DC and AC circuits, acquire proficiency in fabrication of regulated power supply.
- Develop capacity to identify and suggest types and sizes of solid and stranded cables, conduit lengths, cable trays, splices, crimps, terminal blocks and solder.

## Course Code: SEC45PHY101b(T)25

## Credit: 02

## Theory: 30 Hours

**Unit 1**

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

**(3 Lectures)**

Electrical Circuits: Basic electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. 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.

**(4 Lectures)**

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.

**(4 Lectures)**

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

**(2 Lectures)**

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters and motors. Speed & power of ac motor.

**(3 Lectures)**

**Unit 2**

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.

**(3 Lectures)**

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device.

**(3 Lectures)**

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, and solder. Preparation of extension board.

**(5 Lectures)**

Network Theorems:(1) Thevenin theorem (2) Norton theorem (3) Superposition theorem (4) Maximum Power Transfer theorem.

**(3 Lectures)**

**Course Code: SEC45PHY101b(P)25**
**Credit: 01**
**Practical: 30 Hours**

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the physics lab, including necessary precautions.

Sessions on the review of experimental data analysis and its application to the specific experiments done in the lab.

At least 08 Experiments from the following

1. Series and Parallel combinations: Verification of Kirchoff's law.
2. To verify network theorems: (I) Thevenin (II) Norton (III) Superposition theorem (IV) Maximum power transfer theorem
3. To study frequency response curve of a Series LCR circuit.
4. To verify (1) Faraday's law and (2) Lenz's law.
5. Programming with Pspice/NG spice.
6. Demonstration of AC and DC generator.
7. Speed of motor
8. To study the characteristics of a diode.
9. To study rectifiers (I) Half wave (II) Full wave rectifier (III) Bridge rectifier
10. Power supply (I) C-filter, (II) π- filter
11. Transformer – Step up and Step down
12. Preparation of extension board with MCB/fuse, switch, socket-plug, Indicator.
13. Fabrication of Regulated power supply.

It is further suggested that students may be motivated to pursue semester long dissertation wherein he/she may do a hands-on extensive project based on the extension of the practicals enumerated above.

**References Essential Readings:**

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
2. A text book in Electrical Technology - B L Theraja - S Chand & Co.
3. Performance and design of AC machines - M G Say ELBS Edn.
4. Electronic Devices and Circuits, A. Mottershead,1998, PHI Learning Pvt. Ltd.
5. Network, Lines and Fields, John D. Ryder, Pearson Ed. II, 2015.

**Additional Readings:**

1. Electrical Circuit Analysis, K. Mahadevan and C. Chitran, 2nd Edition, 2018, PHI learning Pvt. Ltd.

# Introduction to Physics: MDC45PHY101(T)25
# Credit:03
# Theory: 45 Lectures

## Course Objective

- To give an introduction to the fundamentals of Physics.
- To give introductory concepts on units and measurement, scalar and vectors, laws of motion, work, power and energy, electricity and magnetism, geometry and wave optics, gravity and planetary motion, wave and oscillation, and electronics.

## Course learning Outcomes

- They will understand the basic concepts of units and measurements, motion, optics, electricity and magnetism, energy, waves and oscillation and the concept of electronics which are the fundamental parts of Physics and its application in everyday life.
- On successful completion of the course, students will be able to understand the preliminary idea of the concept of Physics and its phenomena in our daily lives.

**Unit 1**

**Units And Measurement**

Units of measurement, system of units, SI units, fundamental and derived units.

**(2 lectures)**

**Scalar And Vectors**

Vector notation, equality of vectors, vector addition, product of vectors, scalar product and vector product. Position and displacement vectors.

**(4 lectures)**

**Unit 2**

**Laws Of Motion**

Inertia, Newton's law of motion. law of conservation of linear momentum and its applications, impulse, friction and lubrication. Uniform circular motion: centripetal force, centrifugal force, torque, angular momentum, Law of conservation of angular momentum and its applications.

