SYLLABUS

DERGAON KAMAL DOWERAH COLLEGE(AUTONOMOUS) FOUR YEARS UNDERGRADUATE PROGRAMME (FYUGP)
[AS PER NEP 2020]

PHYSICS

(Recommended by Board of Studies in Physics, D. K. D. C. (Autonomous), in its meetings held on 16.05.2026 and approved by the Academic Council meeting held on 30.06.2026 and effective from the session 2026-2027)

PREAMBLE

The National Education Policy (NEP) 2020, approved by the Union Cabinet of India on 29 July 2020, represents a landmark reform aimed at transforming the country's education system to meet the evolving needs and challenges of the 21st century. The policy emphasizes holistic, multidisciplinary, and flexible undergraduate education that fosters critical thinking, creativity, innovation, and lifelong learning among students.

In alignment with the vision and objectives of NEP 2020, the Board of Studies (BoS) in the Department of Physics, Dergaon Kamal Dowerah College (Autonomous), in its meeting held on 16 May 2026, approved the programme structure and syllabus for the Four-Year Undergraduate Programme (FYUGP) in Physics. The syllabus has been designed to provide students with a strong foundation in physics, promote analytical and problem-solving abilities, and prepare them to address contemporary scientific and technological challenges while contributing effectively to society and the global knowledge economy.

This curriculum aims to nurture competent, innovative, and responsible graduates equipped with the knowledge, skills, and values necessary for higher studies, research, employment, and entrepreneurship in diverse fields.

Introduction

The National Education Policy (NEP) 2020 has introduced significant reforms in higher education by placing greater emphasis on student-centric learning, skill development, and outcome-based education. The policy aims to ensure that students acquire not only subject knowledge but also the skills, values, and competencies needed to succeed in the modern world.

In accordance with the vision of NEP 2020, the Department of Physics, Dergaon Kamal Dowerah College (Autonomous), has designed the Four-Year Undergraduate Programme (FYUGP) in Physics to provide students with a strong foundation in physical sciences while developing critical thinking, analytical abilities, scientific temperament, and problem-solving skills. The programme is structured to meet national and global standards in Physics education and to prepare students for higher studies, research, employment, and entrepreneurship.

The curriculum follows a multidisciplinary approach, enabling students to explore subjects beyond Physics and understand the connections between science, technology, humanities, social sciences, and other fields of knowledge. This approach promotes holistic development and helps students become well-rounded individuals.

The syllabus includes both theoretical and practical components, allowing students to gain hands-on experience through laboratory work, projects, and other experiential learning activities. It encourages creativity, innovation, and scientific inquiry while strengthening communication, teamwork, and leadership skills through co-curricular and extracurricular

activities.

The programme also emphasises ethical values, social responsibility, environmental awareness, and sustainable development, helping students become responsible citizens who can contribute positively to society.

To support holistic and multidisciplinary learning, the FYUGP in Physics comprises six categories of courses: Core Courses, Minor Courses, Generic Elective Courses (GEC), Ability Enhancement Courses (AEC), Value-Added Courses (VAC), and Skill Enhancement Courses (SEC). These courses provide flexibility and allow students to pursue their interests while building a strong academic foundation.

As recommended by NEP 2020, the programme offers multiple exit options:

1. Certificate after successful completion of one year of study.
2. Diploma after successful completion of two years of study.
3. Bachelor's Degree after successful completion of three years of study.
4. Four-Year Multidisciplinary Bachelor's Degree after successful completion of four years of study.

The FYUGP in Physics at Dergaon Kamal Dowerah College (Autonomous) is committed to nurturing knowledgeable, skilled, innovative, and responsible graduates who are prepared to meet the challenges and opportunities of the twenty-first century.

Aim and Objectives

The goals and objectives of FYUGP should aim to:

1. Create a learning environment that strengthens the knowledge gained at the higher secondary level and motivates students to develop a deep interest in Physics.
2. Help students understand the fundamental concepts, principles, and laws of Physics through both classroom teaching and practical learning.
3. Enable students to perform laboratory experiments, analyze observations, and relate experimental results to theoretical concepts.
4. Develop the ability to apply physical principles and scientific methods to solve theoretical, experimental, and real-life problems.
5. Introduce students to the wide scope of Physics and its applications in science, technology, industry, healthcare, environmental studies, and everyday life.
6. Encourage interdisciplinary and multidisciplinary learning by highlighting the role of Physics in fields such as materials science, electronics, data science, renewable energy, and engineering.
7. Prepare students for higher education, research, competitive examinations, entrepreneurship, and diverse career opportunities in academia, industry, and government sectors.
8. Foster critical thinking, analytical reasoning, scientific temperament, creativity, and innovation among students.

The curriculum is designed to gradually enhance students' problem-solving abilities throughout the programme. By the end of the first year, students should be able to solve basic

and well-defined Physics problems. By the second year, they should be capable of addressing broader and more application-oriented problems. By the third year, students should be able to tackle complex scientific problems requiring analytical and interdisciplinary approaches. During the fourth year, students will gain practical experience through internships, research projects, field-based studies, or entrepreneurial activities, preparing them for higher studies, research careers, and professional employment.

This programme aims to produce competent, responsible, and innovative graduates who can contribute effectively to scientific advancement and societal development.

Graduate Attributes

The Four-Year Undergraduate Programme (FYUGP) in Physics aims to develop graduates who possess the knowledge, skills, values, and attitudes required for higher studies, research, employment, and responsible citizenship. Upon successful completion of the programme, graduates are expected to demonstrate the following attributes:

1. **Strong Foundation in Physics:** Graduates will have a sound understanding of fundamental concepts, principles, and applications of Physics and will be able to apply them to solve scientific and practical problems.

2. **Effective Communication Skills:** Graduates will be able to communicate scientific ideas, observations, and results clearly and confidently through oral presentations, written reports, and other forms of communication.

3. **Critical Thinking and Problem-Solving Ability:** Graduates will be capable of analysing information, identifying problems, and developing logical and evidence-based solutions.

4. **Scientific Curiosity and Inquiry:** Graduates will develop an inquisitive mindset and a lifelong interest in learning, research, and the exploration of new scientific knowledge.

5. **Teamwork and Collaboration:** Graduates will be able to work effectively both independently and as members of a team in academic, research, and professional environments.

6. **Project and Research Skills:** Graduates will acquire the ability to plan, execute, and manage laboratory experiments, projects, and research activities systematically.

