DEPARTMENT OF PHYSICS

B. N. COLLEGE (AUTONOMOUS), DHUBRI

Syllabus
for
B.Sc. Honours in Physics
(Four Year Degree Course)

Approved by the Board of Studies in Physics
held on **21.12.2024**

SEMESTER I

Name of the Department: Physics
Semester: I
Name of the Paper: Mathematical Physics I and Mechanics
Paper Type: Core
Paper Code:
Credit:4 (Theory:3 + Practical:1), Hours:45 Hours (Theory)+30 Hours (Practical)
Lecture:3 Credits; Practical:1 Credit; Tutorial: 0
Full Marks:100

Course Objectives:

This course provides foundational knowledge of vector calculus, curvilinear coordinates, and mechanics. It covers the fundamental laws of motion, conservation principles, and forces in non-inertial systems. The course develops problem-solving skills and analytical thinking to understand physical systems mathematically and prepares students for advanced physics courses.

Course Outcome:

After successful completion of the course, the students will-		
CO1	Able to understand the calculus of vectors and concept of curved spaces which play central roles in developing insight of the theories of physics.	
	LO1.1	Solve problems involving vector derivatives and integrals in Cartesian and curvilinear coordinates.
	LO1.2	Apply vector calculus concepts to analyse physical phenomena like fields and potentials.
CO2	Able to understand about the basic concepts of mechanics by parallel studies of linear dynamics and rotational dynamics.	
	LO2.1	Analyse the principles of linear and rotational dynamics.
	LO2.2	Solve mechanical problems involving forces and motion in physical systems.
CO3	Understand the concept of frame of reference, importance of relative transformations and invariance of laws of Physics.	
	LO3.1	Apply Galilean transformations to analyse relative motion.
	LO3.2	Demonstrate invariance of physical laws across inertial frames.
CO4	Understand the consequences of a non-inertial frame in our real physical world.	
	LO4.1	Predict the effects of Coriolis and centrifugal forces in rotating systems.
	LO4.2	Analyse physical scenarios in non-inertial frames.
CO5	Able to understand about conservative and non-conservative force in detail.	
	LO5.1	Explain the characteristics and differences between conservative and non-conservative forces.
	LO5.2	Analyse how conservative and non-conservative forces affect the work and energy in a physical system.
CO6	Able to understand how various elastic moduli can be determined.	
	LO6.1	Measure elastic constants of materials through experimental setups.
	LO6.2	Analyse material properties using stress-strain relationships.

Main Syllabus:

Unit No.	Syllabus	Class Hour	Allotted Marks
Theory			
Part A: Mathematical Physics			
Unit I Vector Calculus	Product of three vectors. Scalar and vector fields. Derivatives of vector functions, Directional derivative. Gradient of a scalar field. Divergence and curl of a vector field. Laplacian operator. Vector identities. Vector integration- Line, Surface and Volume integrals. Gauss's divergence theorem and Stokes's theorem, Greens theorem.	12	20
Unit II	Orthogonal Curvilinear Coordinates. Derivation of Gradient,	6	10