**(6 lectures)**

**Unit 3**

**Work, Power and Energy**

Work done by a force. Kinetic energy and potential energy, work-energy theorem, power.

**(2 lectures)**

**Unit 4**

**Waves and oscillations:**

Longitudinal and transverse waves (with examples), periodic motion. Simple harmonic motion (SHM), simple pendulum. Child on a swing, tuning fork, motion of a spring, damped and forced oscillations. **(5 Lectures)**

**Unit 5**

**Gravity and Planetary Motion**

Historical evolution of the concept of gravity: from Aristotle to Newton. gravitational forces in nature: everyday implications, the Universal Law of Gravitation, Kepler's Laws of planetary motion. Role of gravity in maintaining orbital motion, moon's journey around the earth- lunar cycle, tides and gravitational interactions. Satellites.

**(6 Lectures)**

**Unit 6**

**Electricity and Magnetism:**

Electric lines of force, electric permittivity, electric field and potential, electric flux, electrostatic shielding, Lorentz force, magnetic induction. permeability, magnetic susceptibility. brief introduction to dia-, para- and ferro-magnetic materials. electromagnetic induction, eddy current, alternating current, direct current, resistors, capacitors and inductors, electric generators, electric motor and transformer**.**

**(8 lectures)**

**Unit 7**

**Geometric and Wave Optics:**

Electromagnetic spectrum, dual nature of light, reflection, refraction, interference, diffraction, dispersion, scattering, structure of human eye, defects of eye (myopia, hypermetropia, presbyopia and astigmatism) and its remedy, lasers, optical fiber communication. holography, optical phenomena related to daily life (rainbow, halo, mirage, colour of sky etc.).

**(8 lectures)**

**Unit 8**

**Electronics:**

Diode, transistor, solar cell, IC microprocessor, concept of pixel as used in electronic displays, digital data communication (internet).

(*All qualitative only) **(4 Lectures)**

**Reference Books:**


1. Elements of Properties of Matter, D.S. Mathur, 2008, S. Chand and Company Limited
2. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
3. Concept of Physics (I &II), H.C Verma.
4. NCERT Physics Textbooks (Class 9,10 11 &12)
5. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
6. Optics, Ajay Ghatak, 6th ed., 2017, Tata McGraw Hill.
7. Electricity and Magnetism, D.C.Tayal, 1993, Himalaya Publishing House.
8. Electricity and Magnetism, J H Fewkes & J Yarwood, Oxford University Press, Calcutta, 1985
9. SWAYAM/NPTEL modules on basic physics

# FYUG(Physics) Course Curriculum Structure and syllabus for 2nd Semester

| Year | Semester | Major (Credit) | Minor (Credit) | MDC (Credit) | AEC (Credit) | SEC*/ Dissertation (Credit) | Experiential Learning (Credit) | VAC (Credit) | Total Credits | Additional Summer Internship |
|---|---|---|---|---|---|---|---|---|---|---|
| I | I | Major – 2 (4) (Level 100)<br><br>MJC45PHY102(T)25 : Electricity and Magnetism (Credit: 03)<br><br>MJC45PHY102(P)25 : Electricity and Magnetism (Credit: 01) | Minor – 2 (4) (Level 100)<br><br>MNC45PHY102 (T)25: Electricity and Magnetism: 03)<br><br>MNC45PHY102( P)25: Electricity and Magnetism (Credit: 01) | MDC - 2(3)<br><br>MDC45PHY102 (T)25 Introduction to Physics: (Credit:03) | AEC – 2 (Academic Writing) (4) | SEC – 2 (3)<br><br>Renewable Energy and Energy harvesting: SEC45PHY102a (T)25 (Credit: 02) + SEC45PHY102a (P)25 (Credit: 01)<br><br>**Or**<br><br>Radiation Safety: SEC45PHY102b (T)25 (Credit: 02) + SEC45PHY102b (P)25 (Credit: 01) | | VAC – 2 (2) | 20 | Additional for Bachelor's Certificate (4) |

**Course Title: Electricity and Magnetism**
**Credit: 04 (Theory-03, Practical-01)**
**Theory: 45 Hours**
**Practical: 30 Hours**

**Course Objective:** This course reviews the concepts of electromagnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real-world problems.