7. **Digital and Technological Competence:** Graduates will be proficient in the use of computers, digital tools, scientific software, and information and communication technologies relevant to Physics.

8. **Ethical and Professional Responsibility:** Graduates will demonstrate integrity, ethical awareness, and social responsibility in scientific practice and decision-making.

9. **National and Global Awareness:** Graduates will understand the role of Physics in addressing national and global challenges and appreciate the contributions of science and technology to society.

10. **Computational and Analytical Skills:** Graduates will be able to use mathematical and computational techniques for data analysis, modelling, and problem-solving in Physics and related fields.

Programme Learning Outcomes (PLOs)

PO1: Knowledge of Physics
Students will gain a strong understanding of the fundamental concepts, principles, and experimental methods of Physics.

PO2: Problem-Solving Ability
Students will be able to apply physical laws, mathematical techniques, laboratory skills, and computational tools to solve scientific and real-world problems.

PO3: Communication Skills
Students will develop the ability to clearly communicate scientific ideas, observations, and findings through oral presentations, discussions, and written reports.

PO4: Critical and Analytical Thinking
Students will learn to analyze information critically, evaluate evidence, compare different approaches, and make logical conclusions based on scientific reasoning.

PO5: Digital and ICT Competence
Students will be able to use modern digital technologies, software, and Information and Communication Technology (ICT) tools for learning, data analysis, and scientific applications.

PO6: Teamwork and Leadership
Students will develop the ability to work effectively in groups, collaborate with peers, and demonstrate leadership qualities in academic and professional settings.

PO7: Research and Inquiry Skills
Students will acquire the skills to observe, investigate, identify scientific problems, and carry out basic research activities using appropriate methods.

PO8: Multidisciplinary Approach
Students will be able to integrate knowledge from Physics and other disciplines to understand and solve complex problems.

PO9: Ethics and Professional Values
Students will uphold ethical principles, scientific integrity, and professional responsibility in their academic and research activities.

PO10: Employability and Entrepreneurship

Students will gain the knowledge, practical skills, and confidence needed for higher studies, employment opportunities, and entrepreneurial ventures in science and technology-related fields.

Teaching–Learning Process

The teaching-learning framework of the Four-Year Undergraduate Programme (FYUGP) in Physics at the Department of Physics, Dergaon Kamal Dowerah College (Autonomous), follows the **L+T+P model**, where **L**, **T**, and **P** represent **Lecture**, **Tutorial**, and **Practical** components respectively. This approach ensures a balanced integration of theoretical understanding, analytical thinking, and hands-on experience.

The lecture component provides students with fundamental concepts and theoretical knowledge through classroom teaching supported by textbooks, reference materials, digital resources, and self-learning tools. These resources encourage independent learning and help students strengthen their understanding of the subject.

Tutorial sessions offer opportunities for interaction between students and teachers. Through discussions, problem-solving exercises, and doubt-clearing sessions, tutorials promote active learning, critical thinking, and deeper conceptual understanding.

Practical and laboratory courses play a vital role in Physics education by connecting theoretical concepts with experimental observations. Laboratory activities provide students with hands-on training in the use of scientific instruments, data collection, analysis, and interpretation. These experiences help students develop essential experimental and technical skills.

The teaching-learning process also encourages collaborative learning, scientific inquiry, communication skills, and the effective use of modern digital technologies. Students are motivated to think critically, solve problems creatively, and apply their knowledge to real-life situations.

Overall, the FYUGP in Physics adopts a holistic and learner-centric approach that aligns with the vision of NEP 2020. It aims not only to impart scientific knowledge but also to develop competent, responsible, and innovative graduates who are well prepared for higher education, research, employment, and lifelong learning.

Assessment Methods

A variety of assessment procedures appropriate for the Physics discipline will be used to determine how well students are progressing keeping in view of the programme outcomes. Continuous evaluation will decide the final grade which include both in-semester evaluation and the final exam. In-semester evaluation will consist of class exams, mid-term exams, homework assignments, etc. as determined by the concerned teacher of the course of study. The following techniques will be used to evaluate how successfully students are meeting their goals: tutorials, timed exams, problem-based assignments, lab reports for practical assignments, observations of practical skills, individual project reports, team project reports,

oral presentations, including seminar presentations, viva voce interviews, group discussions, quiz and so on.

PROGRAMME STRUCTURE

Year	Semester	Course with Paper code	Title of the Paper	Credit
Year 01	1st Semester	**PHY01MJ01**	Mechanics and Properties of Matter	4 (Th:3+Lab:1)
		PHY01MN01	Mechanics	4 (Th:3+Lab:1)
		PHY01GEC01	Ancient Indian Knowledge System in Physical Sciences	3
		AEC 1A/ AEC1B	**Any One:** **AEC1A:** Assamese/ **AEC1B:** Alternative English	4
		PHY01SEC01	Electrical Circuits and Network Skills	3 (Th:1+Lab:2)
		VAC 1	**Any One:** **VAC1A: Understanding India/ VAC1B: Health and Wellness**	2
		Total Credits		**20**
	2nd Semester	**PHY02MJ02**	Waves and Optics	4 (Th:3+Lab:1)
		PHY02MN02	Waves and Optics	4 (Th:3+Lab:1)
		PHY02GEC02	Fundamentals of Applied Physics	3
		AEC 2	Language and Communication Skills (English IIB)	4
		PHY02SEC02	Basic Instrumentation and LED Assembly	3 (Th:1+Lab:2)
		VAC 2	Environmental Education	2
		Total Credits		**20**

DEPARTMENT OF PHYSICS
FYUGP
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course: Mechanics
Course code: PHY1MJ01T
Nature of the course: PHYSICS (MAJOR)
Total credits: 4 (Th: 3+ Lab:1)
Distribution of marks: (Th:45+ Lab:15) (End SEM) + (Th:25+lab:15) (In-SEM)

Course objectives and outcome

This course introduces the fundamental principles of Newtonian mechanics, including laws of motion, work–energy theorems, conservation laws, properties of matter, and basic concepts of special relativity. The laboratory component provides hands-on experience through experiments on oscillations, moment of inertia, modulus of rigidity, pendulums, free-fall motion, and sextant measurements, enabling students to develop practical skills in measurement, data analysis, and the verification of physical laws.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Understand the Indian origin of the basic ideas of physical sciences.
- **LO1.1:** Describe the Indian origin of the basic ideas of physical sciences.