Curvilinear coordinates	Divergence, Curl and Laplacian operator in Cartesian, Spherical and Cylindrical Coordinate Systems.		
Part B: Mechanics			
Unit III Reference frames	Inertial frames. Galilean transformations; Galilean invariance. Non-inertial frame and fictitious forces. Uniformly rotating frame. Laws of physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.	6	10
Unit IV Gravitation and Central force motion	Motion under central force. Two- body problem and its reduction to one body problem. Kepler's laws, Gravitational potentials and fields due to spherical body and shell.	5	8
Unit V Conversation laws	Dynamics of a system of particles. Centre of mass. Equation of motion of centre of mass, conservation of linear and angular momentum, conservation of energy, variable mass system. Elastic and Inelastic collisions between particles. Centre of mass and laboratory frames.	4	7
Unit VI Dynamics of rigid bodies	Rigid body motion, fixed axis rotation, parallel and perpendicular axes theorem. Moment of inertia of rectangular lamina, disc, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.	5	8
Unit VII Work and Energy	Work and kinetic energy theorem. Conservative and non-conservative forces. Potential energy. Force as a gradient of potential energy. Work and potential energy. Work done by non-conservative forces.	3	5
Unit VIII Properties of matter	Relation between elastic constants. Twisting torque on a cylinder or wire. Cantilever. Kinematics of moving fluids: Poiseuille's equation for flow of a liquid through a capillary tube, equation of continuity, Bernoulli's theorem.	4	7
Laboratory			
At least five experiments from the following: 1. To study the motion of spring and calculate (a) spring constant and (b) rigidity modulus. 2. To determine the moments of inertia of a cylinder about two different axes of symmetry by torsional oscillation method. 3. To determine the coefficient of viscosity of water by capillary flow method (Poiseuille's method). 4. To determine the Young's modulus of a material of a wire by Searle's apparatus. 5. To determine the modulus of rigidity of a wire (static methods). 6. To study the variation of time period of a bar pendulum about different points of suspension and use the result to find the value of 'g' at a place. 7. To determine the value of 'g' using Kater's pendulum. 8. To determine the height of a building using a sextant. 9. To determine 'g' and velocity for a freely falling body using digital timing technique.	30	25

Reference Books:

1. Mathematical Methods for Physicists, G B Arfken, H J Weber, F E Harris, 2013, 7th Edn, Elsevier. Mathematical Physics, Rajput and Yog Prakash, Pragati Prakasan, Meerut.
2. An introduction to ordinary differential equations, E. A. Coddington, 2009, PHI learning
3. Mathematical Physics-I, K.K. Pathak and S. Parasher, Vishal Publications, Jalandhar (Delhi).
4. Mechanics**,** D.S. Mathur, S. Chand & Company Limited.
5. Analytical Mechanics, G.R. Fowles and G.L. Cassiday, Cengage Learning.
6. An introduction to Mechanics, D. Kleppner, R. J. Kolenkow, 1973, McGraw-Hill.
7. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.

8. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
9. Mechanics, B.S.Agarwal, S. Chand and Company.
10. Mathematical physics and Mechanics,P.S.Hemne and C.L Arora, S. Chand & Company Limited,2023

Name of the Department: Physics

Semester: I
Name of the Paper: Physics Workshop Skills
Paper Type: SEC
Paper Code:
Credit: 3 (Theory:2 + Practical:1), Hours: 30 Hours (Theory) +30 Hours (Practical)
Lecture: 2 Credits; Practical: 1 Credit; Tutorial: 0
Full Marks: 75

Course Objectives: This course emphasizes hands-on skills in precision measurement using basic instruments and electrical wiring techniques. Students will gain confidence in using tools like Vernier calipers, screw gauges, and multimeters for practical applications. The course also focuses on safety measures in physics laboratories and introduces foundational concepts of electrical systems and connections.

Course Outcome:

After successful completion of the course, the students will-		
CO 1	Able to understand different measuring units and their conversion.	
	LO1.1	Demonstrate accurate conversions between different measurement units
	LO1.2	Perform precision measurements using tools like Vernier calipers.
CO 2	Able to understand instruments accuracy, precision, sensitivity, resolution, range, errors in measurements and loading effects.	
	LO2.1	Analyze measurement errors and their impacts.
	LO2.2	Assess the accuracy of tools like screw gauges and multimeters.
CO 3	Develop a comprehensive understanding of electrical wiring systems, including safety and practical applications	
	LO3.1	Explain the principles of AC and DC power sources, including their generation, distribution, and applications in electrical systems.
	LO3.2	Analyze the roles and proper usage of tools like testers, multimeters, and screwdrivers in assembling and troubleshooting electrical circuits.
CO 4	Understand and apply the theoretical principles of safety measures in physics laboratories and practical applications.	
	LO4.1	Identify key hazard symbols and explain their significance in laboratory and workshop safety protocols.
	LO4.2	Describe the theoretical basis of fire safety practices, including the appropriate use of extinguishers and preventive measures for electrical and chemical fires.