**Course Learning Outcomes:** At the end of this course the student will be able to • Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.

• Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.

• Apply Gauss's law of electrostatics to solve a variety of problems.

• Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)

• Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws.

• Understand the basics of electrical circuits and analyze circuits using Network Theorems.

• In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learnt.

# MJC45PHY102(T)25: Electricity and Magnetism
# Credit: 03
# Theory: 45 Hours

**UNIT 1**
**Vectors:** Scalar and vector quantities, scalar and vector product. Scalar triple product and its interpretation in terms of area and volume, vector triple product. Differentiation and integration of vectors, scalar and vector fields, gradient of a scalar field in Cartesian coordinates and its physical significance, divergence and curl of a vector field and their physical significances, curl of a vector in Cartesian coordinates. **6 Lectures**

**UNIT 2**
**Electric Field and Electric Potential:** Electric field: Electric field lines. Electric flux, Gauss Law with applications to charge distributions with cylindrical and planar symmetry. **4 Lectures**
Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field of a dipole. Force and Torque on a dipole. **5 Lectures**

**Electrostatic energy of system charge:** Electrostatic energy of a charged sphere. Conductors in an electrostatic Field, Capacitance of a system of charged conductors, Parallel-plate capacitor, Capacitance of an isolated conductor.
Method of Images and its application to Plane Infinite Sheet and Sphere. **7 Lectures**

**UNIT 3**
**Magnetic Field:** Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple application to 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 Solenoid and Toroid. Properties of B: curl and divergence. Vector Potential. **7 Lectures**

**UNIT 4**
**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. **3 Lectures**

**Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. **4 Lectures**

**UNIT 5**
**AC Circuits:** Complex Reactance and Impedance. Series LCR Circuit: Resonance, Power Dissipation and Quality Factor and Band Width. Parallel LCR Circuit. **4 Lectures**

**Network theorems:** Ideal constant-voltage and constant-current Sources. Review of Kirchhoff's Current and Voltage Laws. Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem. **5 Lectures**

# MJC45PHY102(P)25: Electricity and Magnetism
# Credit: 01
# Practical: 30 Hours

**Practical:**
Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.
Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
Sessions on least square fitting and computer programme to find slope and intercept of straight-line graphs of experimental data. Application to the specific experiments done in the laboratory.
**At least 6 experiments from the following:**
1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using CareyFoster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self-inductance of a coil by Anderson's bridge.
9. 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.
10. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

**References for Theory: Essential Readings:**

1. Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn.1981, McGrawHill.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education 3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
5. Network, Lines and Fields, John D. Ryder, 2 nd Edn., 2015, Pearson.

**Additional Readings:**

1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
5. Schaum's Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

**References for Laboratory Work:**

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia 30 Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S. Panigrahi and B. Mallick,2015, Cengage Learning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

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## Course Title: Electricity and Magnetism
## Credit: 04 (Theory-03, Practical-01)
## Theory: 45 Hours
## Practical: 30 Hours

**Course Objective:** This course reviews the concepts of electromagnetism learnt at school from a more advanced perspective and goes on to build new concepts. The course covers static and dynamic electric and magnetic fields, and the principles of electromagnetic induction. It also includes analysis of electrical circuits and introduction of network theorems. The students will be able to apply the concepts learnt to several real-world problems.

**Course Learning Outcomes:** At the end of this course the student will be able to • Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.

• Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.

• Apply Gauss's law of electrostatics to solve a variety of problems.

• Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)

• Understand the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws.

• Understand the basics of electrical circuits and analyze circuits using Network Theorems.

• In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learnt.

# MNC45PHY102(T)25: Electricity and Magnetism
# Credit: 03
# Theory: 45 Hours

**UNIT 1**

**Vectors:** Scalar and vector quantities, scalar and vector product. Scalar triple product and its interpretation in terms of area and volume, vector triple product. Differentiation and integration of vectors, scalar and vector fields, gradient of a scalar field in Cartesian coordinates and its physical significance, divergence and curl of a vector field and their physical significances, curl of a vector in Cartesian coordinates. **6 Lectures**

**UNIT 2**

**Electric Field and Electric Potential:** Electric field: Electric field lines. Electric flux, Gauss Law with applications to charge distributions with cylindrical and planar symmetry. **4 Lectures**

Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field of a dipole. Force and Torque on a dipole. **5 Lectures**

**Electrostatic energy of system charge:** Electrostatic energy of a charged sphere. Conductors in an electrostatic Field, Capacitance of a system of charged conductors, Parallel-plate capacitor, Capacitance of an isolated conductor.
Method of Images and its application to Plane Infinite Sheet and Sphere. **7 Lectures**

**UNIT 3**
**Magnetic Field:** Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple application to 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 Solenoid and Toroid. Properties of B: curl and divergence. Vector Potential. **7 Lectures**

**UNIT 4**
**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. **3 Lectures**

**Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. **4 Lectures**

**UNIT 5**
**AC Circuits:** Complex Reactance and Impedance. Series LCR Circuit: Resonance, Power Dissipation and Quality Factor and Band Width. Parallel LCR Circuit. **4 Lectures**

**Network theorems:** Ideal constant-voltage and constant-current Sources. Review of Kirchhoff's Current and Voltage Laws. Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem. **5 Lectures**

## MNC45PHY102(P)25: Electricity and Magnetism
## Credit: 01
## Practical: 30 Hours

**Practical:**
Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.
Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.
Sessions on least square fitting and computer programme to find slope and intercept of straight-line graphs of experimental data. Application to the specific experiments done in the laboratory.
**At least 6 experiments from the following:**
1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using CareyFoster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self-inductance of a coil by Anderson's bridge.
9. 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.

10. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

**References for Theory: Essential Readings:**

1. Fundamentals of Electricity and Magnetism, Arthur F. Kip, 2nd Edn.1981, McGrawHill.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education 3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
5. Network, Lines and Fields, John D. Ryder, 2 nd Edn., 2015, Pearson.

**Additional Readings:**

1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol.I, 1991, Oxford Univ. Press.
4. Problems and Solutions in Electromagnetics (2015), Ajoy Ghatak, K Thyagarajan & Ravi Varshney.
5. Schaum's Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

**References for Laboratory Work:**

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia 30 Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S. Panigrahi and B. Mallick,2015, Cengage Learning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

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# Course Title: Renewable energy and energy harvesting
# Credit: 03 (2+1)
# Theory: 30 Hours
# Practical: 30 Hours

## Course Objective

To impart knowledge and hands on learning about various alternate energy sources to teach the ways of harvesting energy using wind, solar, mechanical, ocean, geothermal energy etc. To review the working of various energy harvesting systems which are installed worldwide.

## Course Learning Outcomes

At the end of this course, students will be able to achieve the following learning outcomes:
• Knowledge of various sources of energy for harvesting
• Understand the need of energy conversion and the various methods of energy Storage.
• A good understanding of various renewable energy systems, and its components.
• Knowledge about renewable energy technologies, different storage technologies, distribution grid, smart grid including sensors, regulation and their control.
• Design the model for sending the wind energy or solar energy plant.
• The students will gain hand on experience of:
(i) different kinds of alternative energy sources,
(ii) conversion of vibration into voltage using piezoelectric materials,
(iii) conversion of thermal energy into voltage using thermoelectric modules.