CO2: Understand the basic concepts of mechanics, reference frames, and conservation laws.
- **LO2.1**: Define key terms related to mechanics.
- **LO2.2**: Explain linear dynamics and rotational dynamics.
- **LO2.3**: Interpret relative transformations and the invariance of laws of physics.

CO3: Correlate the consequences of non-inertial frame to our real world.
- **LO3.1**: Identify the nature of fictitious forces and their effect on the real world.
- **LO3.2**: Classify these forces arising due to non-inertial frames.
- **LO3.3**: Solve problems related to non-inertial frames and fictitious forces.

CO4: Understand the elastic properties of matter
- **LO4.1**: Define elastic constants of solid materials
- **LO4.2**: Establish relations among elastic constants of solid materials
- **LO4.3**: Describe motion of fluids through a pipe

CO5: Understand and apply the principles of gravitation, central force motion, Kepler's laws, and gravitational fields of spherical bodies and shells.
- **LO5.1**: Analyze orbital motion and solve problems related to gravitational forces, potentials, and fields in celestial systems.

CO6: Understand the fundamental concepts and mathematical framework of Special Theory of Relativity, including Lorentz transformations and relativistic effects.
- **LO6.1**: Define key terms related to the special theory of relativity.
- **LO6.2**: Interpret equivalence of mass and energy, relativistic transformation of momentum and energy and relativistic effects.

C07: Develop experimental skills of a learner in mechanics
- **LO7.1**: Explain the working of Flywheel, Bar and Kater's pendulum.

LO7.2: Classify between spring constant and elastic constant like Young's Modulus and modulus of rigidity.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	**LO1.1** **LO2.1** **LO3.1** **LO5.1**	**LO2.2**	**LO2.3** **LO3.2** **LO3.3** **LO4.1** LO5.2 LO7.1 LO7.2	**CO1** **CO3**		
Procedural		**CO5**		**CO4**		
Metacognitive						

Course Contents:

Unit No	Topic	No of Contact Hours	No of Lectures	Allotted Marks
Unit 1	**IKS-1** Vaiseṣika Philosophy, Idea of anu or paramanu, Kanad's laws of motion,	**3**	**3**	**3**
Unit 2	**Newtonian Mechanics** Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Center of Mass, Principle of Conservation of Linear Momentum.	**6**	**6**	**6**
	The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and Unstable Equilibrium.	**5**	**5**	**5**

	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. Motion involving both translation and rotation.	**6**	**6**	**6**
Unit 3	**Non-Inertial Systems** Non-inertial Frames, Fictitious Forces, Uniformly Rotating Frame, Laws of Physics in rotating coordinate systems, Centrifugal Force, Coriolis Force and its applications, Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.	**6**	**6**	**6**
Unit 4	**Properties of Matter** Relation between Elastic constants, Twisting torque on a Cylinder. Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.	**5**	**5**	**5**
Unit 5	**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.	**4**	**4**	**4**
Unit 6	**Special Theory of Relativity** Michelson-Morley Experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation. Relativistic addition of Velocities, Variation of Mass with Velocity, Mass-energy Equivalence. Relativistic Kinematics, Transformation of Energy and Momentum,	**10**	**10**	**10**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Recommended Readings:

1. Indian Contribution to Science, Vijnana Bharati

2. A Concise History of Science in India, Indian National Science Academy
3. An introduction to Mechanics, D. Kleppner, R. J. Kolenkow, Cambridge University Press.
4. Mechanics: Berkeley Physics Course Vol. 1, C. Kittel, W. Knight, et.al., Tata McGraw-Hill.
5. Fundamentals of Physics, Halliday, Resnick, Walker, John Wiley & Sons.
6. University Physics, R. L. Reese, Brooks/Cole Publishing Company.
7. Introduction to Special Relativity, R. Resnick, John Wiley & Sons.
8. Mechanics, D. S. Mathur, S. Chand and Company Ltd.
9. Theoretical Mechanics (Schaum's Outline series), M. R. Spiegel, Tata McGraw Hill.
10. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, Thomson Brooks/Cole.

Mechanics-Laboratory (PHY1MJ01P)

List of Experiment

1. To determine the height of a building using a Sextant.
2. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine g and velocity for a freely falling body using Digital Timing Technique.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the value of g using Bar Pendulum.
7. To determine the value of g using Kater's Pendulum.

(Total Lectures 15, Total Contact Hours 15, Total Marks 15)

At least 75% of the experiments must be performed from the syllabus.

DEPARTMENT OF PHYSICS
FYUGP
DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course: Mechanics
Course code: PHY1MN01T
Nature of the course: PHYSICS (MINOR)
Total credits: 4 (Th: 3+ Lab:1)
Distribution of marks: (Th:45+ Lab:15) (End SEM) + (Th:25+lab:15) (In-SEM)

Course objectives and outcome

This course introduces the fundamental principles of Newtonian mechanics, including laws of motion, work–energy theorems, conservation laws, properties of matter, and basic concepts of special relativity. The laboratory component provides hands-on experience through experiments on oscillations, moment of inertia, modulus of rigidity, pendulums, free-fall motion, and sextant measurements, enabling students to develop practical skills in measurement, data analysis, and the verification of physical laws.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Understand the Indian origin of the basic ideas of physical sciences.
- **LO1.1:** Describe the Indian origin of the basic ideas of physical sciences.

CO2: Understand the basic concepts of mechanics, reference frames, and conservation laws.
- **LO2.1**: Understanding key terms related to mechanics.
- **LO2.2**: Explain linear dynamics and rotational dynamics.
- **LO2.3**: Interpret relative transformations and the invariance of laws of physics.

CO3: Understand the elastic properties of matter
- **LO3.1**: Understanding elastic constants of solid materials
- **LO3.2**: Establish relations among elastic constants of solid materials
- **LO3.3**: To describe motion of fluids through a pipe

CO4: Understand and apply the principles of gravitation, central force motion, Kepler's laws, and gravitational fields of spherical bodies and shells.
- **LO4.1**: Analyze orbital motion and solve problems related to gravitational forces, potentials, and fields in celestial systems.