Main Syllabus:

Unit No.	Syllabus	Class Hours	Allotted Marks
Unit I: Basic Measuring Instruments	Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge, spherometer and their utility. Use of Sextant to measure height of buildings, mountains, etc. Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.	9	15
Unit II: Electrical Wiring	Introduction to AC and DC electric power sources, Knowledge on electrical wiring equipment: electrical tester, multimeter, screw driver, plier, wire stripper, cutter etc, Single phase and three phase AC power supply system, Knowledge of Phase, Neutral and Ground or Earthing, Electrical circuit, Parallel and series connections, Use of fuse in an electrical circuit.	15	25
Unit III: Safety Measurements	Importance of safety measures, Hazard symbols, Physics laboratory safety, Chemistry laboratory safety, fire safety measurements, construction safety, wiring safety	6	10
Laboratory			
Perform at least five experiments from the following: 1. Use of meter scale, Vernier caliper, Screw Gauge and Spherometer. 2. To measure dimension of solid block, volume of cylindrical beaker/ glass, diameter of thin wire, thickness of metal sheet. 3. To measure height of building, mountain using Sextant. 4. Wiring & connection of a light bulb with a switch. 5. Fan wiring with a regulator and switch. 6. Multiple wiring like light, fan and socket connection in a single board. 7.Circuit Safety Check. 8. Identifying Hazardous Chemicals. 9. Proper Use of a Fire Extinguisher		30	25

Reference Books:

1. Performance and design of AC machines – M.G. Say, ELBS Edn.
2. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480].
3. Basic Electrical Engineering (I.T.I)-M.L. Anwani, Dhanpat Rai and Co.
4. A text book in Electrical Technology-B L Theraja -S. Chand and Company.

Name of the Department: Physics
Semester: I
Name of the Paper: Renewable Energy Source
Paper Type: MDC
Paper Code:
Credit: 3 (Theory:3), Hours: 45 Hours (Theory)
Lecture: 3 Credit; Practical: 0; Tutorial: 0
Full Marks: 75

Course Objectives:

This course explores non-conventional and alternate energy resources, emphasizing their environmental implications, solar energy applications, and potential contributions of ocean energy in energy generation. Students gain insights into renewable energy technologies and their societal impacts.

Course Outcome:

After successful completion of the course, the student will be able		
CO1	To understand the need, importance and scope of non-conventional and alternate energy resources.	
	LO1.1	Evaluate the significance of renewable energy in sustainable development.
	LO1.2	Assess the scope and applications of non-conventional energy resources.
CO2	To explain the environmental aspects of renewable energy resources. In comparison with various conventional energy systems, their prospects and limitations.	
	LO2.1	Analyse the environmental benefits of renewable energy technologies.
	LO2.2	Identify limitations and challenges of conventional energy systems.
CO3	To understand the use of solar energy and the various components used in energy production for applications like heating, cooling, desalination, power generation, etc.	
	LO3.1	Explain the operation of solar heaters and photovoltaic cells.
	LO3.2	Evaluate applications of solar energy in desalination and power generation.
CO4	Understand wind, tidal, and hydrogen energy systems.	
	LO4.1	Explain the mechanics of wind turbines and tidal energy technologies.
	LO4.2	Explain the mechanics of wind turbines and tidal energy technologies.

Main Syllabus:

Unit No.	Syllabus	Class Hours	Allotted Marks
Unit 1 Introduction	Energy concept-sources in general, their significance & necessity.Classification of energy sources: conventional and non-conventional energy sources, renewable and non-renewable energy, the need of renewable energy.	9	15
Unit 2 Solar Energy	**Solar Energy** Key features, its importance, applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar greenhouses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. Merits & demerits of solar energy.	12	20