# Course Code: SEC45PHY102a(T)25
# Credit: 02
# Theory: 30 Hours

**Unit 1**
**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, bio-gas generation, geothermal energy tidal energy, Hydroelectricity.

**(3 Lectures)**

**Unit 2**
**Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photo-voltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

**(3 Lectures)**

**Unit 3**
**Wind Energy harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **(6 Lectures)**

**Unit 4**
**Ocean Energy:** Ocean Energy Potential against Wind and Solar, Wave characteristics and and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

**(3 Lectures)**

**Geothermal Energy:** Geothermal Resources, Geothermal Technologies.
**Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Rain water harvesting.

**(6 Lectures)**

**Unit 5**

**Piezoelectric Energy harvesting:** Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezo-electricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power
**Electromagnetic Energy Harvesting:** Linear generators, physical/mathematical models, recent applications Carbon captured technologies, cell, batteries, power consumption Environmental issues and Renewable sources of energy, sustainability. Merits of Rain Water harvesting. **(9 Lectures)**

# Course Code: SEC45PHY102a(P)25
# Credit: 01
# Practical: 30 Hours

Teacher may give long duration project based on this paper.
Sessions on the use of equipment used in the workshop, including necessary precautions.
Sessions on the review of experimental data analysis and its application to the specific experiments done in the lab.

**Demonstrations and Experiments:**

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage-driven thermo-electric modules.

**References**

1. Non-conventional energy sources, B.H. Khan, McGraw Hill 60
2. Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.
4. Solar Energy: Resource Assessment Handbook, P Jayakumar, 2009
5. J.Balfour, M.Shaw and S. Jarosek, Photo-voltaics, Lawrence J Goodrich (USA).

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# Course Title: Radiation Safety
# Credit: 03 (2+1)
# Theory: 30 Hours
# Practical: 30 Hours

## Course Objective

This course focusses on the applications of nuclear techniques and radiation protection. It will not only enhance the skills towards the basic understanding of the radiation but will also provide the knowledge about the protective measures against the radiation exposure. It imparts all the skills required by a radiation safety officer or any job dealing with radiation such as X-ray operators, nuclear medicine dealing jobs: chemotherapists, PET MRI CT scan, gamma camera etc. operators etc.

## Course Learning Outcomes

This course will help students in the following ways:

• Awareness and understanding the hazards of radiation and the safety measures to guard against these hazards.

• Learning the basic aspects of the atomic and nuclear Physics, specially the radiations that originate from the atom and the nucleus.

• Having a comprehensive knowledge about the nature of interaction of matter with radiations like gamma, beta, alpha rays, neutrons etc. and radiation shielding by appropriate materials.

• Knowing about the units of radiations and their safety limits, the devises to detect and measure radiation.

• Learning radiation safety management, biological effects of ionizing radiation, operational limits and basics of radiation hazards evaluation and control, radiation protection standards, 'International Commission on Radiological Protection' (ICRP) its principles, justification, optimization, limitation, introduction of safety and risk management of radiation, nuclear waste and disposal management, brief idea about Accelerator driven Sub- Critical System' (ADS) for waste management.

• Learning about the devices which apply radiations in medical sciences, such as MRI, PET.

• Understanding and performing experiments like Study the background radiation levels using Radiation detectors, Determination of gamma ray linear and mass absorption coefficient of a given material for radiation shielding application.

# Course Code: SEC45PHY102b(T)25
# Credit: 02
# Theory: 30 Hours

**Unit 1**

**Basics of Atomic and Nuclear Physics:** Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron. The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and halflife, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission. **(6 Lectures)**

**Unit 2**

**Interaction of Radiation with matter:** Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, Interaction of Photons - Photoelectric
effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channelling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation. **(7 Lectures)**

**Unit 3**

**Radiation detection and monitoring devices:** Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Geiger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermo luminescent Dosimetry.