CO5: Understand the fundamental concepts and mathematical framework of Special Theory of Relativity, including Lorentz transformations and relativistic effects.
- **LO5.1**: Understanding key terms related to the special theory of relativity.
- **LO5.2**: Apply relativistic principles to analyze space-time phenomena, velocity transformation, and mass–energy equivalence

C06: Develop experimental skills of a learner in mechanics
- **LO6.1**: Explain the working of Flywheel, Bar and Kater's pendulum.
- **LO6.2**: Classify between spring constant and elastic constant like Young's Modulus and modulus of rigidity.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	**LO2.1** **LO3.1** **LO5.1**	**LO1.1** **LO2.2**	**LO2.3** **LO3.2** **LO3.3** **LO4.1** **LO5.2** **LO6.1** **LO6.2**	**CO1** **CO3**		
Procedural		**CO5**		**CO4**		
Metacognitive						

Course Contents:

Unit No	Topic	No of Contact Hours	Allotted Marks
Unit 1	**IKS-1** Vaiseṣika Philosophy, Idea of *anu* or *paramanu*, Kanad's laws of motion,	**3**	**3**
Unit 2	**Newtonian Mechanics** Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum. The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and Unstable Equilibrium. 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, Motion involving both translation and rotation.	**6** **6** **6**	**6** **6** **6**
Unit 3	**Properties of Matter** Relation between Elastic constants, Twisting torque on a Cylinder. Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.	**8**	**8**

Unit 4	**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.	**6**	**6**
Unit 5	**Special Theory of Relativity** Michelson-Morley Experiment and its outcome, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation. Relativistic addition of Velocities, Variation of Mass with Velocity, Mass-energy Equivalence.	**10**	**10**

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Recommended Readings:

1. Indian Contribution to Science, Vijnana Bharati
2. A Concise History of Science in India, Indian National Science Academy
3. An introduction to Mechanics, D. Kleppner, R. J. Kolenkow, Cambridge University Press.
4. Mechanics: Berkeley Physics Course Vol. 1, C. Kittel, W. Knight, et.al., Tata McGraw-Hill.
5. Fundamentals of Physics, Halliday, Resnick, Walker, John Wiley & Sons.
6. University Physics, R. L. Reese, Brooks/Cole Publishing Company.
7. Introduction to Special Relativity, R. Resnick, John Wiley & Sons.
8. Mechanics, D. S. Mathur, S. Chand and Company Ltd.
9. Theoretical Mechanics (Schaum's Outline series), M. R. Spiegel, Tata McGraw Hill.
10. Analytical Mechanics**,** G. R. Fowles and G. L. Cassiday, Thomson Brooks/Cole

Mech an ics -L ab oratory (PHY1MN01P)

List of Experiment

1. To determine the height of a building using a Sextant.
2. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine g and velocity for a freely falling body using Digital Timing Technique.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the value of g using Bar Pendulum.
7. To determine the value of g using Kater's Pendulum.

(Total Lectures 15, Total Contact Hours 15, Total Marks 15)
At least 75% of the experiments must be performed from the syllabus.

SEMESTER I

Course title: Electrical Circuits and Network Skills
Course code: PHY1SEC01
Nature of the course: Skill Enhancement Course
Total credits: 3 (T-1, P-2)
Distribution of marks: 60 (End sem) **+ 40** (In-sem)

Course Description: Electrical Circuits and Network Skills is a skill-based course that introduces the basic concepts of electrical components, symbols, circuits, and devices. The course helps students develop practical skills in designing, analyzing, and troubleshooting electrical circuits and appliances through hands-on learning. It also helps students apply theoretical knowledge to real-life electrical applications.

Course Objectives:

1. To help students learn the design, testing, and troubleshooting of electrical circuits and appliances through practical activities.
2. To develop basic skills in electrical wiring and repair of household electrical equipment.
3. To provide knowledge about common electrical and electronic devices and their applications.

Course Outcomes (COs): The students will be able to

CO1: Demonstrate proficiency in circuit analysis and apply fundamental concepts of electrical circuits.
- **LO1.1:** Identify basic circuit elements.
- **LO1.2:** Explain the effects of electric current.
- **LO1.3:** Solve DC circuits using Ohm's law and Kirchhoff's laws.
- **LO1.4:** Explain the working and principles of generators and motors.

CO2: Develop and Implement Electrical circuits.
- **LO2.1:** Build dc circuits using elements.
- **LO2.2:** Utilize breadboard techniques to construct and troubleshoot simple electrical circuits.
- **LO2.3:** Understand and simulate basic electrical and energy systems.

CO3: Develop Proficiency in Electrical Safety and Protection.
- **LO3.1** Explain the concept and purpose of earthing, along with different types of earthing methods and their procedures.
- **LO3.2** Draw earthing system and build safety protocols and precautions for electrical installations.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual	LO1.1					
Conceptual	LO3.1	LO1.2 LO 1.4 LO 3.1	CO1 LO1.3			
Procedural		LO3.2 LO2.3	LO2.1 LO2.2 LO2.3			
Metacognitive						

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	M	M	M
CO2	S	S	M	M	S	S	M	M	M	S
CO3	S	S	M	M	S	S	M	M	M	S

(S: Strong, M: Medium, W: Weak)

Course Contents: 1-Credit Theory

Unit No	Topic	No of Contact Hours	No of Lectures	Allotted Marks
Unit 1	**Basic Electricity Principles** Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC, Electricity. Familiarization with multimeter, voltmeter and ammeter.	**2**	**2**	**3**
Unit 2	**Understanding Electrical Circuits** Main 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.	**2**	**2**	**4**
Unit 3	**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 identifying current flow and voltage drop.	**2**	**2**	**4**
Unit 4	**Generators and Motors** DC Power sources. AC/DC generators. Operation of transformers, Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heater and motors, speed and power of ac motor.	**2**	**2**	**5**
Unit 5	**Solid State Devices** Resistors, inductors and capacitors, Diode and rectifiers, Components in series or in shunt, Response of Inductors and capacitors with AC or DC sources.	**1**	**1**	**3**
Unit 6	**Electrical Protections** Relays, fuses and disconnect switches, Circuit breakers, Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection.	**2**	**2**	**3**
Unit 7	**Electrical Wiring** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drops and losses across cables and conductors. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of the extension board.	**2**	**2**	**4**

Unit 8	**Applied Electrical Skills and Simulation** Introduction to inverter and UPS, Basic solar power system, Circuit simulation software (LTspice, Qucs), Energy-efficient electrical systems.	**2**	**2**	**4**

(Total Lectures 15, Total Contact Hours 15, Total Marks 30)