Unit 3 Other Alternative Energy Source	**Wind Energy** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **Tidal Energy** Ocean Energy Potential against Wind and Solar, Tidal energy characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy. **Fuel Cell** Introduction to Fuel cells: Classification of fuel cells – H2; Operating principles, Zero Energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problems associated with hydrogen energy, Hydrogen Fuel cell: Concept and Working principle, Bio fuel cell, Brief introduction about Proton Exchange membrane	18	30
Unit 4 Status of Renewable Energy	Impact of renewable energy on society, worldwide renewable energy availability, Present scenario of renewal energy in India, National Solar Mission, 500GW Nonfossil Fuel Target, Carbon neutrality target, Green Hydrogen Mission, National Wind-Solar Hybrid Policy	6	10

Reference Book

1. Energy Technology, S. Rao and Dr. B.B. Parulekar, Khanna Publication.
2. Solar energy, Subhas P. Sukhatme, Tata McGrawHill, 2nd Edition,1996.
3. Godfrey Boyle, "Renewable Energy: Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
4. Fundamentals and Applications of Renewable Energy, Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, Tata McGrawHill, 1st Edition, 2020
5. Renewable Energy & Green Technology: A reference book for graduate and post-graduate students of Indian Universities, Anjan K. Sahoo & Dr. S. P. Nanda, Notion Publication, 2021

SEMESTER II

Name of the Department: Physics
Semester: II
Name of the Paper: Wave Optics & Electricity and Magnetism
Paper Type: Core
Paper Code:
Credit: 4 (Theory:3 + Practical: 1); Hours: 45 Hours (Theory)+ 30 Hours (Practical)
Lecture: 3 Credits; Practical: 1 Credit; Tutorial:0
Full Marks: 100

Course Objectives:

This course provides a comprehensive understanding of wave optics, covering interference, diffraction, and polarization. It also introduces electricity and magnetism, focusing on electrostatic and magnetic fields, dielectric properties, and circuit analysis. Students gain both theoretical and practical skills essential for solving problems in optics and electromagnetism.

Course Outcome:

After successful completion of the course, the student will be able to		
CO1	Understand the interference as superposition of waves from coherent sources and also understand the basic principle of Young's double slit experiment, Fresnel's Biprism, Newton's Rings, Michelson interferometer etc.	
	LO1.1	Explain interference patterns using Fresnel's Biprism and measure wavelength with Michelson interferometer.
	LO1.2	Analyse optical path differences in interference patterns using Newton's Rings.
CO2	Understand the basic concept of diffraction, Fresnel and Fraunhofer diffraction from a slit.	
	LO2.1	Evaluate Fresnel diffraction patterns and calculate diffraction effects on light intensity.
	LO2.2	Use Fraunhofer diffraction principles to assess resolving power of gratings.
CO3	Understand the concept of polarisation of light, the production and detection of polarized light.	
	LO3.1	Analyse polarization by reflection and refraction and detect polarized light.
	LO3.2	Apply Nicol prism to create and study elliptically polarized light.
CO4	To apply of Kirchhoff's law in different circuits, and application of network theorem in different circuits	
	LO4.1	Solve circuit problems using Kirchhoff's laws for voltage and current.
	LO4.2	Apply Thevenin's and Norton's theorems to simplify complex circuits.
CO5	To analyze some of the important physical quantities related to electricity and magnetism for a better understanding of the topic.	
	LO5.1	Calculate electric fields, potentials, and forces in different charge configurations.
	LO5.2	Evaluate magnetic dipole moments and their interactions with magnetic fields.

Main Syllabus:

Part I: Wave Optics			
Unit No.		**Class Hours**	**Allotted Marks**
Unit I Wave Optics	Wave optics: Electromagnetic nature of light, definition and properties of wave front. Huygen's principle. Temporal and Spatial coherence. Young's double slit experiment. Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: Measurement of wavelength and refractive index. Michelson interferometer.	6	10
Unit II Diffraction	Fresnel and Fraunhofer diffraction. Fresnel's Half-Period Zones for Plane Wave. Fresnel diffraction pattern at a straight edge and a circular aperture. Fraunhofer diffraction: Single slit, Double slit. Diffraction grating. Resolving power of grating.	7	12
Unit III Polarization	Polarized light and its mathematical representation. Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory. Nicol prism, Production and analysis of circularly and elliptically polarized light.	5	8
Part II: Electricity and Magnetism			
Unit IV Electric field and electric potential	Electrostatic field, electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness theorem. Electrostatic boundary conditions. Laplace's and Poisson's equations. Application of Laplace's equation involving planar, spherical and cylindrical symmetries. Potential and electric field of a dipole. Force and torque on a dipole. Capacitance of an isolated conductor. Capacitance of a Parallel plate capacitor.	10	17
Unit V Dielectric properties of matter	Dielectric, Dielectric Polarisation, Polarisation charges. Electrical susceptibility and dielectric constant. Capacitor (parallel plate, spherical and cylindrical) filled with dielectric. Displacement vector $\vec{D}$. Relation between $\vec{E}$, $\vec{P}$ and $\vec{D}$. Gauss's law in dielectrics.	4	7
Unit VI Magnetic field	Magnetic force on a charged particle, Definition and properties of magnetic field $\vec{B}$, Curl and divergence of a magnetic field. Magnetic scalar potential and magnetic vector potential. Magnetic force (i) on a current carrying wire and (ii) between two elements. Lorentz force. Torque on a current loop in a uniform magnetic field. Biot-Savart's law and its simple application in 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 (i) solenoid and (ii) torus. Electromagnetic Induction, Faraday's law. Working principle of Ballistic Galvanometer.	5	8
Unit VII Magnetic properties of matter	Magnetisation vector $\vec{M}$, Magnetic intensity $\vec{H}$, Magnetic susceptibility and permeability. Relation between $\vec{B}$, $\vec{H}$ and $\vec{M}$. Ferromagnetism. B-H curve and hysteresis.	3	5
Unit VIII Electrical circuits	AC circuits: Kirchhoff's laws for AC circuits. I-V relations. Complex reactance and inductance. Series LCR circuit and parallel LCR circuit: (i) phasor diagram, (ii) resonance and sharpness of resonance, (iii) power dissipation, (iv) quality factor and (v) band width. Ideal	5	8

	constant-voltage and constant-current sources. Thevenin's theorem and Norton's theorem (only statements and solving of related problems), Maximum power transfer theorem and related numerical problems.		
Laboratory (Practical)			
At least five experiments from the following: 1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current,(d) Capacitances, and (e) Checking electrical fuses. 2. To determine an unknown Low Resistance using a Potentiometer. 3. To determine an unknown Low Resistance using Carey Foster's Bridge. 4. To verify Thevenin's and Norton's Theorems. 5. To verify the superposition and maximum power transfer theorems. 6. To determine the self-inductance of a coil by Anderson's bridge. 7. To study the 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. 8. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q. 9. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer. 10. Determine a high resistance by leakage method using Ballistic Galvanometer. 11. To determine the self-inductance of a coil by Rayleigh's method. 12. Familiarization with: Schuster's focusing, determination of angle of prism. 13. To determine refractive index of the material of a prism using sodium source. 14. To determine wavelength of sodium light using Newton's ring method.	30	25

Reference Book

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. A Textbook of Sound, 3rd Edition, A. B. Wood, 1955, Bell & Sons.
3. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
4. Fundamentals of Optics, F. A. Jenkins and H.E. White, 1981, McGrawHill.
5. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
6. Principles of Optics, B. K. Mathur and T. P. Pandya, 1981, Tata McGrawHill International.
7. Fundamental of Optics, A. Kumar, H. R. Gulati and D. R. Khanna, 2011, S Chand Publications.
8. Electricity and Magnetism [With electromagnetic theory and special theory of relativity], D. Chattopadhyay and P. C. Rakshit, New Central Book Agency (P) Limited.
9. Introduction to Electrodynamics, D.J.Griffiths, Pearson.
10. Electromagnetics, B.B. Laud, New Age International Publishers.
11. Electricity and Magnetism, J.W.Fewkes and J.Yarwood, Vol.I, OxfordUniv.Press.
12. Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.