**Radiation detection:** Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter and Geiger Muller Counter), Scintillation Detectors (Inorganic and Organic Scintillators), Solid States Detectors and Neutron Detectors, Thermoluminescent Dosimetry. **(7 Lectures)**

**Unit 4**

**Radiation safety management:** Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitations, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.

**(5 Lectures)**

**Unit 5**

**Application of nuclear techniques:** Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterilization, Food preservation.

**(5 Lectures)**

## Course Code: SEC45PHY102(P)b25
## Credit: 01
## Practical: 30 Hours

Teacher may give long duration project based on this paper.

Sessions on the construction and use of specific measurement instruments and experimental apparatuses used in the physics lab, including necessary precautions.

Sessions on the review of experimental data analysis and its application to the specific experiments done in the lab.

**Experiments:**

Minimum five experiments need to be performed from the following,

1. Estimate the energy loss of different projectiles/ions in Water and carbon, using SRIM/TRIM etc. simulation software.
2. Simulation study (using SRIM/TRIM or any other software) of radiation depth in materials (Carbon, Silver, Gold, Lead) using H as projectile/ion.
3. Comparison of interaction of projectiles with $Z_P = 1$ to 92 (where $Z_P$ is atomic number of projectile/ion) in a given medium (Mylar, Carbon, Water) using simulation software (SRIM etc).
4. SRIM/TRIM based experiments to study ion-matter interaction of heavy projectiles on heavy atoms. The range of investigations will be $Z_P = 6$ to 92 on $Z_A = 16$ to 92 (where $Z_P$ and $Z_A$ are atomic numbers of projectile and atoms respectively). Draw and infer appropriate Bragg Curves.
5. Calculation of absorption/transmission of X-rays, γ-rays through Mylar, Be, C, Al, Fe and $Z_A = 47$ to 92 (where $Z_A$ is atomic number of atoms to be investigated as targets) using XCOM, NIST (https://physics.nist.gov/PhysRefData/Xcom/html/xcom1.html).
6. Study the background radiation in different places and identify the source material from gamma ray energy spectrum. (Data may be taken from the Department of Physics & Astrophysics, University of Delhi and gamma ray energies are available in the website http://www.nndc.bnl.gov/nudat2/).
7. Study the background radiation levels using Radiation meter.
8. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
9. Study of counting statistics using background radiation using GM counter.
10. Study of radiation in various materials (e.g. $KSO_4$ etc.). Investigation of possible radiation in different routine materials by operating GM counter at operating voltage.
11. Study of absorption of beta particles in Aluminum using GM counter.
12. Detection of α particles using reference source & determining its half-life using spark counter.
13. Gamma spectrum of Gas Light mantle (Source of Thorium).

**References for Theory: Essential reading:**

1. Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.
2. Nuclear Physics by S N Ghoshal, First edition, S. Chand Publication, 2010.
3. Nuclear Physics: Principles and Applications by J Lilley, Wiley Publication, 2006.
4. Fundamental Physics of Radiology by W J Meredith and B Massey John Wright and Sons, UK,1989.
5. An Introduction to Radiation Protection by A Martin and Sam Harbison, John Willey & Sons, Inc. New York, 1981.

**Additional reading:**

1. Radiation detection and measurement by G F Knoll, 4th Edition, Wiley Publications, 2010.
2. Techniques for Nuclear and Particle Physics experiments by W R Leo, Springer, 1994.
3. Thermoluminescence dosimetry by A F McKinlay, Bristol, Adam Hilger (Medical Physics Hand book 5.
4. Medical Radiation Physics by W R Hendee, Year book Medical Publishers, Inc., London, 1981.
5. Physics and Engineering of Radiation Detection by S N Ahmed, Academic Press Elsevier, 2007.
6. Nuclear and Particle Physics by W E Burcham and M Jobes, Harlow Longman Group, 1995.

