Department of Physics
Dhakuakhana College (Autonomous)
Dhakuakhana – 787055
Lakhimpur, Assam, India

SYLLABUS for FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP) in PHYSICS

w.e.f. 2024

As Per NEP-2020 Guidelines

Approved by the Board of Studies on

06/12/2024

Assessment Methods

A. Assessment Method for a Theory-based Major Course: The assessment of a 4-credit theory-based Major course will be performed over a total of 100 marks which is distributed as: (i) 40 marks for internal assessment and (ii) 60 marks for an end semester examination.

- **Mode of Internal Assessment:** The internal assessment shall be based on a continuous formative evaluation process over the entire semester. Evaluation of 40 marks shall be done as per the following scheme:

Activity	Marks
1st In-Semester Examination	10
2nd In-Semester Examination	10
Student's activities • Attendance = 05 • Seminar/Group Discussion/Departmental Participation = 10 • Assignment = 05	20

- **End Semester Examination:**
  Total Marks: **60**
  Duration of examination and setting of the question paper shall be in conformity with the Dibrugarh University guidelines.

B. Assessment Method for a Theory-based Minor Course: The assessment of a 4-credit theory- based Minor course will be performed over a total of 100 marks which is distributed as: (i) 40 marks for internal assessment and (ii) 60 marks for an end semester examination.

- **Mode of Internal Assessment:** The internal assessment shall be based on a continuous formative evaluation process over the entire semester. Evaluation of 40 marks shall be done as per the following scheme:

Activity	Marks
1st In-Semester Examination	10
2nd In-Semester Examination	10
Student's activities • Attendance = 05 • Seminar/ Group Discussion/ Classroom Activities = 10 • Assignment = 05	20

- **End Semester Examination:**
  Total Marks: **60**
  Duration of examination and setting of the question paper shall be in conformity with the Dibrugarh University guidelines.

C. Assessment Method for a Skill Enhancement Course (SEC): The assessment of a 3-credit [2 (T) + 1 (P)] SE Course will be performed over a total of 100 marks which is distributed as: (i) 40 marks for internal assessment and (ii) 60 marks for an end semester examination.

- **Mode of Internal Assessment:** The internal assessment shall be based on a continuous formative evaluation process over the entire semester. Evaluation of 40 marks shall be done as per the following scheme:

Activity	Marks
1st In-Semester Examination	10
2nd In-Semester Examination	10
Student's activities • Attendance = 05 • Seminar/Group Discussion/Departmental Participation = 10 • Assignment = 05	20

- **End Semester Examination:**

  Total Marks: **60**

  Duration of examination and setting of the question papers shall be in conformity with the Dibrugarh University guidelines.

  The total of 60 marks shall be distributed as:

Type of examination	Marks
Written examination for 2-credit theory	40
Practical/Hands-on examination for 1-credit practical	20

  Duration of examination and setting of the question paper shall be in conformity with the Dibrugarh University guidelines.

D. Assessment Method for a Generic Elective Course (GE): The assessment of a 3-credit GE course will be performed over a total of 100 marks which is distributed as: (i) 40 marks for internal assessment and (ii) 60 marks for an end semester examination.

- **Mode of Internal Assessment:** The internal assessment shall be based on a continuous formative evaluation process over the entire semester. Evaluation of 40 marks shall be done as per the following scheme:

Activity	Marks
1st In-Semester Examination	10
2nd In-Semester Examination	10
Student's activities • Attendance = 05 • Seminar/Group Discussion/ Classroom Activities = 10 • Assignment = 05	20

- **End Semester Examination:**

  Total Marks: **60**

  Duration of examination and setting of the question paper shall be in conformity with the Dibrugarh University guidelines.

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PROGRAMME STRUCTURE

Year	Semester	Course	Title of the Course	Total Credits
Year 01	1st semester	PHYMJ101	Mechanics and Mathematical Physics-I	4
		PHYMN101	Mechanics and Mathematical Physics-I	4
		AEC	Modern Indian Language	4
		GEC	Evolution of Science	3
		SEC110	LED Bulb Assembly	3
		VAC	Value Added Course	2
			Total of Semester 1	**20**
	2nd Semester	PHYMJ201	Waves and Optics	4
		PHYMJ201	Waves and Optics	4
		AEC	English Language and Communication Skills	4
		GEC	Introduction to Materials Science	3
		SEC210	Introduction to Cloud-Based Tools	3
		VAC	Value Added Course	2
			Total of Semester 2	**20**
	Grand Total (Semester 1 and 2)			**40**
Students who wish to exit after the 2nd semesters will undergo a 4-credit internship/apprenticeship during the summer term in order to get a UG Certificate.				
Year 02	3rd Semester	PHYMJ301	Mathematical Physics II	4
		PHYMJ302	Physics Lab I (Waves and Oscillation)	4
		PHYMN301	Physics Lab I (Waves and Oscillation)	4
		GEC	The Universe	3
		SEC310	Electrical Wiring and Maintenance	3
		VAC	Value Added Course	2
			Total of Semester 3	**20**
	4th Semester	PHYMJ401	Electricity and Magnetism	4
		PHYMJ402	Thermal Physics	4
		PHYMJ403	Mathematical Physics III	4
		PHYMJ404	Physics Lab II (Electricity and Magnetism & Thermal Physics and modern Physics)	4
		PHYMN401	Electricity and Magnetism	4
			Total of Semester 4	**20**
	Grand Total (Semester 1 to 4)			80
Students who wish to exit after the 4th semester will undergo a 4-credit internship/apprenticeship during the summer term in order to get a UG Certificate.				
Year 03	5th Semester	PHYMJ501	Elements of Modern Physics	4
		PHYMJ502	Quantum Mechanics I	4
		PHYMJ503	Statistical Mechanics	4
		PHYMN501	Thermal Physics	4
		Internship	Internship	4
			Total of Semester 5	**20**
	6th Semester	PHYMJ601	Electromagnetic Theory	4
		PHYMJ602	Condensed Matter Physics	4
		PHYMJ603	Electronics	4
		PHYMJ604	Physics Lab IV (Electromagnetic Theory, Condensed Matter Physics & Electronics)	4
		PHYMN601	Physics Lab II (Electricity and Magnetism & Thermal Physics and modern Physics)	4
			Total of Semester 6	**20**
	Grand Total (Semester 1 to 6)			120

<table>
<tr><td colspan="5">Students who wish to exit after the 6th semester will be awarded the UG Degree.</td></tr>
<tr><td colspan="5">Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year.</td></tr>
<tr><td rowspan="13">Year 04</td><td rowspan="6">7th Semester</td><td>PHYMJ701</td><td>Mathematical Physics IV</td><td>4</td></tr>
<tr><td>PHYMJ702</td><td>Classical Mechanics</td><td>4</td></tr>
<tr><td>PHYMJ703</td><td>Lab V (Quantum Mechanics, Statistical Mechanics)</td><td>4</td></tr>
<tr><td>PHYMN701</td><td>Elements of Modern Physics</td><td>4</td></tr>
<tr><td>Research/ PHYDSE1</td><td>Research Methodology
or
Introduction to SciLab</td><td>4</td></tr>
<tr><td></td><td>Total of Semester 7</td><td>20</td></tr>
<tr><td rowspan="6">8th Semester</td><td>PHYMJ801</td><td>Astronomy and Astrophysics</td><td>4</td></tr>
<tr><td>PHYMJ802</td><td>Quantum Mechanics II</td><td>4</td></tr>
<tr><td>PHYMN801</td><td>Condensed Matter Physics</td><td>4</td></tr>
<tr><td>Research / PHYDSE2 or PHYDSE3 And PHYDSE4 or PHYDSE5</td><td>Dissertation
or
Nuclear and Particle Physics/Plasma Physics
and
Nanomaterials and Applications/Atmospheric Physics</td><td>8</td></tr>
<tr><td></td><td>Total of Semester 8</td><td>20</td></tr>
<tr><td colspan="3">Grand Total (Semester 1 to 8)</td><td>160</td></tr>
<tr><td colspan="5">A four-year UG degree (Honours) will be awarded to those who complete the four-year degree programme without research. Those that complete their research project and successfully submit their dissertation will be awarded the four-year UG degree (Honours with Research).</td></tr>
</table>

Abbreviations used:

1. MJ = Major
2. MN= Minor
3. GE = Generic Elective Course / Multidisciplinary Course
4. AEC = Ability Enhancement Course
5. SEC = Skill Enhancement Course
6. VAC = Value Added Course
7. T = Theory Class
8. P = Practical Class
9. L = Lectures
10. M = Marks
11. H = Hours

SEMESTER I

Course title	**: Mechanics and Mathematical Physics-I**
Course code	**: PHYMJ101**
Nature of the course	**: Major**
Total credits	**: 4**
Distribution of marks	**: 60 (End-sem) + 40 (In-sem)**

Course Description: This course offers a foundational understanding of classical mechanics, encompassing key concepts such as frames of reference, Newtonian mechanics, the work-energy theorem, central force motions and conservation principles. Students will study rotational motions, the Coriolis force, and a few topics on properties of matter. A significant portion of the course is dedicated to vector calculus, where students will learn to apply mathematical tools such as gradient, divergence, and curl, essential for solving complex physical problems involving fluid dynamics, electromagnetism, and more. The course also covers orthogonal curvilinear coordinates for analyzing systems and their applicability.
The structure of the course ties together the theoretical aspects and practicability in real life situations.