Name of the Department: Physics
Semester: II
Name of the Paper: Basic Instrumentation Skills
Paper Type: SEC
Paper Code:
Credit: 3 (Theory: 2+ Practical:1); Hours: 30 Hours (Theory) + 30 Hours (Practical)
Lecture: 2 Credits; Practical: 1 Credit; Tutorial: 0
Full Marks: 75

Course Objectives:

This course introduces fundamental concepts of electronic instrumentation, including the working principles of digital multimeters, oscilloscopes, and signal generators. It emphasizes accuracy, safety, and effective use of laboratory tools for precise measurements. Students gain practical skills in assembling and testing electronic components and circuits.

Course Outcome:

After successful completion of the course, the students will-		
CO 1	Able to understand different working of principle of digital multimeter and different soldering techniques.	
	LO1.1	Demonstrate soldering techniques for Electronic components such as resistor, diode, transistor, capacitor etc. and repair tasks
	LO1.2	Explain the block diagram of digital multimeters and their use for precision measurements.
CO 2	Able to apply multimeter to measure different electrical quantities and test different electronic components.	
	LO2.1	Measure resistance, voltage, and current using a multimeter.
	LO2.2	Test the functionality of electronic components such as diodes and transistors.
CO 3	Able to understand the working of CRO	
	LO3.1	Describe the block diagram and key functionalities of a CRO.
	LO3.2	Demonstrate the measurement of voltage, frequency, and phase using CRO.
CO 4	Able to apply to CRO to measure rise, fall and delay times of electrical signals.	
	LO4.1	Use CRO to accurately measure time-domain characteristics of signals.
	LO4.2	Analyze the shape and delay properties of various waveforms.
CO 5	Able to understand the working of Electronic Voltmeter.	
	LO5.1	Explain the advantages of electronic voltmeters.
	LO5.2	Measure small voltage differences with high sensitivity using electronic voltmeters.
CO 6	Able to understand the basics of Signal Generators.	
	LO6.1	Operate low-frequency signal generators for circuit testing and analysis.
	LO6.2	Evaluate waveform properties using function generators.

Main Syllabus:

Unit No.	Syllabus	Class Hours	Allotted Marks
Unit I: Electrical and Electronic Skill	Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Operation principle of regulated power supply. Timer circuit, Electronic switch using transistor and relay.	5	8
Unit II: Digital Multimeter	Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.	6	10
Unit III: 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.	6	10
Unit IV: Electronic Voltmeter	Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity.Principles of voltage measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier-amplifier. Block diagram of ac millivoltmeter, specifications and their significance.	9	15
Unit V: Signal Generators and Analysis Instruments	Block diagram, explanation and specifications of low frequency signal generator, pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.	4	7

Laboratories Perform At least five experiments from the following: 1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance. 2. Study the use of multimeter and Oscilloscope. 3. To use soldering of electrical circuit having discrete components on PCB. 4. 5. To construct a regulated power supply, 6. To observe the limitations of a multimeter for measuring high frequency voltage and currents. 7. To measure Q of a coil and its dependence on frequency using a Q-meter. 8. Measurement of voltage, frequency, time period and phase angle using CRO. 9. Measurement of time period, frequency, average period using universal counter/ frequency counter. 10. Measurement of rise, fall and delay times using a CRO. 11. Measurement of distortion of a RF signal generator using distortion factor meter. 12. Measurement of R, L and C using a LCR bridge/ universal bridge.	30	25

Reference Book

1. Electronic Measurements and Instrumentation, K. Lal Kishore, Pearson India
2. Electrical and Electronics Measurements and Instrumentation, Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, McGraw Hill India.
3. A text book in Electrical Technology - B L Theraja - S Chand and Co.
4. Performance and design of AC machines - M G Say ELBS Edn.
5. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
6. Logic circuit design, Shimon P. Vingron, 2012, Springer.
7. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
8. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
9. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
10. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Name of the Department: Physics
Semester: II
Name of the Paper: Evolution and Prospects of Physical Science
Paper Type: MDC
Paper Code:
Credit: 3 (Theory: 3); Hours: 45 Hours (Theory)
Lecture: 3 Credits; Practical:0; Tutorial:0
Full Marks: 75

Course Objectives:

This course provides a comprehensive overview of the evolution of physics, basic laws of physical science, and their applications in electricity, magnetism, quantum mechanics, and thermodynamics. Special focus is given to the contributions of Indian physicists and their impact on global scientific advancements.