7. IAEA Publications: (a) General safety requirements Part 1, No. GSR Part 1 (2010), Part 3 No. GSR Part 3 (Interium) (2010); (b) Safety Standards Series No. RS-G-1.5 (2002), Rs-G-1.9 (2005), Safety Series No. 120 (1996); (c) Safety Guide GS-G-2.1 (2007).

**References for Laboratory Work:**

1. Schaum's Outline of Modern Physics, McGraw-Hill, 1999.
2. Schaum's Outline of College Physics, by E. Hecht, 11th edition, McGraw Hill, 2009.
3. Modern Physics by K Sivaprasath and R Murugeshan, S Chand Publication, 2010.
4. AERB Safety Guide (Guide No. AERB/RF-RS/SG-1), Security of radioactive sources in radiation facilities, 2011
5. AERB Safety Standard No. AERB/SS/3 (Rev. 1), Testing and Classification of sealed Radioactivity Sources., 2007.

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# Introduction to Physics: MDC45PHY102(T)25
# Credit:03
# Theory: 45 Lectures

## Course Objective

- To give an introduction to the fundamentals of Physics.
- To give introductory concepts on units and measurement, scalar and vectors, laws of motion, work, power and energy, electricity and magnetism, geometry and wave optics, gravity and planetary motion, wave and oscillation, and electronics.

## Course learning Outcomes

- They will understand the basic concepts of units and measurements, motion, optics, electricity and magnetism, energy, waves and oscillation and the concept of electronics which are the fundamental parts of Physics and its application in everyday life.
- On successful completion of the course, students will be able to understand the preliminary idea of the concept of Physics and its phenomena in our daily lives.

## UNIT 1
## Mechanics

Physical quantities, Units of measurement, SI units, Scalars and Vectors, Speed and Velocity, Linear momentum and Acceleration. Laws of motion, friction and lubrication, uniform circular motion.
Work, energy, power; principle of conservation of energy.
Newton’s law of gravitation, acceleration due to gravity. **(15 Lectures)**

## UNIT 2

## Heat and Thermodynamics

Concept of heat and temperature, specific heat, Latent heat.
Laws of thermodynamics (zeroth, first and second), Heat transfer: conduction, convection and radiation. **(5 Lectures)**

## UNIT 3

## Waves and Optics

Introduction to waves and its characteristics, Longitudinal and transverse waves, Simple harmonic motion, simple pendulum.
Dual nature of light, Reflection, refraction and total internal reflection (simple examples), Interference, diffraction, and polarization (Simple idea only)
Principle of optical fibers and LASER **(8 Lectures)**

## UNIT 4

## Electricity and Magnetism

Electric charge, current, Coulomb's law. Electric field Intensity and Electric potential (simple idea). Capacitance and Capacitors.
Ohm's law, resistances and their combination. Kirchoff's laws.
Alternating currents, Electromagnetic induction, Faraday's laws and Lenz law. Applications to transformer, generator and motor (no derivation). **(10 Lectures)**

## UNIT 5

## Electronic and modern Physics

Semiconductors, diodes and transistors, Solar cell, digital mobile data communication.
Radioactivity, half life and mean life.Nuclear fission and fusion. (Elementary idea).
**(7 Lectures)**

## Reference Books:


1. Elements of Properties of Matter, D.S. Mathur, 2008, S. Chand and Company Limited
2. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
3. Concept of Physics (I &II), H.C Verma.
4. NCERT Physics Textbooks (Class 9,10 11 &12)
5. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
6. Optics, Ajay Ghatak, 6th ed., 2017, Tata McGraw Hill.
7. Electricity and Magnetism, D.C.Tayal, 1993, Himalaya Publishing House.
8. Electricity and Magnetism, J H Fewkes & J Yarwood, Oxford University Press, Calcutta, 1985
9. SWAYAM/NPTEL modules on basic physics


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