Course Objectives:
1. To introduce fundamental concepts of classical mechanics and their applications in various physical situations.
2. To provide a deep understanding of frames of reference and how they affect the observation of motion.
3. To apply Newton's laws of motion to solve problems involving the dynamics of systems of particles.
4. To explore the principles of conservation of linear momentum, angular momentum, and energy.
5. To analyze the motion of rotational kinematics and dynamics.
6. To study forces in rotating frames, with a focus on the Coriolis force and its effects.
7. To introduce vector calculus and its applications in physical problems.
8. To develop mathematical skills to handle physical problems using orthogonal curvilinear coordinates.

Course Outcomes: By the end of this course, students will be able to:
1. Analyze physical systems using different frames of reference and recognize the effects of inertial and non-inertial frames.
2. Apply the work-energy theorem and the principles of conservation of momentum in both linear and rotational motion.
3. Solve complex mechanical problems using Newtonian mechanics for both single and multiple particle systems.
4. Derive and apply the equations for central force motion.
5. Understand the origin and effect of fictitious forces such as the Coriolis force in rotating systems.
6. Utilize vector calculus, including gradient, divergence, and curl, in solving problems related to physical systems.
7. Work with orthogonal curvilinear coordinates to solve complex problems in physics.

Relevancy of the Course:
1. Foundation for Advanced Studies: Provides the groundwork for advanced physics topics like quantum mechanics, electrodynamics, and statistical physics.
2. Problem-Solving Skills: Enhances the ability to apply mathematical methods and physical principles to solve complex real-world problems.
3. Application-Oriented: Concepts such as the Coriolis force and rotational dynamics are critical for understanding phenomena in astrophysics, meteorology, and engineering.
4. Interdisciplinary Relevance: The mathematical techniques, such as vector calculus and curvilinear coordinates, are utilized across various fields including mechanical engineering, aerospace, and robotics.

Course Contents

Unit 1: 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. The Work-Energy Principle, 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. Rotational Dynamics: Principle of Conservation of Angular Momentum, Rotation about a fixed axis. Kinetic Energy of Rotation, Motion involving both translation and rotation. **(L 16, H 16, M 16)**

Unit 2: Properties of Matter:
Relation between Elastic constants, Twisting torque on a Cylinder or Wire. Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **(L 6, H 6, M 6)**

Unit 3: Central Force Motion:
Central forces, Law of conservation of angular momentum for central forces, Two-body problem, equivalent one-body problem and its solution. Concept of effective potential energy, stability of orbits for central potentials of the form kr^n (for $n = 2$ and -1 using energy diagram, discussion on trajectories for $n = -2$). Solution of Kepler's problem, Kepler's laws for planetary motion, orbit for artificial satellites
(L 8, H 8, M 8)

Unit 4: Non-Inertial Systems
Non-inertial Frames and Fictitious Forces, Uniformly Rotating Frame, Rotating coordinate systems, Centrifugal Force, Coriolis Force and its applications. **(L 6, H 6, M 6)**

Unit 5: Vector Calculus
Revision of Vector algebra, Dot Product, Cross Product, Scalar Triple Product, Cartesian Components of a vector, Scalar and Vector Fields. Vector Differentiation: Directional Derivatives and Normal Derivative, Gradient of a Scalar Field, Divergence and Curl of a Vector Field, Del and Laplacian Operators, Vector identities. Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of Infinitesimal Line, Surface and Volume Elements, Line, Surface and Volume Integrals of Vector Fields, Flux of a Vector Field, Gauss' Divergence Theorem, Green's and Stokes Theorems and their applications (no proofs required). **(L 17, H 17, M 17)**

Unit 6: Orthogonal Curvilinear Coordinates
Orthogonal Curvilinear Coordinates. Gradient, Divergence, Curl, and Laplacian in Orthogonal Curvilinear Coordinates (No derivation required); Gradient, Divergence, Curl and Laplacian in Spherical and Cylindrical Coordinate Systems. **(L 7, H 7, M 7)**

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

Recommended Readings:

1. An introduction to Mechanics, *D. Kleppner, R. J. Kolenkow*, Cambridge University Press.
2. Mechanics: Berkeley Physics Course Vol. 1, *C. Kittel, W. Knight, et.al.*, Tata McGraw-Hill.
3. Fundamentals of Physics, *Halliday, Resnick, Walker,* John Wiley & Sons.
4. University Physics, *R. L. Reese*, Brooks/Cole Publishing Company.
5. Introduction to Special Relativity, *R. Resnick*, John Wiley & Sons.
6. Mechanics, *D. S. Mathur*, S. Chand and Company Ltd.
7. Theoretical Mechanics (Schaum's Outline series), *M. R. Spiegel,* Tata McGraw Hill.
8. Analytical Mechanics, *G. R. Fowles and G. L. Cassiday*, Thomson Brooks/Cole.
9. Mathematical Methods for Physicists, *G. B. Arfken, H. J. Weber, F. E. Harris*, Elsevier.

10. Mathematical Methods for Physics and Engineering, *K. F. Riley, M. P.Hobson, S. J. Bence,* Cambridge University Press.
11. Mathematical Physics, *H. K. Das*, S. Chand *Publications.*
12. Classical mechanics, *H. Goldstein,* Pearson Publications.

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Course title : **Mechanics and Mathematical Physics-I**
Course code : **PHYMN101**
Nature of the course : **Minor**
Total credits : **4**
Distribution of marks : **60 (End sem) + 40 (In-sem)**

Course Description: This course offers a foundational understanding of classical mechanics, encompassing key concepts such as frames of reference, Newtonian mechanics, the work-energy theorem, central force motions and conservation principles. Students will study rotational motions, the Coriolis force, and a few topics on properties of matter. A significant portion of the course is dedicated to vector calculus, where students will learn to apply mathematical tools such as gradient, divergence, and curl, essential for solving complex physical problems involving fluid dynamics, electromagnetism, and more. The course also covers orthogonal curvilinear coordinates for analyzing systems and their applicability.
The structure of the course ties together the theoretical aspects and practicability in real life situations.

Course Objectives:
1. To introduce fundamental concepts of classical mechanics and their applications in various physical situations.
2. To provide a deep understanding of frames of reference and how they affect the observation of motion.
3. To apply Newton's laws of motion to solve problems involving the dynamics of systems of particles.
4. To explore the principles of conservation of linear momentum, angular momentum, and energy.
5. To analyze the motion of rotational kinematics and dynamics.
6. To study forces in rotating frames, with a focus on the Coriolis force and its effects.
7. To introduce vector calculus and its applications in physical problems.
8. To develop mathematical skills to handle physical problems using orthogonal curvilinear coordinates.

Course Outcomes: By the end of this course, students will be able to:
1. Analyze physical systems using different frames of reference and recognize the effects of inertial and non-inertial frames.
2. Apply the work-energy theorem and the principles of conservation of momentum in both linear and rotational motion.
3. Solve complex mechanical problems using Newtonian mechanics for both single and multiple particle systems.
4. Derive and apply the equations for central force motion.
5. Understand the origin and effect of fictitious forces such as the Coriolis force in rotating systems.
6. Utilize vector calculus, including gradient, divergence, and curl, in solving problems related to physical systems.
7. Work with orthogonal curvilinear coordinates to solve complex problems in physics.

Relevancy of the Course:
1. Foundation for Advanced Studies: Provides the groundwork for advanced physics topics like quantum mechanics, electrodynamics, and statistical physics.

2. Problem-Solving Skills: Enhances the ability to apply mathematical methods and physical principles to solve complex real-world problems.
3. Application-Oriented: Concepts such as the Coriolis force and rotational dynamics are critical for understanding phenomena in astrophysics, meteorology, and engineering.
4. Interdisciplinary Relevance: The mathematical techniques, such as vector calculus and curvilinear coordinates, are utilized across various fields including mechanical engineering, aerospace, and robotics.