Course Outcome:

After successful completion of the course, the student will be able		
CO1	To understand about the evolution of Physics, basic laws of physics, gravity and astronomy	
	LO1.1	Identify the key laws of physics and their importance in understanding natural phenomena like gravity.
	LO1.2	Describe the Big Bang, black holes, and gravitational waves in simple terms, focusing on their role in the universe's evolution.
CO2	To understand the basic laws of electricity and magnetism, heat and thermodynamics.	
	LO2.1	Explain how thermodynamics applies to everyday tools like refrigerators and engines.
	LO2.2	Describe simple concepts of electricity and magnetism, such as how magnets attract or repel and how electric circuits work.
CO3	To understand the basic laws of quantum theory	
	LO3.1	Introduce quantum ideas, such as the dual nature of light (wave and particle), in a simple way.
	LO3.2	Explain how quantum mechanics helps us understand the behavior of very small particles like electrons.
CO4	Ccontributions of Indian science and its historical context.	
	LO4.1	Discuss the achievements of ancient Indian scientists in physical sciences.
	LO4.2	Summarize modern Indian physicists' contributions and their global impact.
CO5	Understand the fundamental discoveries in physical sciences and their implications	
	LO5.1	Evaluate the societal and technological significance of discoveries like the electron and neutron.
	LO5.2	Discuss the implications of quantum mechanics and nuclear physics on modern technology.

Main Syllabus:

Unit No.	Syllabus	Class Hours	Allotted Marks
Unit I Classical Physics	A brief history of the evolution of Physical Science, Fundamental forces of nature, Newton's law of Gravitation and its implications, the formation of stars, Black holes, Warm holes, the Big Bang, the Laser Interferometer Gravitational-Wave Observatory (LIGO), LIGO in India.	7	12
Unit II Evolution of	Historical Development of Electromagnetism: Concept of charge and Coulomb’s law, evolution of electric and magnetic field	9	15

Electromagnetism and Thermodynamics	theories, key discoveries (Faraday's Law, Maxwell's equations).Foundations of Thermodynamics: Origins and significance of heat and energy, historical perspectives on the laws of thermodynamics, role of thermodynamics in scientific advancements.Evolution of black body radiation theory, Planck's contribution, impact on modern physics.		
Unit III Quantum Theory and application	Failure of classical physics, evolution of quantum theory and applications, wave-particle duality, Brief introduction of Schrodinger equation and its applications	15	25
Unit IV Fundamental Discoveries and their implications	Rutherford's Experiment and the discovery of the Atomic Nucleus, Thomson's Experiment and the discovery of the Electron, Millikan's Oil Drop Experiment, Chadwick's Experiment and the discovery of the Neutron Implications of Fundamental Discoveries: Advancement of atomic models, the development of quantum mechanics, Applications in nuclear energy, semiconductors, and particle physics. Broader societal and ethical considerations of discoveries in physical sciences.	9	15
Unit V Indian Contributions to Science and Technology	Ancient Indian Scientists and their contributions: Kanada, Aryabhata, Brahmagupta, Bhaskara II (Bhaskaracharya), Varāhamihira, Modern Indian Physicists and their Contributions: C.V. Raman, S.N. Bose, Homi J. Bhabha, Meghnad Saha, Vikram Sarabhai, Satish Dhawan, APJ Abdul Kalam, Modern Institutions and Milestones: Role of Indian Science Academies: INSA, IAS, NAS, Chandrayaan Missions, Mangalyaan, NISAR Mission, National Quantum Mission.	5	8

Reference Book

1. Concepts of ModernPhysics, Beiser, A. (2003), Tata McGraw-Hill Education.
2. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
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