2-credits Practical

Demonstration and Laboratory:

1. Identify different electrical components: Resistor, Capacitor, variable resistor, Rheostat, dc voltage sources: battery, battery eliminator, power supply.
2. Use ammeter and voltmeter in a circuit and measure current and voltage.
3. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and Checking electrical continuity and fuses.
4. Connect resistances in series and parallel and measure the equivalent resistance using a multimeter.
5. Build a dc circuit using elements like battery, resistances and switch and measure current flow and voltage drop across the components.
6. Demonstration of dc motor and ac motor (like motor of a fan) and identify the differences between them.
7. Identify the electronic components like rectifying diodes, Zener diodes, transistor, carbon resistance, capacitors, and test them with a multimeter.
8. Read electrical diagrams and draw an electrical diagram of the room with proper symbols.
9. To study & find the specifications of various types of wires and cables.
10. Simulation of electrical circuits using software
11. Domestic wiring practice (lamp, switch, socket connection)
12. Identify the different types of Protection Devices: that prevent electrical damages: Fuse, Circuit Breaker, MCB, Lighting Arrester.
13. Preparation of extension board with switches, sockets and indicator.
14. Mini project preparation and demonstration (Suggested Mini Projects**:** Automatic night lamp, Emergency LED light, Extension board fabrication, Simple doorbell circuit, Water level indicator)

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 30)

Recommended Readings:

1. A textbook in Electrical Technology, *B. L. Theraja,* S Chand & Co.
2. Basic Electrical Engineering by V.K. Mehta*,* S Chand & Co.
3. A textbook of Electrical Technology, *A. K. Theraja,* S Chand & Co.
4. Performance and design of AC machines, *M. G. Say,* ELBS Edition.

SEMESTER-I

Course title: Ancient Indian Knowledge Systems in Physical Sciences

Course code: PHY1GEC01

Nature of the course: GEC

Total credits: 3

Distribution of marks: 60 (End-sem) + **40** (In-sem)

Course Description:

This course introduces the Ancient Indian Knowledge Systems in the Physical Sciences, with an emphasis on the contributions of ancient India to mathematics, astronomy, and physics. It covers traditional scientific ideas, indigenous technologies, and the contributions of renowned Indian mathematicians and physicists. The course aims to develop awareness of India's scientific heritage and its relevance to modern science.

Course Objectives:

The course aims to impart knowledge of ancient Indian scientific traditions in the field of Physical Sciences, with special emphasis on Mathematics, Astronomy, and Physics. It also aims to develop awareness about the contributions of ancient Indian scientists and the relevance of Indian Knowledge Systems in modern science.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Acquire knowledge of the origin and development of Physical Sciences in ancient India.

LO1.1: Describe the fundamental ideas of Physics in ancient Indian knowledge systems.

LO1.2: Explain the developments of Astronomy and indigenous scientific technologies in ancient India.

CO2: Acquire knowledge of Indian contributions in the field of Mathematics and Astronomy from ancient times.

LO2.1: Describe the major developments of Mathematical knowledge in ancient India.

LO2.2: Explain the Indian contributions to astronomy, calendar systems, and eclipse prediction.

CO3: Recognize the contributions of great Indian mathematicians and physicists in ancient India.

LO3.1: Describe the scientific contributions of renowned Indian mathematicians and physicists.

LO3.2: Explain the relevance of ancient Indian scientific knowledge in modern science.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	LO1.1 LO2.1 LO2.2 LO3.1 LO3.2 CO1, CO2, CO3	LO1.1 LO1.2 LO2.1 LO2.2 LO3.1 LO3.2 CO1, CO2, CO3				
Procedural						
Metacognitive						

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	W									
CO2	W									
CO3	W									

(S: Strong, M: Medium, W: Weak)

Course Contents:

Unit No	Topic	No of Contact Hours	No of Lecture	Allotted Marks
Unit 1	**Introduction to Science and Indian Knowledge Tradition:** Meaning and nature of science, Scientific method and observation, Ancient Indian education systems: Takshashila, Nalanda, Vikramashila, Indian Knowledge System (IKS): concept and scope, Science in Vedas and classical Indian literature, Contributions of ancient Indian civilization to world science	**10**	**10**	**15**
Unit 2	**Indian Contributions to Mathematics, Astronomy and Physics:** Decimal number system and concept of zero, Indian calendar and time measurement, Ancient Indian astronomy and planetary motion, Eclipse prediction in ancient India, Kerala school and early ideas of calculus, Basic ideas of matter and atom in Vaisheshika philosophy, Concepts of motion, force, light, and sound in ancient India, Development of optics and acoustics, Ancient Indian metallurgy and materials science, Traditional technologies and indigenous engineering	**20**	**20**	**25**
Unit 3	**Mathematicians and Physicists in Ancient India:** Brief biography and contributions of Aryabhatta, Varahamihira, Bhaskara I and Bhaskara II, Brahmgupta, Mahaviracharya, Shripati, Baudhayan, Kamalakara, Kanada, Nagarjuna, Lagadha, Lalla, Mahendra Suri, Nilakanthan Somayaji, Acyuta Pisaradi	**15**	**15**	**20**

(Total Lectures 45, Total Contact Hours 45, Total Marks 60)

References:

[1] Journey of Science and Technology in India: A Historical Perspective, *Ajay Ghatak*, National Academy of Sciences
[2] Indian Contribution to Science, *Vijnana Bharati*
[3] A Concise History of Science in India, Indian National Science Academy
[4] History of Science, Technology and Medicine in India, *Binod Bihari Satpathy*, Himalaya Publishing House
[5] Indian Physics: Outline of Early History, *Subhash Kak,* https://arxiv.org/abs/physics/0310001
[6] https://sathee.iitk.ac.in/ncert-books/class-11/knowledge-traditions-and-practices-of-india

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SEMESTER II

Course title: Waves and Optics
Course code: PHY02MJ02
Nature of the course: PHYSICS (MAJOR)
Total credits: 4 (Th: 3+ Lab:1)
Distribution of marks: (Th:45+ Lab:15) (End SEM) + (Th:25+lab:15) (In-SEM)

Course Description: This course provides an introduction to the basic concepts of waves, oscillation, and optics. It aims to provide knowledge about superposition principles, give comprehensive ideas about simple harmonic oscillations, and introduce wave concepts, including group velocities and phase velocities. It depicts the electromagnetic nature of light and enters the domain of optics by providing in depth knowledge of optical phenomena and optical instruments based on these phenomena to undergraduate students.