Course Contents

Unit 1: 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. The Work-Energy Principle, 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. Rotational Dynamics: Principle of Conservation of Angular Momentum, Rotation about a fixed axis. Kinetic Energy of Rotation, Motion involving both translation and rotation. **(L 16, H 16, M 16)**

Unit 2: Properties of Matter:

Relation between Elastic constants, Twisting torque on a Cylinder or Wire. Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **(L 6, H 6, M 6)**

Unit 3: Central Force Motion:

Central forces, Law of conservation of angular momentum for central forces, Two-body problem, equivalent one-body problem and its solution. Concept of effective potential energy, stability of orbits for central potentials of the form kr^n (for $n = 2$ and -1 using energy diagram, discussion on trajectories for $n = -2$). Solution of Kepler's problem, Kepler's laws for planetary motion, orbit for artificial satellites

(L 8, H 8, M 8)

Unit 4: Non-Inertial Systems

Non-inertial Frames and Fictitious Forces, Uniformly Rotating Frame, Rotating coordinate systems, Centrifugal Force, Coriolis Force and its applications. **(L 6, H 6, M 6)**

Unit 5: Vector Calculus

Revision of Vector algebra, Dot Product, Cross Product, Scalar Triple Product, Cartesian Components of a vector, Scalar and Vector Fields. Vector Differentiation: Directional Derivatives and Normal Derivative, Gradient of a Scalar Field, Divergence and Curl of a Vector Field, Del and Laplacian Operators, Vector identities. Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of Infinitesimal Line, Surface and Volume Elements, Line, Surface and Volume Integrals of Vector Fields, Flux of a Vector Field, Gauss' Divergence Theorem, Green's and Stokes Theorems and their applications (no proofs required). **(L 17, H 17, M 17)**

Unit 6: Orthogonal Curvilinear Coordinates

Orthogonal Curvilinear Coordinates. Gradient, Divergence, Curl, and Laplacian in Orthogonal Curvilinear Coordinates (No derivation required); Gradient, Divergence, Curl and Laplacian in Spherical and Cylindrical Coordinate Systems. **(L 7, H 7, M 7)**

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

Recommended Readings:

1. An introduction to Mechanics, *D. Kleppner, R. J. Kolenkow*, Cambridge University Press.
2. Mechanics: Berkeley Physics Course Vol. 1, *C. Kittel, W. Knight, et.al.*, Tata McGraw-Hill.

3. Fundamentals of Physics, *Halliday, Resnick, Walker,* John Wiley & Sons.
4. University Physics, *R. L. Reese*, Brooks/Cole Publishing Company.
5. Introduction to Special Relativity, *R. Resnick*, John Wiley & Sons.
6. Mechanics, *D. S. Mathur*, S. Chand and Company Ltd.
7. Theoretical Mechanics (Schaum's Outline series), *M. R. Spiegel,* Tata McGraw Hill.
8. Analytical Mechanics, *G. R. Fowles and G. L. Cassiday*, Thomson Brooks/Cole.
9. Mathematical Methods for Physicists, *G. B. Arfken, H. J. Weber, F. E. Harris*, Elsevier.
10. Mathematical Methods for Physics and Engineering, *K. F. Riley, M. P.Hobson, S. J. Bence,* Cambridge University Press
11. Mathematical Physics, *H. K. Das*, S. Chand Pulications.
12. Classical mechanics, *H. Goldstein*, Pearson Publications.

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Course title : Evolution of Science
Course code : PHYGE101
Nature of the course : Generic Elective Course
Total credits : 3
Distribution of marks : 60 (End-sem) + 40 (In-sem)

Course Description: General elective course, which is intended for beginners, comprises about the evolution of science from its very earliest stages to the present. This course consists of three parts. The Early Stage: this part comprises the early stage of science when the wheel was invented, all the way up to Newton's well-known Universal Law of Gravitation. The Middle Stage: this stage comprises about the history of electricity and magnetism, from Maxwell's works to Thomas Alva Edison. The Modern Stage: this stage starts with the development of quantum concept to the birth of computer and laser. It also includes Indian contribution to the scientific developments.

Course Objectives: This course aims to equip students with a comprehensive understanding of science's evolution, its societal impact, and its future trajectory. To achieve this, the curriculum focuses on:

1. Delving into the historical development of scientific knowledge, highlighting key figures and their significant contributions.
2. Exploring the interconnectedness of science with various fields and industries, demonstrating its far-reaching influence.
3. Examining the ethical and social implications of scientific advancements, fostering critical thinking about their potential consequences.
4. Cultivating an appreciation for the scientific method and the pivotal roles of experimentation and observation in driving scientific progress.

Course Outcomes: Students will be able to:

- Comprehend the historical evolution of scientific knowledge, including key figures and their contributions.
- Analyse the impact of the wheel as a pivotal point in the transition from early science to the industrial revolution.
- Illustrate the significant scientific advancements of the 19th century, such as developments in electricity and magnetism, which laid the groundwork for modern science.
- Outline the major developments in modern science, from quantum mechanics and relativity to electronics, computers, and laser technology. Explain contemporary scientific advancements and India's contributions to the field.

- Describe the interconnectedness of science with various fields and industries, highlighting its broad impact.
- Analyse the ethical and social implications of scientific advancements, promoting critical thinking about their consequences. Understand the dedication, patience, ethical values, and social responsibility of scientists in their pursuit of scientific knowledge and goals.
- Recognise the importance of scientific methods, such as experimentation and observation, in driving scientific progress.

Course Contents

Unit I: Early Stage

Science in ancient and medieval world - discovery of fire, the wheel, ancient metallurgy, contributions of Aristotle, Archimedes, Contributions during the Renaissance period – Copernicus, Galileo Galilei, Robert Hooke, Kepler, Sir Isaac Newton. **(L 14, H 14, M 20)**

Unit II: Middle Stage

Industrial Revolution: Invention of Steam Engine, Radio, Telegraph, Telephone. Contributions of Maxwell, Heinrich Hertz, Roentgen and Thomas A. Edison. **(L 13, H 13, M 16)**

Unit III: Modern Stage

Planck's Black Body Radiation, Dual Nature of Radiation and Matter, Photoelectric effect, Basics of Special Theory of Relativity, Nuclear Fission, Fusion, Space technology -Satellites, Space Exploration, the Moon Landing. Electronic age, birth of computers, Lasers. Contributions of Indian Scientists - Chandrasekhara Venkata Raman, Satyendra Nath Bose, Subrahmanyan Chandrasekhar, Meghnad Saha.

(L 18, H 18, M 24)

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

Recommended Readings:

1. The Scientific Revolution, *Steven Shapin*, University of Chicago Press.
2. A History of Physics in its Elementary Branches: Including the Evolution of Physical Laboratories, *Florian Cajori*, Macmillan.
3. A Brief History of Physics, *Paul F. Kisak*, Create Space Independent Publishing Platform.

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Course Code	**: SEC110**
Title of the Course	**: LED bulb Assembly**
Nature of the Course	**: Skill Enhancement Course (SEC)**
Total Credits	**: 3**
Credit Distribution	**: Theory-02, Practical -01**
End Semester	**: 60 Marks (Theory-40, Practical-20)**
In Semester	**: 40 Marks**

COURSE OBJECTIVES:

1. The course is designed to develop an entrepreneurial mindset among the students. This course involves the practical application of Electronics.
2. To boost the skill development credibility and improve the ability of the students in repairing electrical components used in our daily life.

3. To provide opportunity for realizing one's potential through practical experiences.

LEARNER OUTCOMES:

After the completion of this course, the learner will:

- Acquire of the concept of working principle and usage of various electronics components.
- Be able to identify various components of soldering tools and able to perform soldering.
- Be able assemble and repair an LED bulb on their own.

Course Contents

Unit I: Basics of Electronics

Basic electrical and electronic components. Idea of Resistivity and Conductivity. Identification of resistors by their color codes. Parameters of an electric circuit - voltage, current and resistance. Alternating current (AC) and direct current (DC). Regulated power supply, precautious dealing with AC & DC current. Functionality of multimeter, Different modes of testing in multi-meter. **(L 10, H 10, M 15)**

Unit II: Basics of LED

Basics of semiconductors, PN junction diode, Principle of illumination from a LED, properties of LED, Various blocks of a LED: power supplies, LED drivers, Chip on Board (COB), Heat sinks. **(L 7, H 7, M 10)**

Unit III: LED Assembly

Soldering of semiconductor devices, Soldering Iron, Soldering and Desoldering, Types of solder and flux, components of a soldering iron, LED Driver Tester. Tools required for LED bulb assembly, Importance of Ingress Protection (IP) rating, LED failure - hot environment, incorrect LED driver, incorrect polarity. Diagnosing and repairing of faulty LED bulbs. **(L 13, H 13, M 15)**

PRACTICALS: (20 marks)

1. Demonstrate the process of soldering
2. Demonstrate LED working principle
3. Demonstrate basic knowledge of product assembly
4. Demonstrate driver selection according to the LED
5. Check the LED light engine with DC supply as per the voltage / current requirements of the product
6. Check the supply unit with AC supply / multimeter to find out the voltage /current output in case LED light engine is not found defective
7. Check voltage / current output at different sections of the supply unit in case of no voltage / current
8. Check the components with multimeter individually of the section where voltage output is found to be less than desired / no output
9. Perform repair / replacement of the damaged components / SMPs

(Total Theory Lectures 30, Total Practical Hour 30, Total Contact Hours 60 , Total Marks 60)

READING LIST:

- Zhe Chun Feng (2019) **,** *Handbook of Solid- state Lighting and LEDs* , Taylor & Francis Ltd.
- Ron Lenk – Carol Lenk (2011) **,** *Practical Lighting Design with LEDs,* John Wiley and Sons Ltd.
- Gilbert held (2019) , *Introduction to light emitting diode technology and application*, Taylor and Francis

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SEMESTER II

Course title: Waves and Optics
Course code: PHYMJ201
Nature of the course: Major
Total credits: 4
Distribution of Marks: 60 (End sem) + 40 (In-sem)

Course Description: This course introduces fundamental concepts in waves, oscillations, and optics. It delves into superposition principles, simple harmonic motion, and wave properties like group and phase velocities. The electromagnetic nature of light is explored, and the course dives into the realm of optics, covering in-depth knowledge of optical phenomena and instruments for undergraduate students.

