COURSE CONTENT						
Course Type	**Course Code**	**Name of Course**	**L**	**T**	**P**	**Credit**
IDC2	**NPHI101**	**ENGINEERING PHYSICS**	**3**	**0**	**0**	**3**

Course Objective

PART 1: Classical Mechanics and Electrodynamics:
The goal of this course is to introduce Classical Mechanics and Electrodynamics to be useful for further applications in engineering and science. In particular, the course would present the first year graduate student or senior undergraduate student a broad introduction to the principles of classical mechanics beyond Newtonian mechanics for broad applications. Similarly, introduction to electrodynamics will help the students navigate their imagination in practical applications, especially encountered in designing prototype products and processes. The course is suitable for those students who have completed their course in undergraduate. It would be further useful if the student has also done the first undergraduate course on Newtonian mechanics, calculus and electricity & magnetism. Lecture notes will be provided and supplemented with assignments that emphasize systematic problem solving.

PART 2: Thermal and Statistical Physics:
The goal of this course is to introduce thermodynamics and statistical physics as a practical tool for engineering applications. In particular, the course would present the first year graduate student or senior undergraduate student a broad introduction to the principles of thermodynamics typically encountered in designing prototype products and processes. The course is suitable for those students who have completed their course in undergraduate. It would be further useful if the student has also done the first undergraduate course on engineering thermodynamics and Statistical Physics. Lecture notes will be provided and supplemented with assignments that emphasize systematic problem solving.

PART 3: Modern Physics:
The objective of the course is to give a brief idea of some very important and fascinating areas of Modern Physics with an emphasis on Physics Concepts applied to them.

Learning Outcomes

PART 1: Classical Mechanics and Electrodynamics:

On completion of the course, the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

- Knowledge: The student having thorough knowledge can derive complicated expressions in classical and quantum mechanics. Moreover, the student can have an expanded knowledge of the applications based on Maxwell's electrodynamic principles.
- Skills: The student can use classical mechanics, such as Lagrangian and Hamiltonian equations to solve advanced problems based on equations of motion. After learning Maxwell's electrodynamic laws and related principles, he/she can apply it to solve different problems related to electromagnetic waves, antenna, wave guides etc.
- General competence: The student can apply the principle of classical mechanics and electrodynamics in other fields of physics, engineering, and related areas.
- Prototype Products development: The student will understand the underlying electrodynamic and classical mechanics principles required to build prototype models.

PART 2: Thermal and Statistical Physics:

On completion of the course: the student should have the following learning outcomes defined in terms of knowledge, skills and general competence:

- Knowledge: The student has thorough knowledge and can explain the procedures for deriving the relation between thermodynamic parameters such as pressure, temperature and change in entropy.
- Skills: The student can use statistical physics methods, such as Maxwell-Boltzmann, Fermi- Dirac and Bose-Einstein distributions to solve problems in some physical systems. Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
- General competence: The student can apply the principle of thermodynamics and statistical physics in other fields of physics and related fields.
- Prototype Products development: The student can be able to do the prototype of the thermodynamic module.

PART 3: Modern Physics

Upon successful completion of this course, students will:

- have a good understanding of Laser Physics and will be acquainted with basic principle and working of some of the laser systems.
- have a good understanding of the quantum mechanical concepts in studying the wave character of a moving particle.
- be able to understand and conceptualize origin of various types of Atomic and Molecular Spectra.
- have a good understanding of importance of electronic band structures of solids and their origin.
- be introduced to the fascinating world of nanoscience and nanotechnology.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
	PART 1: Classical Mechanics and Electrodynamics		
1	**Mechanics of many-body systems:** Equation of motion for many-particle system, conservation of linear and angular momenta and energy, constraints.	2	The student having thorough knowledge can derive complicated expressions in classical and quantum mechanics.
2	**Lagrangian and Hamiltonian Equations:** Generalized coordinates, D'Alembert principle, Lagrangian equation, principle of stationary action, Hamiltonian equations	5	The student can apply the principle of classical mechanics and electrodynamics in other fields of physics and related areas
3	**Electrodynamics:** Maxwell's equations and derivations. Electromagnetic wave equation: in vacuum and isotropic media, Electromagnetic energy density, Poynting theorem	7	After learning Maxwell's electrodynamic laws and related principles, he/she can be able to apply it to solve different problems related to electromagnetic waves, antenna, wave guides.
	PART 2: Thermal and Statistical Physics		
4	**Principles of thermodynamics** (with applications to simple fluids); thermodynamic potentials: enthalpy, Helmholtz potential, Gibbs potential; Entropy; conditions of equilibrium, concepts of stable, metastable and unstable equilibrium.	4	The student has thorough knowledge and can explain the procedures for deriving the relation between thermodynamic parameters such as pressure, temperature, change in entropy and equilibrium concept.
5	**Black body radiation:** Classical approach (Rayleigh-Jeans theory and Wien's displacement law); ultraviolet catastrophe; Planks law of Black body radiation.	4	Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
6	**Statistical Physics:** Micro-Canonical, Canonical and Grand Canonical ensembles; Corresponding Partition Functions and their relations to thermodynamic potentials MB, BE and FD Statistical distribution laws.	6	The students can use statistical physics methods, such as Maxwell-Boltzmann, Fermi- Dirac and Bose-Einstein distributions to solve problems in some physical systems.
	PART 3: Modern Physics		
7	**Lasers and Laser System:** Definition, Properties, Spontaneous and Stimulated Emissions, Einstein's Coefficient, Population Inversion	2	This introductory topic will help students gain a broad understanding of basic concepts of different processes involving lasers.
8	Two Level System/Three Level System, Rate Equations	2	In these topics students will learn about the minimum requirement of having 3-levels in a laser system.
9	Components of a Laser, Types of Lasers (He-Ne and Ruby Lasers).	1	This will help students in understanding the basic structure of a laser, and based upon that student will be able to explain the construction and working of a given laser.

10	Quantum Mechanics: Introduction to Quantum Mechanics, Brief idea of Wave Packet and Wave Function, Its Physical Significance	2	This unit will provide an insight to a new concept of Physics in the microscopic world. The student will learn about the need for quantum mechanics and its importance.
11	Schrödinger Wave Equation	1	Students will be able to understand the wave character of a moving particle.
12	Particle in a Box (Energy value in one-dimension and three-dimension).	1	Students will be able to apply the Quantum Mechanical concepts (Schroedinger Wave equation) to solve some real problems like if a particle is confined within a box.
13	Atomic and Molecular Spectra: Origin of Atomic Spectra, Brief idea of Molecular Spectra	1	This unit will provide brief idea about Spectroscopy, a special branch of Physics and how different kind of spectra originates.
14	Pure Rotational Spectra, Pure Vibrational Spectra of Simple Molecules and Rotational-Vibrational Spectra. Molecule as a Rigid rotator.	2	Students will be able to learn and understand the details of different kinds of molecular spectra, their nature, origin, properties etc.
15	Band Theory of Solids; Hall Effect	1	Students will be able to understand the electronic band structure of a solid, Why do bands and band gaps occur in a solid?
16	Introduction to Nanoscience and its Societal Impact	1	Students will be introduced to the fascinating world of nanoscience and nanotechnology giving emphasis on its importance in our day-to-day life.
	Total	**42**	

Textbooks:

1. Classical Mechanics by H. Goldstein; Springer
2. Classical Mechanics by J. C. Upadhyaya
3. Thermal physics by S. C. Garg, R. M. Bansal, & C. K. Ghosh, Tata McGraw Hill.
4. Thermodynamic and Statistical Mechanics by W. Greiner; Springer
5. Concepts Of Modern Physics; Beiser; McGraw-Hill Science; 2010
6. Lasers by Anthony E. Siegman; University Science Books, U.S.; New edition (17 October 1990)

Reference Books:

1. Classical Mechanics: System of particles and Hamiltonian dynamics by W. Greiner
2. Heat and Thermodynamics by M. Zimansky; McGraw Hill
3. Thermal Physics; Schroeder; Dorling Kindersley India; 2007
4. Basics of Laser Physics: for students of Science and Engineering by K. F. Renk; Springer
5. Introduction to Solid State Physics by C. Kittel; John-Willey and Sons.
6. Introduction to Quantum Mechanics by David J. Griffiths; Pearson Prentice Hall; 2nd edition (April 10, 2004)
7. Heat, Thermodynamics and Statistical physics, Brijlal, Dr. N. Subrahmanyam & P. S. Hemne