Course Objectives: This course aims to develop theoretical knowledge of waves, oscillations, and the superposition principle. The course provides fundamental concepts in the study of wave phenomena and the behavior of light, especially in thin films. To acquaint the learner with the principles behind various optical instruments and to build a theoretical knowledge of them.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Acquiring the knowledge of Indian contribution to the field of Mathematics from ancient time.

LO1.1: Understand the basic concepts of light, zero, numbers, arithmetic, the Pythagorean theorem, and π.

LO1.2: Use these concepts to solve simple mathematical and scientific problems.

CO2: Analyze the principle of linearity and superposition, concepts of wave motion and standing waves.

LO2.1: Concept of superposition, plane and spherical waves, and stationary waves.

LO2.2: Explain the superposition of waves and the role of standing waves indifferent physical systems**.**

LO2.3: Construct Lissajous figures and develop the differential equation of a wave.

CO3: Connect the knowledge obtained from the wave with the behavior of light.

LO3.1: Explain the phenomenon of interference in thin films.

LO3.2: Develop theoretical knowledge of various optical instruments.

LO3.3: Illustrate key concepts of diffraction.

C04: Develop experimental skills of a learner in waves and optics

LO4.1: Perform experiments to determine frequency, wavelength, refractive index, and dispersive power using optical instruments.

LO4.2: Verify fundamental principles of wave motion, interference, diffraction, and dispersion through experimental analysis.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	LO1.1 LO1.2 LO2.1 CO1	LO2.2 LO3.1 LO3.3	LO2.3 LO3.2 **LO4.1** **LO4.2**	CO3		
Procedural						
Meta cognitive						

Course Contents:				
Unit No	**Topic**	**No of Contact Hours**	**No of Lectures**	**Allotted Marks**
Unit 1	**IKS-2** Concept of light. Concept of Zero, Number System, Arithmetic, Pythagoras theorem; Concept of Pi.	2	2	2
Unit 2	**Oscillations and Superposition of Harmonic Oscillations** Review of Simple Harmonic Motion (SHM) Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor. Linearity and Superposition Principle. Superposition of two collinear harmonic oscillations having equal frequencies and different frequencies (Beats). Superposition of N collinear harmonic oscillations with equal phase differences and equal frequency differences. Graphical and Analytical Methods: Lissajous Figures with equal and unequal frequency and their use.	10	10	10
Unit 3	**Wave Motion** Wave Equation, Particle and Wave Velocities, Differential Equation of a Wave. Velocity of transverse vibrations of stretched strings, Velocity of longitudinal waves in a fluid in a pipe, Pressure of a longitudinal wave, Newton's formula for velocity of sound, Laplace's correction, Energy, power transport and intensity of wave.	7	7	7
Unit 4	**Standing Waves** Standing Waves in a String: Fixed and Free ends, Normal Modes of Stretched Strings, Comparison of Standing Wave with Travelling Waves, Displacement and Velocity of a Particle in a Standing Wave, Melde's Experiment, Longitudinal Standing Waves in Open and Closed Pipes, Normal Modes of Longitudinal Waves, Phase and Group Velocities.	7	7	7

Unit 5	**Interference** Review of electromagnetic waves. Temporal and Spatial coherence, Division of amplitude and wavefront, Young's double slit experiment, Phase change on reflection: Stokes' treatment, Lloyd's Mirror and Fresnel's Biprism. Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer-(i) Idea of form of fringes (No theory required), (ii) Determination OF Wavelength, (iii) Wavelength Difference, (iv) Refractive Index and (v)Visibility of Fringes.	8	8	8
Unit 6	**Diffraction** Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula (Qualitative discussion only). Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of straight edge and slit. Fraunhofer Diffraction: Single slit, Double slit, Diffraction grating, Resolving power of grating.	11	11	11

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Recommended Readings:

1. Indian Contribution to Science, *Vijnana Bharati*
2. A Concise History of Science in India, Indian National Science Academy
3. Waves: Berkeley Physics Course, *F. Crawford*, Tata McGraw-Hill.
4. Fundamentals of Optics, *F. A. Jenkins and H. E. White*, McGraw-Hill.
5. Principles of Optics, *M. Bornand E.Wolf,* Pergamon Press.
6. Optics, *A.Ghatak,*Tata McGrawHill.
7. Modern Optics, *A. B. Gupta*, Books & Allied (P) Ltd.
8. The Physics of Vibrations and Waves, *H. J. Pain*, John Wiley and Sons.
9. The Physics of Waves and Oscillations, *N. K. Bajaj*, Tata McGrawHill.
10. Fundamental of Optics, *A. Kumar, H. R. Gulati and D. R. Khanna*, R. Chand Publications.

Waves and Optics-Laboratory (PHY2MJ02P)

List of Experiment

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To determine the refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Newton's Rings.
5. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
6. To determine dispersive power and resolving power of a plane diffraction grating.

(Total Lectures 15, Total Contact Hours 15, Total Marks 15)

At least 75% of the experiments must be performed from the syllabus.

SEMESTER II

Course title: Waves and Optics
Course code: PHY02MIN02
Nature of the course: PHYSICS (MINOR)
Total credits: 4 (Th: 3+ Lab:1)
Distribution of marks: (Th:45+ Lab:15) (End SEM) + (Th:25+lab:15) (In-SEM)

Course Description: This course provides an introduction to the basic concepts of waves, oscillation, and optics. It aims to provide knowledge about superposition principles, give comprehensive ideas about simple harmonic oscillations, and introduce wave concepts, including group velocities and phase velocities. It depicts the electromagnetic nature of light and enters the domain of optics by providing in depth knowledge of optical phenomena and optical instruments based on these phenomena to undergraduate students.

Course Objectives: This course aims to develop theoretical knowledge of waves, oscillations, and the superposition principle. The course provides fundamental concepts in the study of wave phenomena and the behavior of light, especially in thin films. To acquaint the learner with the principles behind various optical instruments and to build a theoretical knowledge of them.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Acquiring the knowledge of Indian contribution to the field of Mathematics from ancient time.

LO1.1: Understand the basic concepts of light, zero, numbers, arithmetic, the Pythagorean theorem, and π.

LO1.2: Use these concepts to solve simple mathematical and scientific problems.

CO2: Analyze the principle of linearity and superposition, concepts of wave motion and standing waves.