Course Objectives: The curriculum focuses on

- cultivating a comprehensive theoretical foundation in wave propagation, oscillatory motion, and the superposition principle.
- developing a deep understanding of the optical properties of light, with a specific focus on thin film interference and diffraction phenomena.
- acquiring a strong theoretical knowledge of the principles underlying a variety of optical instruments, including lenses, mirrors, and interferometers.

Course Outcomes: Upon successful completion of this course, students will be able to:

- understand and apply the fundamental concepts of harmonic motion, wave propagation, superposition, interference, diffraction, and the electromagnetic nature of light.
- analyze and solve wave equations, optical phenomena, and design optical instruments.
- evaluate experimental data, theoretical models, and the limitations of classical and quantum theories of light.

Course Contents

Unit 1: Oscillations:
Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time-average values, Damped oscillation, Forced oscillations (Qualitative), Resonance, Power Dissipation and Quality Factor. **(L 6, H 6, M 6)**

Unit 2: Superposition of Harmonic Oscillations:
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 Analysis of Lissajous Figures with equal and unequal frequencies and their uses. **(L 8, H 8, M 8)**

Unit 3: Wave Motion:
Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, 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, Comparison of velocity of sound in different media: air, liquid, solid. Pressure of a longitudinal wave. Energy, power transport and intensity of wave. **(L 6, H 6, M 6)**

Unit 4: Standing Waves:
Standing (Stationary) 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, Plucked and Struck Strings, Melde's Experiment, Longitudinal Standing Waves in Open and Closed Pipes, Normal Modes of Longitudinal Waves, Phase and Group Velocities. **(L 8, H 8, M 8)**

Unit 5: Wave optics:
Electromagnetic nature of light, definition and properties of wavefront, Huygens' principle, Temporal and Spatial coherence. Basics of Polarization: Linear Polarization, Circular Polarization, Polarizer, Nicole's Prism. **(L 5, H 5, M 5)**

Unit 6: Interference:
Division of amplitude and wavefront, Young's double slit experiment, Phase change on reflection: Stokes' treatment, Lloyd's Mirror, Fresnel's Biprism, Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer- (i) Idea of formation of fringes (No theory required), (ii) Determination of Wavelength, (iii) Wavelength Difference, (iv) Refractive Index and (v) Visibility of Fringes. Introduction to Fabry-Perot interferometer. **(L 14, H 14, M 14)**

Unit 7: Diffraction:
Fraunhofer Diffraction: Single slit, Circular aperture, Double slit, Multiple slits. Diffraction grating, Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. **(L 13, H 13, M 13)**

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

Recommended Readings:

1. Waves: Berkeley Physics Course, F. Crawford, Tata McGraw-Hill.
2. Fundamentals of Optics, F. A. Jenkins and H. E. White, McGraw-Hill.
3. Principles of Optics, M. Born and E. Wolf, Pergamon Press.
4. Optics, A. Ghatak, Tata McGraw Hill.
5. Modern Optics, A. B. Gupta, Books & Allied (P) Ltd.
6. The Physics of Vibrations and Waves, H. J. Pain, John Wiley and Sons.
7. The Physics of Waves and Oscillations, N. K. Bajaj, Tata McGraw Hill.
8. Fundamental of Optics, A. Kumar, H. R. Gulati and D. R. Khanna, R. Chand Publications.
9. Vibrations and Waves, A.P. French, 1st Edn., 2003, CRC press.

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Course title: Waves and Optics
Course code: PHYMN201
Nature of the course: MINOR
Total credits: 4
Distribution of Marks: 60 (End sem) + 40 (In-sem)

Course Description: This course introduces fundamental concepts in waves, oscillations, and optics. It delves into superposition principles, simple harmonic motion, and wave properties like group and phase velocities. The electromagnetic nature of light is explored, and the course dives into the realm of optics, covering in-depth knowledge of optical phenomena and instruments for undergraduate students.

Course Objectives: The curriculum focuses on

- cultivating a comprehensive theoretical foundation in wave propagation, oscillatory motion, and the superposition principle.

- developing a deep understanding of the optical properties of light, with a specific focus on thin film interference and diffraction phenomena.
- acquiring a strong theoretical knowledge of the principles underlying a variety of optical instruments, including lenses, mirrors, and interferometers.

Course Outcomes: Upon successful completion of this course, students will be able to:
- understand and apply the fundamental concepts of harmonic motion, wave propagation, superposition, interference, diffraction, and the electromagnetic nature of light.
- analyze and solve wave equations, optical phenomena, and design optical instruments.
- evaluate experimental data, theoretical models, and the limitations of classical and quantum theories of light.

Course Contents

Unit 1: Oscillations:
Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time-average values, Damped oscillation, Forced oscillations (Qualitative), Resonance, Power Dissipation and Quality Factor. **(L 6, H 6, M 6)**

Unit 2: Superposition of Harmonic Oscillations:
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 Analysis of Lissajous Figures with equal and unequal frequencies and their uses. **(L 8, H 8, M 8)**

Unit 3: Wave Motion:
Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, 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, Comparison of velocity of sound in different media: air, liquid, solid. Pressure of a longitudinal wave. Energy, power transport and intensity of wave. **(L 6, H 6, M 6)**

Unit 4: Standing Waves:
Standing (Stationary) 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, Plucked and Struck Strings, Melde's Experiment, Longitudinal Standing Waves in Open and Closed Pipes, Normal Modes of Longitudinal Waves, Phase and Group Velocities. **(L 8, H 8, M 8)**

Unit 5: Wave optics:
Electromagnetic nature of light, definition and properties of wavefront, Huygens' principle, Temporal and Spatial coherence. Basics of Polarization: Linear Polarization, Circular Polarization, Polarizer, Nicole's Prism. **(L 5, H 5, M 5)**

Unit 6: Interference:
Division of amplitude and wavefront, Young's double slit experiment, Phase change on reflection: Stokes' treatment, Lloyd's Mirror, Fresnel's Biprism, Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. Michelson Interferometer- (i) Idea of formation of fringes (No theory required), (ii) Determination of Wavelength, (iii) Wavelength Difference, (iv) Refractive Index and (v) Visibility of Fringes. Introduction to Fabry-Perot interferometer. **(L 14, H 14, M 14)**

Unit 7: Diffraction:
Fraunhofer Diffraction: Single slit, Circular aperture, Double slit, Multiple slits. Diffraction grating, Resolving

power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. **(L 13, H 13, M 13)**

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

Recommended Readings:

1. Waves: Berkeley Physics Course, F. Crawford, Tata McGraw-Hill.
2. Fundamentals of Optics, F. A. Jenkins and H. E. White, McGraw-Hill.
3. Principles of Optics, M. Born and E. Wolf, Pergamon Press.
4. Optics, A. Ghatak, Tata McGraw Hill.
5. Modern Optics, A. B. Gupta, Books & Allied (P) Ltd.
6. The Physics of Vibrations and Waves, H. J. Pain, John Wiley and Sons.
7. The Physics of Waves and Oscillations, N. K. Bajaj, Tata McGraw Hill.
8. Fundamental of Optics, A. Kumar, H. R. Gulati and D. R. Khanna, R. Chand Publications.
9. Vibrations and Waves, A.P. French, 1st Edn., 2003, CRC press.

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Course title: Introduction to Materials Science
Course code: PHYGE201
Nature of the course: Generic Elective Course
Total credits: 3
Distribution of marks: 60 (End Sem) + 40 (In-Sem)

Course Description: The course provides a comprehensive overview of the diverse forms of matter and traces the historical evolution of material science and engineering. It delves into the classification of engineering materials and explores the latest advancements in the field of advanced materials.

Course Objectives:

1. To familiarize the learners about the diverse forms of matter and their historical evolution.
2. To classify the materials based on their composition and properties.
3. To analyze the structure-property relationships of different materials.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. classify materials based on their composition and properties.
2. analyze the historical evolution of materials and their applications.
3. identify the unique properties and applications of nanomaterials.
4. apply nanomaterials to solve engineering challenges and develop innovative products.

Course Contents

Unit I: Introduction to Matter:

States of matter: Solid, Liquid, Gases, Plasma. Basic concept of Atoms and Molecules. Structure of an atom, discovery of electron, proton and neutron. Bonding in a solid – Ionic, Covalent, Metallic, Van der Waal's and hydrogen bonds. **(L 7, H 7, M 10)**

Unit II: History and Evolution of Materials:

Historical perspective: materials used in Stone age, Copper age, Bronze age, Iron age. Industrial revolution, development of steel and its applications. Invention of synthetic polymers (plastics and rubber). Discovery of semiconductors and their impacts on electronics. **(L 10, H 10, M 15)**

Unit III: Classification of Engineering Materials:

Metals - Iron, Copper, Aluminum; Alloys – Brass, bronze, steel; Ceramics – Bricks, glass; Polymers – Rubber, Plastics; Composites – Carbon Fiber. Physical and chemical properties. Applications. **(L 15, H 15, M 20)**

Unit IV: Trends in Advanced Materials:
Solar cells and Photovoltaic devices. Lithium ions based energy storage units. Piezoelectric devices. Optical fibers. Introduction to Nanomaterials. Size effects. Application of nanomaterials in Display Devices, biosensors. Environmental Applications – Air and Water purification. **(L 13, H 13, M 15)**

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

Recommended Readings:

1. Materials Science and Engineering: An introduction, William D. Callister, Jr. and David G. Rethwisch, John Wiley & Sons, Inc.
2. Understanding Materials Science: History, Properties, Applications, Rolf E. Hummel, Springer-Verlag, New York.
3. Essentials of Materials Science and Engineering, Donald R. Askeland and Pradeep P. Fulay, Cengage learning, Canada.