LO2.1: Concept of superposition, plane and spherical waves, and stationary waves.

LO2.2: Explain the superposition of waves and the role of standing waves indifferent physical systems**.**

LO2.3: Construct Lissajous figures and develop the differential equation of a wave.

CO3: Connect the knowledge obtained from the wave with the behavior of light.

LO3.1: Explain the phenomenon of interference in thin films.

LO3.2: Develop theoretical knowledge of various optical instruments.

LO3.3: Illustrate key concepts of diffraction.

C04: Develop experimental skills of a learner in waves and optics

LO4.1: Perform experiments to determine frequency, wavelength, refractive index, and dispersive power using optical instruments.

LO4.2: Verify fundamental principles of wave motion, interference, diffraction, and dispersion through experimental analysis.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	LO1.1 LO1.2 LO2.1 CO1	LO2.2 LO3.1 LO3.3	LO2.3 LO3.2 **LO4.1** **LO4.2**	CO3		
Procedural						
Meta cognitive						

Course Contents:				
Unit No	**Topic**	**No of Contact Hours**	**No of Lectures**	**Allotted Marks**
Unit 1	**IKS-2** Concept of light. Concept of Zero, Number System, Arithmetic, Pythagoras theorem; Concept of Pi.	2	2	2
Unit 2	**Oscillations and Superposition of Harmonic Oscillations** Review of Simple Harmonic Motion (SHM) Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor. Linearity and Superposition Principle. Superposition of two collinear harmonic oscillations having equal frequencies and different frequencies (Beats). Superposition of N collinear harmonic oscillations with equal phase differences and equal frequency differences. Graphical and Analytical Methods: Lissajous Figures with equal and unequal frequency and their use.	10	10	10
Unit 3	**Wave Motion** Wave Equation, Particle and Wave Velocities, Differential Equation of a Wave. Velocity of transverse vibrations of stretched strings, Velocity of longitudinal waves in a fluid in a pipe, Pressure of a longitudinal wave, Newton's formula for velocity of sound, Laplace's correction, Energy, power transport and intensity of wave.	7	7	7
Unit 4	**Standing Waves** Standing Waves in a String: Fixed and Free ends, Normal Modes of Stretched Strings, Comparison of Standing Wave with Travelling Waves, Displacement and Velocity of a Particle in a Standing Wave, Melde's Experiment, Longitudinal Standing Waves in Open and Closed Pipes, Normal Modes of Longitudinal Waves, Phase and Group Velocities.	7	7	7

Unit 5	**Interference** Review of electromagnetic waves. Temporal and Spatial coherence, Division of amplitude and wavefront, Young's double slit experiment, Phase change on reflection: Stokes' treatment, Lloyd's Mirror and Fresnel's Biprism. Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer-(i) Idea of form of fringes (No theory required), (ii) Determination OF Wavelength, (iii) Wavelength Difference, (iv) Refractive Index and (v)Visibility of Fringes.	8	8	8
Unit 6	**Diffraction** Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula (Qualitative discussion only). Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of straight edge and slit. Fraunhofer Diffraction: Single slit, Double slit, Diffraction grating, Resolving power of grating.	11	11	11

(Total Lectures 45, Total Contact Hours 45, Total Marks 45)

Recommended Readings:

1. Indian Contribution to Science, *Vijnana Bharati*
2. A Concise History of Science in India, Indian National Science Academy
3. Waves: Berkeley Physics Course, *F. Crawford*, Tata McGraw-Hill.
4. Fundamentals of Optics, *F. A. Jenkins and H. E. White*, McGraw-Hill.
5. Principles of Optics, *M. Bornand E.Wolf,* Pergamon Press.
6. Optics, *A.Ghatak,*Tata McGrawHill.
7. Modern Optics, *A. B. Gupta*, Books & Allied (P) Ltd.
8. The Physics of Vibrations and Waves, *H. J. Pain*, John Wiley and Sons.
9. The Physics of Waves and Oscillations, *N. K. Bajaj*, Tata McGrawHill.
10. Fundamental of Optics, *A. Kumar, H. R. Gulati and D. R. Khanna*, R. Chand Publications.

Waves and Optics-Laboratory (PHY2MJ02P)

List of Experiment

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To determine the refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Newton's Rings.
5. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
6. To determine dispersive power and resolving power of a plane diffraction grating.

(Total Lectures 15, Total Contact Hours 15, Total Marks 15)

At least 75% of the experiments must be performed from the syllabus.

SEMESTER II

Course Title: Basic Instrumentation and LED Assembly
Course Code: PHY2SEC02
Nature of the Course: Skill Enhancement Course
Total Credits: 3 (T-1, P-2)
Distribution of marks: 60 (End-sem) + **40** (In-sem)

Course Description: The course on Basic Instrumentation and LED Assembly Skills is an introductory course on basic instruments and equipment used in laboratories. It describes different types of analog and digital voltmeters, ammeters, and multimeters used in measurements. The course also covers the concepts of CRO, function generator, and frequency measurement techniques used in laboratory experiments. In addition, the course introduces LED technology, LED assembly, soldering, testing, and troubleshooting techniques. Laboratory sessions are included to help students learn basic experimental and practical electronic assembly skills.

Course Objectives: This course aims to

1. Provide basic knowledge of electronic measuring instruments and LED technology
2. Develop hands-on skills in handling laboratory instruments and LED assembly.
3. Teach basic testing, troubleshooting, and debugging techniques for electronic instruments and LED circuits.

Course Outcomes (COs): The students will able to

CO1: Understand the basic principle and techniques required to carry out laboratory measurements
- **LO1.1:** Define terms related to measurement such as accuracy, precision, sensitivity, and resolution.
- **LO1.2:** Explain the construction and operation principles of CRT, including electron gun and electrostatic focusing.
- **LO1.3:** Explain the block diagram and working principle of digital voltmeters.

CO2: Explain the working of multimeter, CRO, etc.
- **LO2.1:** Explain the block diagram and working principle of digital voltmeters.
- **LO2.2:** Explain the time base operation and synchronization in CROs.

CO3: Apply CRO, Multimeters for different measurements.
- **LO3.1:** Make use of CRO to measure voltage (DC and AC), frequency, and time period.
- **LO3.2:** Utilize signal generators and frequency counters in practical measurement scenarios.

CO4: Apply LED assembly and troubleshooting techniques in basic electronic circuits.
- **LO4.1:** Identify LED terminals, polarity, and select suitable components for LED circuits.
- **LO4.2:** Perform soldering, assembly, testing, and troubleshooting of simple LED lighting circuits.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		LO1.1 LO1.2 LO1.3 LO2.1				
Conceptual		LO2.2 LO4.1	LO3.1 LO3.2 LO4.1	**CO2** CO3		
Procedural			LO4.2			
Metacognitive						

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	S	M	M	S
CO2	S	S	M	S	M	M	M	M	M	M
CO3	M	S	M	S	M	M	S	M	M	S

(S: Strong, M: Medium, W: Weak)

Course Contents:

Unit No	Topic	No of Contact Hours	No of Lecture	Allotted Marks
Unit 1	**Basic of Measurement** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Ideal Voltage and Current source.	**2**	**2**	**5**
Unit 2	**Voltmeter and Multimeter** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Principles of voltage measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. Digital Voltmeter, Block diagram and working of a digital Voltmeter.	**4**	**4**	**7**
Unit 3	**Cathode Ray Oscilloscope** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), Time base operation, synchronization.	**4**	**4**	**7**

	Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Digital storage Oscilloscope.			
Unit 4	**Signal Generators and Analysis Instruments** Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.	**3**	**3**	**6**
Unit 5	**LED Assembly and Manufacturing Skills** Introduction to LED technology and applications, types of LEDs and LED components, identification of LED polarity and ratings, basic LED circuit design, series and parallel LED connections, LED bulb making and assembly techniques, soldering and PCB mounting, testing and troubleshooting of LED units, and safety precautions during LED assembly.	**2**	**2**	**5**

(Total Lectures 15, Total Contact Hours 15, Total Marks 30)

2-credits Practical

Demonstration and Laboratory:

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

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment.
4. Use of Digital multimeter / VTVM for measuring voltages.
5. Circuit tracing of Laboratory electronic equipment.
6. Winding a coil / transformer.
7. Study the layout of a receiver circuit.
8. Troubleshooting a circuit.
9. LED connection on breadboard
10. Soldering of LED circuits
11. Testing LED using multimeter

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
4. Measurement of time period, frequency, average period using universal counter/ frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Identification of LED polarity and testing of LEDs using a multimeter.
7. Design and assembly of simple series LED circuits.
8. Design and assembly of parallel LED circuits.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope.
2. Converting the range of a given measuring instrument (voltmeter, ammeter).
3. Assembly of a simple LED lamp/bulb circuit.

(Total Practical Classes 30, Total Contact Hours 60, Total Marks 30)

Recommended Readings:

1. Modern Electronic Instrumentation & Measurement Techniques, *A. D. Helfrick, W.D. Cooper*, Pearson India.
2. A textbook in Electrical Technology, *B. L. Theraja, A.K. Theraja*, S Chand and Co.
3. Electronic Measurements and Instrumentation, *R.S. Sedha*, S Chand and Co.

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SEMESTER-II

Course title: Fundamentals of Applied Physics
Course code: PHY2GEC02
Nature of the course: GEC
Total credits: 3
Distribution of marks: 60 (End-sem) + **40** (In-sem)

Course Description:

This course introduces the basic concepts of applied physics and their applications in everyday life and modern technology. It covers simple principles of motion, heat, light, sound, electricity, electronics, renewable energy, and communication systems. The course is designed for Arts, Science, and Commerce students to develop scientific awareness, logical thinking, and understanding of the role of physics in modern society.

Course Objectives:

1. Provide basic knowledge of applied physics and its practical applications.
2. Develop scientific understanding and analytical thinking among students.
3. Introduce students to modern technologies used in daily life.
4. Create awareness about renewable energy and emerging technologies.

Course Outcomes (COs): After the completion of the course, a student will be able to

CO1: Acquire knowledge of the basic principles of applied physics.

LO1.1: Explain the concepts of motion, force, work, and energy.

LO1.2: Identify applications of physics in daily life.

CO2: Understand the principles of heat, light, and sound.

LO2.1: Describe heat transfer, reflection, refraction, and sound propagation.

LO2.2: Explain the uses of optical and acoustic devices.

CO3: Acquire knowledge of electricity, electronics, and communication systems.

LO3.1: Explain electric current, voltage, resistance, and simple electric circuits.

LO3.2: Identify common electronic devices and communication technologies.

CO4: Understand renewable energy resources and modern technological developments.

LO4.1: Describe renewable energy systems and their importance.

LO4.2: Explain the basic concepts of smart devices, robotics, and emerging technologies.

Correlations of Learning Outcomes and Course Outcomes with Level of Learning:

Factual Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual	LO1.1 LO2.1 **LO2.2** LO3.1 **LO3.2** CO1, CO2, CO3, CO4	LO1.1 **LO1.2** LO2.1 **LO2.2** LO3.1 **LO3.2** CO1, CO2, CO3, CO4				
Procedural						
Metacognitive						

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	W									
CO2	W									
CO3	W									
CO4	W									

(S: Strong, M: Medium, W: Weak)

Course Contents:

Unit No	Topic	No of Contact Hours	No of Lecture	Allotted Marks
Unit 1	**Basics of Applied Physics:** Meaning and scope of applied physics, scientific method and measurement, motion, force, work, power and energy, conservation of energy,	**12**	**12**	**15**
Unit 2	**Heat, Light and Sound:** Heat and temperature, modes of heat transfer, thermal expansion, reflection and refraction of light, mirrors and lenses, optical instruments, production and propagation of sound, noise pollution.	**12**	**12**	**15**
Unit 3	**Electricity, Electronics and Communication:** Electric current, voltage and resistance, Ohm's law, household electricity and electrical safety, basic electronic components (resistor, capacitor, diode, LED), mobile communication, internet and satellite communication.	**12**	**12**	**15**
Unit 4	**Renewable Energy and Emerging Technologies:** Solar energy, wind energy, hydroelectric energy, energy conservation, nanotechnology, artificial intelligence.	**09**	**09**	**15**

(Total Lectures 45, Total Contact Hours 45, Total Marks 60)

References:

[1] Conceptual Physics – Paul G. Hewitt

[2] Applied Physics – Arthur Beiser

[3] Basic Electronics – B. L. Theraja

[4] Fundamentals of Physics – Halliday, Resnick & Walker

[5] Renewable Energy Sources – G. D. Rai