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Course Title: Introduction to Cloud-Based Tools
Course Code : SEC210
Nature of the Course : Skill Enhancement Course (SEC)
Total credits: 3
Distribution of marks: 60 (40T+20P) (End sem) + 40 (In-sem)

Course Description: This course will introduce students to the Google Workspace , empowering them to effectively navigate and utilize tools like Gmail, Drive, Docs, Sheets, and Slides. Students will learn to develop skills in collaborative document creation, data analysis, and presentation design. They will also learn cloud-based file management and organization, explore automation and workflow optimization, and design and create professional websites.

Course Outcomes: Upon completing this course, the students will be able to:

- navigate Google Workspace apps.
- collaborate effectively using Google Workspace tools.
- apply Google Workspace to real-world problems.
- develop strong communication and problem-solving skills.

Course Contents

Unit 1: Introduction to Google Cloud Workspace
Overview of Google Workspace Applications and Tools, Google Workspace interface, Benefits of using Google Workspace, cloud computing and its application to Google Workspace. **(L 2, H 2, M 4)**

Unit 2: Account management with Google Account
Introduction to Google account, setup and customization. Changing Passwords. Account Protection. Storing and managing phone contacts. Search History and Personalized Ads. Communication via Gmail: Creating, formatting, and attaching files to emails. Inbox organization, archiving, and marking emails. Labels, filters, and folder management. **(L 5, H 5, M 9)**

Unit 3: Cloud-based file management Google Drive
Overview of the Google Drive interface, Uploading and downloading files and folders. Sharing files with individuals or groups, setting different permission levels, collaboration. Managing file versions and revisions. **(L 4, H 4, M 6)**

Unit 4: Cloud-based document processing: Google Docs

Creating new Google Docs documents, formatting text with fonts, styles, and colors. Adding images, tables, and other elements to documents. Page layout, margins, and orientation. Sharing, real time collaboration, tracking, comments, suggestions. **(L 4, H 4, M 6)**

Unit 5: Data collection and analysis using Google Sheet and Google Form

Organizing and Formatting Data in Google Sheet, mathematical operations, analyzing data using sorting, filtering. Inserting tables, charts and graphs. Designing and creating surveys with Google Forms. Question formats, quizzes, sections. Reviewing and analyzing form responses. Linking Google Forms to Google Sheets. **(L 6, H 6, M 10)**

Unit 6: Presentation using Google Slides

Google slide layouts. Insert images, videos, and audio into slides. Slide transitions. Embedding Google Docs, Sheets, and Forms into presentations. **(L 3, H 3, M 5)**

(Total Lectures 24, Total Contact Hours 24, Total Marks 40)

Practical Activity (20 marks):

1. Create a new Google account.
2. Write an application for leave using Google Docs, save it in a new folder in google drive and send it via gmail.
3. Create a Students Satisfaction Survey using google form, send and collect data and analyze it using google sheets.
4. Create a google slides presentation on the steps undertaken in the above three activities. Screenshots and pictures are mandatory.

Reading List:

1. Google Workspace for Dummies, Paul McFedries, John Wiley & Sons, Inc.
2. Google Drive & Docs In 30 Minutes, Ian Lamont, I30 Media Corporation.

SEMESTER III

Course title: Mathematical Physics II
Course code: PHYMJ301
Nature of the course: Major
Total credits: 4
Distribution of Marks: 60 (End sem) + 40 (In-sem)

Course Description:
This foundational course in mathematical physics presents a rigorous treatment of essential mathematical concepts, including differential equations, Dirac delta functions, matrices, and numerical analysis. The course emphasizes the application of these tools to various domains of physics.

Course Objectives:
The primary objectives of this course are to:
- Introduce fundamental concepts in differential equations, matrices, and numerical analysis.
- Develop a solid understanding of these mathematical tools and techniques.
- Illustrate the application of these mathematical methods to various physical phenomena.
- Cultivate the mathematical skills required to navigate diverse areas of physics.

Course Outcomes: Acquire a comprehensive understanding of fundamental mathematical concepts and their applications in physics:
- Define and elucidate key terms and operations in differential equations, Dirac delta functions, matrices, and numerical analysis.
- Explore the properties and rules governing differential equations, Dirac delta functions, matrices, and numerical analysis.
- Formulate and solve physical problems using differential equations, Dirac delta functions, matrices, and numerical analysis.
- Apply advanced mathematical techniques, including differential equations, Dirac delta functions, matrices, and numerical analysis to solve problems in mechanics, electromagnetism, thermal physics, and other branches of physics.

Course Contents

Unit 1: Calculus
Taylor and binomial series (statements only). First Order Differential equations (variable separable, homogeneous, nonhomogeneous), Integrating Factor. Second Order Differential equations: Homogeneous Equations with constant coefficients. Particular Integral with operator method, method of undetermined coefficients and variation method of parameters. Statement of existence and Uniqueness Theorem for Initial Value Problems. Partial Derivatives, Exact and Inexact Differentials, Integrating Factor.
(L 26, H 26, M 26)

Unit 2: Dirac Delta Function
Definition of Dirac Delta Function, Representation as limit of a Gaussian function and rectangular function, Properties of Dirac Delta Function. **(L 4, H 4, M 4)**

Unit 3: Matrices
Definition, Addition and Multiplication of matrices, Transpose of a matrix, Hermitian conjugate of a matrix, Trace and Determinant, Inverse of a matrix, Special types of square matrices-Diagonal, Unitary, Orthogonal, Symmetric and Skew-symmetric, Hermitian and Skew-Hermitian. Solution of homogeneous and inhomogeneous linear equations using matrices. Finding Eigen-values and Eigen-vectors of a Matrix.

Diagonalization of Matrices (Basics). **(L 14, H 14, M 14)**

Unit 4: Numerical Analysis

Errors and iterative Methods: Truncation and Round-off Errors. Floating Point Computation, Overflow and underflow. Single and Double Precision Arithmetic. Fixed point iteration method, Bisection method, Secant Method, Newton Raphson method. Least Square fitting (straight line). Trapezoidal Rule. Simpson's 1/3 and 3/8 Rules. **(L 16, H 16, M 16)**

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

Recommended Readings:

1. Mathematical Methods for Physicists, G. B. Arfken, H. J. Weber, F. E. Harris, Elsevier.
2. Differential Equations, G. F. Simmons, McGraw Hill.
3. Mathematical Physics, Goswami, Cengage Learning.
4. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
5. Introduction to Matrices & Linear Transformations, D.T.Finkbeiner,1978, Dover Pub.
6. Introduction to Numerical Analysis, S.S. Sastry, 2012, PHI Learning Pvt. Ltd.
7. Elementary Numerical Analysis, K.E. Atkinson, 2007, Wiley India Edition.

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Course title: Physics Lab I (Major)
Course code: PHYMJ302
Nature of the course: Major
Total credits: 4
Distribution of Marks: 60 (End sem) + 40 (In-sem)

Course Description:

Physics Lab I (Major) is a laboratory course designed to provide students with practical experience in the fields of mechanics and wave optics. The course includes experiments on moment of inertia, viscosity, Young's modulus, rigidity modulus, simple harmonic motion, and optical phenomena such as interference and diffraction using tools like prisms, Michelson interferometers, Fresnel biprisms, and Newton's rings.

Course Objectives:

- To cultivate experimental skills in the domains of mechanics and wave optics.
- To foster a comprehensive understanding of fundamental physics concepts.
- To impart knowledge of error propagation and its significance in drawing reliable conclusions from experimental data.

Course Outcomes:

- Understand fundamental concepts in mechanics and wave optics.
- Explain the principles behind various experimental setups.
- Distinguish between different elastic properties.
- Interpret the working of optical instruments.
- Apply theoretical knowledge to practical applications.
- Analyze mechanical systems using elasticity principles.
- Conduct experiments and analyze data related to wavelength, diffraction, interference, dispersion, and resolving power.
- Correlate experimental results with theoretical predictions.

Course Contents

List of Experiments

Unit 1: Mechanics

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 Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Kater's Pendulum.

Unit 2: Waves and Optics

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 – T law.
2. To determine the phase difference between two waves using Lissajous Figures.
3. To determine the refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine the wavelength of sodium source using Michelson's interferometer.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light using Newton's Rings.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
10. To determine dispersive power and resolving power of a plane diffraction grating.
11. To study polarization of light using a polarimeter.

(Total Practical Classes 60, Total Contact Hours 120, Total Marks 60)

Recommended Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, Asia Publishing House.
2. Advanced level Physics Practicals, M. Nelson and J. M. Ogborn, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, Cambridge University Press.
6. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, Vani Pub. Waves: Berkeley Physics Course, F. Crawford, Tata McGraw-Hill.

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Course title: Physics Lab I (Minor)

Course code: PHYMN301

Nature of the course: Major

Total credits: 4

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

Course Description:

Physics Lab I (Minor) is a laboratory course designed to provide students with practical experience in the fields of mechanics and wave optics. The course includes experiments on moment of inertia, viscosity, Young's modulus, rigidity modulus, simple harmonic motion, and optical phenomena such as interference and diffraction using tools like prisms, Michelson interferometers, Fresnel biprisms, and Newton's rings.

Course Objectives:

- To cultivate experimental skills in the domains of mechanics and wave optics.
- To foster a comprehensive understanding of fundamental physics concepts.
- To impart knowledge of error propagation and its significance in drawing reliable conclusions from experimental data.

Course Outcomes:

- Understand fundamental concepts in mechanics and wave optics.
- Explain the principles behind various experimental setups.
- Distinguish between different elastic properties.
- Interpret the working of optical instruments.
- Apply theoretical knowledge to practical applications.
- Analyze mechanical systems using elasticity principles.
- Conduct experiments and analyze data related to wavelength, diffraction, interference, dispersion, and resolving power.
- Correlate experimental results with theoretical predictions.

Course Contents

List of Experiments

Unit 1: Mechanics

1. Measurements of length (or diameter) using vernier caliper, screw gauge and traveling microscope.
2. To study the random error in observations
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
8. To determine the elastic Constants of a wire by Searle's method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.

Unit 2: Waves and Optics

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda^2 - T$ law.
2. To determine the phase difference between two waves using Lissajous Figures.
3. To determine the refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine the wavelength of sodium source using Michelson's interferometer.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light using Newton's Rings.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
10. To determine dispersive power and resolving power of a plane diffraction grating.
11. To study polarization of light using a polarimeter.

(Total Practical Classes 60, Total Contact Hours 120, Total Marks 60)

Recommended Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, Asia Publishing House.
2. Advanced level Physics Practicals, M. Nelson and J. M. Ogborn, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, Cambridge University Press.
6. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, Vani Pub. Waves: Berkeley Physics Course, F. Crawford, Tata McGraw-Hill.

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Course title: The Universe
Course code: PHYGE301
Nature of the course: Generic Elective Course
Total credits: 3
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description:
This course provides an introduction to fundamental topics in astronomy and cosmology, encompassing our solar system, stars, galaxies, and astronomical telescopes.

Course Objectives: The primary objectives of this course are to:

- Provide a comprehensive overview of astronomy and cosmology.
- Develop a thorough understanding of the observed properties of physical systems that constitute the known universe, across various scales.

Course Outcomes: The outcomes of the course are;

- Understand fundamental concepts in astronomy and cosmology.
- Define key terms and phenomena.
- Describe the origin, composition, and evolution of the universe.
- Explain various astrophysical and cosmological phenomena.
- Apply knowledge to astronomical observations.
- Solve problems based on astronomical concepts.

Course Contents

Unit I: Solar System Planets
Formation of Solar System, planet types, planet atmospheres, extrasolar planets. Sun: Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, solar flare.**(L 10, H 10, M 13)**

Unit II: Stars and Galaxies Stars
Measuring stellar characteristics (temperature, distance, luminosity, mass, size) -stellar evolution; Galaxies: Our Milky Way, Galactic structure, Galaxy types, Galaxy formation, Hubble's Classification of Galaxies. **(L 9, H 9, M 12)**

Unit III: Constellation
Bright stars in the night sky, constellations, Zodiacs, Orion, Ursa Major, Ursa Minor. **(L 6, H 6, M 8)**

Unit IV: Basic Astronomy
Astronomical Distance - light years and parsec, Mass and Time Scales, Stellar mass and temperature, Astronomical Quantities measurement and Astronomical Distances. **(L 8, H 8, M 10)**

Unit V: Basic Cosmology
History of the Universe, Big Bang model, expansion of the Universe, fate of the Universe. Other stellar objects: White dwarf, Black hole, nebula, supernova, comets and Kuiper belt. **(L 8, H 8, M 10)**

Unit VI: Astronomical telescope.
Hubble telescope, James Webb telescope. **(L 4, H 4, M 7)**

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

Recommended Readings:

1. Introduction to Astronomy from Darkness to Blazing Glory, Jeffrey Wright Scott, Minuteman Press, California.
2. Astronomy for beginners, Jeff Becan, For beginner series.
3. Astronomy For Beginners: The Introduction Guide to Space, Cosmos, Galaxies and Celestial Bodies, Sally r Ball, Han Global Trading Pvt. Ltd.
4. Stargazing: Beginners Guide to Astronomy, Radmila Topalovic and Tom Kerss, Collins publication.
5. Astronomy: The Complete Beginners Guide to Discover Stars and Astronomy, Nicole Carlisle, Andrew Zen.

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Course Title: Electrical Wiring And Maintenance
Course Code : SEC310
Nature of the Course : Skill Enhancement Course (SEC)
Total credits: 3
Distribution of marks: 60 (40T+20P) (End Sem) + 40 (In-Sem)

Course Description: This course provides a foundational understanding of electrical concepts and maintenance techniques. It covers essential topics such as circuit analysis, component identification, and safety protocols.

Course Outcomes: Upon successful completion of this course, students will be able to:

- Demonstrate a comprehensive understanding of basic electrical appliances.
- Identify and analyze problems in various types of household electric circuits.
- Utilize a multimeter to diagnose dysfunctional components through visual inspection.
- Demonstrate a thorough understanding of various electronic and electrical components, materials, and their specific properties and usages.
- Perform hands-on activities related to electrical wiring.
- Adhere to special safety and handling precautions during electric circuit testing and servicing.
- Assemble various parts of electric circuits.

Course Contents

Unit 1: Overview And Introduction
Introduction to electricity, Ohm's Law, Resistance, Series and parallel connections, Kirchoff's Law, Electrical Signs and Symbols. Identification of various tools and electrical components. Direct and Alternating Current. Importance of safety and general instructions. Electrical Conduction in the Human Body. Case study: Accidents due to the lack of electrical safety knowledge. Damp Situations: baths, showers, pools and tubs. Electric screwdriver tester-working principle and uses. **(L 4, H 4, M 8)**

Unit 2: Electrical Wires and Measuring Devices
Types of wires used for house wiring: Lead covered, Enameled, Super Enameled Wire, Earthing Wire (G.I

and Copper), Guide Wire. Usage of Galvanometer, Ammeter, Voltmeter, Multi-meter, Wattmeter, Energy Meter. Principle and working of digital meters. Comparison of analog & digital instruments.

(L 4, H 4, M 8)

Unit 3: Earthing and Other Protective Devices:
Purpose of Earthing, Methods of Earthing, Indian electricity rules for earthling. Fuses and circuit breakers: Kit-Kat Type, High Rupturing Capacity fuse, Cartridge Fuse, Miniature Circuit Breaker, Earth-leakage circuit breaker. Safety against undervoltage. Safety against overvoltage. Protection against thermal effects.

(L 4, H 4, M 8)

Unit 4: Power Sources and Motors
AC and DC generators. AC and DC motors. Operation of transformers. Interfacing DC or AC sources to electrical appliances. Household Phase, Wattage, Supply Voltage. **(L 3, H 3, M 6)**

Unit 5: Electrical Insulator Tapes and Soldering Iron
Electrical Insulating Tape and types - Polyvinyl chloride, Polytetrafluoroethylene, Rubber, Vinyl, Polyester. Uses of Electrical tape. Soldering Iron, the process of soldering and desoldering, types of solder and flux. Uses of Soldering. **(L 3, H 3, M 6)**

Unit 6: Domestic Electrical Panel
Identification of Live, Neutral, and Ground wires. Connection of wires to plugs, switches and sockets. Use of different coloured wires for identification. Electricity indicator lamps. **(L 2, H 2, M 4)**

(Total Lectures 20, Total Contact Hours 20, Total Marks 40)

Project/ Practical Activity (20 marks):

1. Construct a PVC electric board with 3 Switch, 3 Socket, 1 M.C.B. and 1 electricity indicator lamp.
2. Submit a report on the wire connections of the constructed board.

Reading List:

1. Principle of Electronics, V.K. Mehta.
2. Electricity and Magnetism, R Murugeshan.
3. Electrical Engineering and Electronics, B.L. Theraja.
4. A B C of Electrical Engineering, A.K. Theraja.

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SEMESTER IV

Course title: Electricity and Magnetism
Nature of the course: Major
Course code: PHYMJ401
Total credit assigned: 4
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description: With an emphasis on both electrostatics and magnetostatics, as well as their possible uses in diverse fields, this course offers a thorough introduction to the basic ideas of electromagnetism. The curriculum explores important ideas including Gauss' law, Laplace's and Poisson's equations, and the method of images while covering the behavior of electric fields, electric potential, and energy. It also explores the magnetic properties of materials, the dielectric characteristics of matter, and the fundamentals of magnetostatics. Along with introducing Maxwell's equations, the course also looks at electromagnetic induction, including Faraday's and Lenz's laws. Students will also learn about network theorems, electrical circuits, and how they apply to both AC and DC circuits. This course seeks to establish a solid foundation in electromagnetism and its relation to everyday phenomena and technological applications through a combination of theoretical discussions and real-world examples.

Course Objectives: The basic objective of this course is to

- Explain the basic ideas of electromagnetism to students.
- Gain a fundamental grasp of electromagnetic induction, magnetostatics, and electrostatics.
- Introduce students to the magnetic and dielectric characteristics of materials.
- Introduce students to important subjects including network theorems, AC and DC circuits, and how these could be used to solve practical problems.

Course Outcomes: After completion of the course the students will be able to

- Recognize the basic principles of electromagnetism and their significance in physics.
- Describe the fundamental ideas of magnetic field, electric field and electromagnetic induction.
- Explain polarization phenomena and the behavior of electric fields in matter.
- Using B-H curves and magnetization principles, talk about the magnetic properties of materials.
- Use fundamental laws to address real-world problems.
- To solve issues with symmetrical charge distributions, apply Gauss's law.
- Use the Laplace and Poisson equations as well as the method of images to solve various problems.
- Use several methods to assess how electrical circuits and networks behave.
- Utilize Norton's and Thevenin's theorems to simplify complicate circuits.
- Using Kirchhoff's rules, analyze AC circuits and get complex reactance and impedances.

Course Contents:

Unit 1: Electrostatics

Electric Field, Electric Lines of Force, Electric Flux, Gauss' Law with applications to charge distributions with Spherical, Cylindrical and Planar symmetry**.** Conservative nature of Electrostatic Field, Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field of a dipole, Force and Torque on a Dipole. Electrostatic Energy of System of Charges, Electrostatic Energy of a Charged Sphere, Conductors in an electrostatic field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate Capacitor, Capacitance of an isolated conductor. **(L 21, H 21, M 21)**

Unit 2: Dielectric Properties of Matter

Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant; Capacitor (parallel plate, spherical, cylindrical) filled with dielectric; Displacement vector D, Relations between Electric field vector E, Polarization vector P and D, Gauss' Law in dielectrics. **(L 8, H 8, M 8)**

Unit 3: Magnetostatics

Magnetic force between current elements and definition of Magnetic Field B, Biot-Savart's Law and its simple applications (straight wire and circular loop), Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole), Ampere's Circuital Law and its application to (i) Solenoid and (ii) Toroid, Properties of B: curl and divergence, Vector Potential, Lorentz Force Law, Magnetic Force on (i) point charge (ii) current carrying wire (iii) between current elements, Torque on a current loop in a uniform Magnetic Field. Torque on a current loop, Ballistic Galvanometer, Current and Charge Sensitivity, Electromagnetic Damping, Logarithmic Damping, CDR.

(L 13, M 13, H 13)

Unit 4: Magnetic Properties of Matter

Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability. Relation between B, H and M. Ferromagnetism. B-H curve and hysteresis. **(L 4, H 4, M 4)**

Unit 5: Electromagnetic Induction
Faraday's Law, Lenz's Law, Self-Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations, Charge Conservation and Displacement current. **(L 6, H 6, M 6)**

Unit 6: Electrical Circuits
AC Circuits, Kirchhoff's Laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit: (i) Resonance, (ii) Power Dissipation (iii) Quality Factor and (iv) Band Width. Parallel LCR Circuit. **(L 4, H 4, M 4)**

Unit 7: Network Theorems
Ideal voltage and current Sources, Network Theorems: Thevenin Theorem, Norton Theorem, Superposition Theorem, Reciprocity Theorem, Maximum Power Transfer theorem, Applications to DC circuits**.** **(L 4, H 4, M 4)**

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

Recommended Readings:

1. Electricity, Magnetism & Electromagnetic Theory, *S. Mahajan and Choudhury*, Tata McGraw.
2. Electricity and Magnetism, *E. M. Purcell*, McGraw-Hill Education.
3. Introduction to Electrodynamics*, D. J. Griffiths*, Pearson Education.
4. Feynman Lectures Vol.2, *R. P. Feynman, R. B. Leighton, M. Sands*, Pearson Education.
5. Elements of Electromagnetics*, M. N. O. Sadiku*, Oxford University Press.
6. Electricity and Magnetism, *J. H. Fewkes & J. Yarwood*. Vol. I, Oxford University Press.

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Course title: Thermal Physics
Nature of the course: Major
Course code: PHYMJ402
Total credits: 4
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description: The basic thermodynamic concepts and kinetic theory of gases are covered in this course. The fundamentals of thermodynamics, energy conservation, isothermal and adiabatic processes, and the connection between specific heats are covered at the beginning of the course. After that, entropy ideas, heat engines, and Carnot cycles are also examined. Along with Maxwell's relations and their uses, thermodynamic potentials such as internal energy, enthalpy, and Gibbs free energy are examined. The Maxwell-Boltzmann distribution, molecular collisions, and real gas behavior are covered in the kinetic theory section. Students will comprehend and be able to apply thermodynamic principles and the concepts of kinetic theory of gases to a variety of physical systems at the end of the course.

Course Objectives: The fundamental understanding of energy transformation and conservation concepts that thermal physics imparts is vital for a variety of scientific and engineering fields. For the design and optimization of technical systems such as engines, refrigerators, and power plants, an understanding of thermodynamics is essential. Students who successfully complete the course will have the analytical and problem-solving abilities necessary to apply thermodynamic laws in practical settings. Furthermore, thermodynamics is extremely significant for interdisciplinary applications because it crosses over into disciplines like chemistry, biology, and materials science. By giving students the fundamental theoretical and practical abilities they need, this course prepares them for postsecondary education and employment in science and engineering.

Course Outcomes : After the completion of this course the students will be able to

- Recognize the basic ideas of thermodynamics.
- Describe how the Zeroth Law of Thermodynamics determines temperature.
- Analyze processes and compute energy changes by applying the First Law of Thermodynamics.
- Investigate devices for useful thermodynamic applications.
- Create justifications for entropy shifts in processes that are irreversible and reversible.
- Explain the Second Law of Thermodynamics' consequences in relation to entropy.
- Use the Ehrenfest and Clausius-Clapeyron equations to construct equations and relations.
- Provide an overview of the various thermodynamic cycles' performances.
- Examine how gases behave and other associated phenomena.
- Explain the relevance of the Maxwell-Boltzmann distribution.
- Apply the Van der Waals equation to examine the behavior of real gases.
- Examine gas cooling processes using the Joule-Thomson phenomenon.

Course Contents

Unit 1: Zeroth and First Law of Thermodynamics

Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Temperature Coefficient of Resistance, Concept of Work & Heat, Mechanical Equivalent of Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient. **(L 8, H 8, M 8)**

Unit 2: Second Law of Thermodynamics

Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Theorem, Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **(L 10, H 10, M 10)**

Unit 3: Entropy

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. **(L 7, H 7, M 7)**

Unit 4: Thermodynamic Potentials

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. **(L 7, H 7, M 7)**

Unit 5: Maxwell's Thermodynamic Relations

Derivations and applications of Maxwell's Relations, Maxwell's Relations: (i) Clausius Clapeyron equation, (ii) Values of C_P-C_V, (iii) TdS Equations, (iv) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (v) Energy equations, (vi) Change of Temperature during Adiabatic Process.

(L 7, H 7, M 7)

Unit 6: Distribution of Velocities

Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific Heats of Gases.

(L 7, H 7, M 7)

Unit 7: Molecular Collisions

Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (i) Viscosity, (ii) Thermal Conductivity and (iii) Diffusion. Brownian Motion and its Significance. **(L 4, H 4, M 4)**

Unit 8: Real Gasses

Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waals Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

(L 10, H 10, M 10)

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

Recommended Readings:

1. Heat and Thermodynamics, *M.W. Zemansky and R. Dittman,* McGraw-Hill.
2. A Treatise on Heat, *M. Saha, and B. N. Srivastava*, Indian Press.
3. Thermal Physics, *S. Garg, R. Bansal and Ghosh*, Tata McGraw-Hill.
4. Modern Thermodynamics with Statistical Mechanics, *C. S. Helrich*, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, *Sears & Salinger*, Narosa.
6. Concepts in Thermal Physics, *S. J. Blundell and K. M. Blundell*, 2012, Oxford University Press.
7. Thermal Physics, *A. Kumar and S. P. Taneja*, R. Chand Publications.

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Course title: Mathematical Physics – III

Course code: PHYMJ403

Nature of the course: Major

Total credit assigned: 4

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

Course Description: Relatively more complex subjects than those covered in Mathematical Physics-II are covered in this course, which is an extension of that course. It mostly discusses four subjects: Fourier series; second order differential equations and special functions, including Legendre, Bessel, Hermite, and Laguerre polynomials; some special integrals, including beta and gamma functions; partial differential equations. The main focus of the course is these subjects and how they are used in physics.

Course Objectives: The aim of this course is to

- Introduce a student to various mathematical methods and techniques.
- Gain a fundamental comprehension of these mathematical methods and techniques.
- Introduce a student to how these mathematical techniques and tools are used in physics.
- Help students gain enough mathematical proficiency.

Course Outcomes : At the completion of this course, a learner will be able to -

- Understand a few mathematical concepts and their importance in physics.
- Describe a problem in physics in terms of Fourier series, second order differential equations and special functions such as Legendre, Bessel, Hermite and Laguerre polynomials, some special integrals such as beta and gamma functions and partial differential equations.
- Apply the above mathematical concepts to solve problems.
- Solve advanced level mathematical problems based on the key concepts in Fourier series, second order differential equation and special functions such as Legendre, Bessel, Hermite and Laguerre polynomials, some special integrals such as beta and gamma functions and partial differential equations.
- Use Fourier series, second order differential equation and special functions such as Legendre, Bessel, Hermite and Laguerre polynomials, some special integrals such as beta and gamma functions and partial differential equations to solve problems in branches of physics like quantum mechanics, electromagnetic theory, thermal physics, electronics etc.

Course Contents

Unit 1: Fourier Series

Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity. **(L 15, H 15, M 15)**

Unit 2: Second Order Differential Equation and Special Functions

Second Order Linear Differential Equations and their importance. Singular Points, Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality. **(L 25, H 25, M 25)**

Unit 3: Some Special Integrals

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **(L 6, H 6, M 6)**

Unit 4: Partial Differential Equations

Solutions to Partial Differential Equations using Separation of Variables Method, Laplace's Equation in problems of Rectangular, Cylindrical and Spherical symmetry. Wave equation, Laplace Equation, Diffusion Equation, Examples of boundary value problems in physics. **(L 14, H 14, M 14)**

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

Recommended Readings:

1. Mathematical Methods for Physicists, *G. B. Arfken, H. J. Weber, F. E. Harris*, Elsevier.
2. Fourier Analysis, *M. R. Spiegel,* Tata McGraw-Hill.
3. Mathematics for Physicists, *S. M. Lea,* Thomson Brooks/Cole.
4. Differential Equations, *G. F. Simmons,* Tata McGraw-Hill.
5. Partial Differential Equations for Scientists and Engineers, *S. J. Farlow,* Dover Publication.

6. Engineering Mathematics, *S. Pal and S. C. Bhunia*, Oxford University Press.
7. Mathematical methods for Scientists & Engineers, *D. A. McQuarrie*, Viva Books.

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Course title: Physics Lab II (Major)
Course code: PHYMJ404
Nature of the course: Major
Total credit assigned: 4
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description: The course on Physics Lab II (Major) comprises experiments covering Electricity, magnetism and thermal physics.

Course Objectives: This course will enable the students to

- Understand and appreciate the theory of Electricity, magnetism and thermal physics.
- Develop the ability to relate the theories into everyday applications.

Course Outcomes : At the completion of the course, the students will be able to

- Understand the basic concepts in hands-on mode through the basic electricity, magnetism and thermal physics experiments
- Recall the concepts of series and Parallel LCR circuits
- Explain the characteristics of RC circuit, Thevenin and Norton theorem
- Recall the basics of thermal conductivity and thermo emf.
- Experiment with various electrical circuits and electronic instruments.
- Analyze different electronic components and circuits to understand its functioning.
- Analyze the frequency response curve to determine impedance and resonance.

Course Contents

Lists of Experiments:

Unit 1: Electricity and Magnetism

1. To study the characteristics of a series RC circuit.
2. To determine an unknown Low Resistance using Potentiometer/Carey Foster's Bridge.
3. To verify the Thevenin and Norton theorems.
4. To verify the Superposition, and Maximum power transfer theorems.
5. To determine self-inductance of a coil by Anderson's bridge.
6. To study the response curve of a series and parallel LCR circuit and determine its (a) Resonant frequency (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
7. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
8. Determine a high resistance by leakage method using Ballistic Galvanometer.

Unit 2: Thermal Physics

1. To determine Mechanical Equivalent of Heat, J by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

7. To determine the specific heat of a solids.
8. To determine the specific heat of a liquids.
9. To determine the ratio of specific heat of gases by Clement and Desrome's method.

(Total Practical Classes 60, Total Contact Hours 120, Total Marks 60)
At least 60% of the experiments must be performed from each unit.

Recommended Readings:

1. Advanced Practical Physics for students, *B. L. Flint and H. T. Worsnop*, Asia Publishing House.
2. A Text Book of Practical Physics, *I. Prakash & Ramakrishna,* Kitab Mahal.
3. Advanced Level Physics Practicals, *M. Nelson and Jon M. Ogborn*, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, *D. P. Khandelwal*, Vani Publication.

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Course title: Electricity and Magnetism
Nature of the course: MINOR
Course code: PHYMN401
Total credit assigned: 4
Distribution of marks: 60 (End sem) + 40 (In-sem)

Course Description: With an emphasis on both electrostatics and magnetostatics, as well as their possible uses in diverse fields, this course offers a thorough introduction to the basic ideas of electromagnetism. The curriculum explores important ideas including Gauss' law, Laplace's and Poisson's equations, and the method of images while covering the behavior of electric fields, electric potential, and energy. It also explores the magnetic properties of materials, the dielectric characteristics of matter, and the fundamentals of magnetostatics. Along with introducing Maxwell's equations, the course also looks at electromagnetic induction, including Faraday's and Lenz's laws. Students will also learn about network theorems, electrical circuits, and how they apply to both AC and DC circuits. This course seeks to establish a solid foundation in electromagnetism and its relation to everyday phenomena and technological applications through a combination of theoretical discussions and real-world examples.

Course Objectives: The basic objective of this course is to

- Explain the basic ideas of electromagnetism to students.
- Gain a fundamental grasp of electromagnetic induction, magnetostatics, and electrostatics.
- Introduce students to the magnetic and dielectric characteristics of materials.
- Introduce students to important subjects including network theorems, AC and DC circuits, and how these could be used to solve practical problems.

Course Outcomes: After completion of the course the students will be able to

- Recognize the basic principles of electromagnetism and their significance in physics.
- Describe the fundamental ideas of magnetic field, electric field and electromagnetic induction.
- Explain polarization phenomena and the behavior of electric fields in matter.
- Using B-H curves and magnetization principles, talk about the magnetic properties of materials.
- Use fundamental laws to address real-world problems.
- To solve issues with symmetrical charge distributions, apply Gauss's law.
- Use the Laplace and Poisson equations as well as the method of images to solve various problems.

- Use several methods to assess how electrical circuits and networks behave.
- Utilize Norton's and Thevenin's theorems to simplify complicate circuits.
- Using Kirchhoff's rules, analyze AC circuits and get complex reactances and impedances.

Course Contents:

Unit 1: Electrostatics

Electric Field, Electric Lines of Force, Electric Flux, Gauss' Law with applications to charge distributions with Spherical, Cylindrical and Planar symmetry**.** Conservative nature of Electrostatic Field, Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field of a dipole, Force and Torque on a Dipole. Electrostatic Energy of System of Charges, Electrostatic Energy of a Charged Sphere, Conductors in an electrostatic field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate Capacitor, Capacitance of an isolated conductor. **(L 21, H 21, M 21)**

Unit 2: Dielectric Properties of Matter

Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant; Capacitor (parallel plate, spherical, cylindrical) filled with dielectric; Displacement vector D, Relations between Electric field vector E, Polarization vector P and D, Gauss' Law in dielectrics. **(L 8, H 8, M 8)**

Unit 3: Magnetostatics

Magnetic force between current elements and definition of Magnetic Field B, Biot-Savart's Law and its simple applications (straight wire and circular loop), Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole), Ampere's Circuital Law and its application to (i) Solenoid and (ii) Toroid, Properties of B: curl and divergence, Vector Potential, Lorentz Force Law, Magnetic Force on (i) point charge (ii) current carrying wire (iii) between current elements, Torque on a current loop in a uniform Magnetic Field. Torque on a current loop, Ballistic Galvanometer, Current and Charge Sensitivity, Electromagnetic Damping, Logarithmic Damping, CDR.
(L 13, M 13, H 13)

Unit 4: Magnetic Properties of Matter

Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability. Relation between B, H and M. Ferromagnetism. B-H curve and hysteresis. **(L 4, H 4, M 4)**

Unit 5: Electromagnetic Induction

Faraday's Law, Lenz's Law, Self-Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations, Charge Conservation and Displacement current. **(L 6, H 6, M 6)**

Unit 6: Electrical Circuits

AC Circuits, Kirchhoff's Laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit: (i) Resonance, (ii) Power Dissipation (iii) Quality Factor and (iv) Band Width. Parallel LCR Circuit. **(L 4, H 4, M 4)**

Unit 7: Network Theorems

Ideal voltage and current Sources, Network Theorems: Thevenin Theorem, Norton Theorem, Superposition Theorem, Reciprocity Theorem, Maximum Power Transfer theorem, Applications to DC circuits**.** **(L 4, H 4, M 4)**

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

Recommended Readings:

1. Electricity, Magnetism & Electromagnetic Theory, *S. Mahajan and Choudhury*, Tata McGraw.
2. Electricity and Magnetism, *E. M. Purcell*, McGraw-Hill Education.
3. Introduction to Electrodynamics*, D. J. Griffiths*, Pearson Education.
4. Feynman Lectures Vol.2, *R. P. Feynman, R. B. Leighton, M. Sands*, Pearson Education.
5. Elements of Electromagnetics*, M. N. O. Sadiku*, Oxford University Press.
6. Electricity and Magnetism, *J. H. Fewkes & J. Yarwood*. Vol. I, Oxford University Press.

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