Semester 5 Major

Course- 352T

Major Course – 4 Credits

Semester: 5	**Course No.: 352(T)**	**Course Code:** PHM 352(T) **Course Title Solid state physics- Electromagnetics- Nuclear Physics- Electronics**
Credits: 4	1 Session = 1 hour	**Course Category: Major Paper**

Course Objectives:

By the end of this course, students will:

1. Understand and apply the fundamental principles of solid state physics, particularly elasticity and the behaviour of free electron gases in metals.
2. Comprehend the core concepts of electromagnetism, including Maxwell's equations, electromagnetic wave propagation, and associated phenomena like radiation pressure and energy flux.
3. Explore the nature of nuclear radiation, focusing on alpha, beta and gamma decay, their theoretical underpinnings, and experimental evidence.
4. Analyze the operation and characteristics of electronic amplifiers and evaluate various types of amplifier distortions

Course Outcomes: On successful completion of the course the learner will be able to

CO	COURSE OUTCOMES	Bloom's Verb
CO-1	Analyze elastic strains. Calculate elastic constants and explain wave propagation in crystalline solids. Evaluate the free electron model, calculate Fermi energy and density of states, Explain thermal and electrical conductivities in metals	**Apply** **Analyze** **Evaluate**
CO-2	Apply Maxwell equation to understand and analyze the electromagnetic waves propagation in different mediums. Apply the concept to understand the skin depth. Apply the concepts of electrostatics for analyzing the boundary value problems and method of images	**Apply** **Analyze**
CO-3	Apply theory of radioactive decay of unstable nuclei and understand the properties and characteristics of α, β and Y decay. Also evaluate the possible energy levels during this decay & disintegration energy and study the hyperfine structure of element.	**Apply** **Analyze** **Evaluate**
CO-4	Remember the basic working characteristics of active devices like transistor. Understand the amplification process and analyse the characteristics of transistor amplification. By applying these characteristics, calculation of different parameters related with amplification process can be done.	**Understand** **Apply**

Unit No.	Unit Contents	Sessions Allotted
1	**Solid State Physics** **Elastic constants and elastic waves**: Analysis of elastic strains, Dilation, stress components, Elastic compliance and stiffness constants, Elastic energy density, elastic stiffness constants of cubic crystals, Bulk modulus and compressibility. Elastic waves in cubic crystals, waves in the [100] direction, waves in the [110] direction. **Free electron Fermi gas**: Introduction, Energy levels in one dimension, Effect of temperature on the Fermi-Dirac distribution, Free electron gas in three dimensions and density of states, Heat capacity of the electron gas and experimental heat capacity of metals, Electrical conductivity and ohm's law, Experimental electrical resistivity of metals, Thermal conductivity of metals, ratio of thermal to electrical conductivity.	**15 Hours**

2	**Electromagnetics** **Electromagnetic waves:** Plane waves in non-conducting media, Polarization, Energy flux in a plane wave, Radiation pressure and Momentum, Plane waves in conducting medium, Skin effect. **Boundary value problem in electromagnetic field** Poisson and Laplace equation, Boundary condition and Uniqueness theorem, Solution of Laplace equation in rectangular coordinates, Laplace equation in Spherical polar coordinates, Laplace equation in cylindrical coordinates, The Multipole expansion, Method of electrostatic images	**15 Hours**
3	**Nuclear Physics** **Alpha Rays**: Range of alpha particles, Disintegration energy of the spontaneous alpha decay, Alpha decay paradox -barrier penetration. **Beta Rays**: Introduction, Continuous Beta ray spectrum – difficulties in understanding it, Pauli's Neutrino Hypothesis, Fermi's theory of Beta decay, the detection of neutrino, Parity non-conservation in Beta decay. **Gamma-rays:** Gamma Rays: Introduction, Gamma-ray emission – selection rules, Internal conversion, Nuclear isomerism.	**15 Hours**
4	**Electronics** **General Amplifier Characteristics I: Distortion.** Introduction, concept of amplification, amplifier notations, current gain, voltage gain, power gain, amplifier input resistance, amplifier output resistance, maximum power transfer, conversion efficiency, classes of amplifier operation, harmonic distortion, three point method of calculating harmonic distortion, five point method of calculating harmonic distortion, oscilloscope display of an amplifier dynamic transfer curve, measurement of harmonic distortion, other types of amplifier distortion. **General Amplifier Characteristics II: Decibels.** Decibels, other equations for decibel computation, zero dB reference level, use of voltmeter as dB indicator, voltmeter range correction factors, impedance correction factor, frequency response curves, amplifier bandwidth.	**15 Hours**

Unit-1 Solid state physics

Text Book: Introduction to Solid State Physics by C. Kittel, (Eight Edition) John Wiley and Sons. Chapters 3 & 6

Reference Book:

1.Elements of Solid State Physics by J. P. Srivastava, Prentice-Hall of India Private Limited, New Delhi

2. Solid State Physics by S. O. Pillai, New Age International Publishers

3. Introduction to Solid State Physics (7^{th} Edition) by C. Kittle, Wiley (India)

Unit-2 Electromagnetics

Text Book: Electromagnetics by B. B. Laud, 2nd Edition, 1987, New age international (P) Limited.

Chapter-6: Article Nos.: 6.1 - 6.6; chapter-3: Article Nos.: 3.1, 3.3 to3.5, 3.8 to 3.11

Electromagnetic fields (Theory and problems) by T. V. S. Arun Murthy; S Chand and Company Ltd. First edition 2008;

Reference books:

1. Introduction to Electrodynamics by David J. Grifiths; Cambridge University Press, 4^{th} edition, 2013.

2. Classical electromagnetism by H. C. Verma; 1^{st} edition Bharat Bhavan Publishers and Distributers.

3. Electrodynamics by Gupta, Kumar and Singh, 22^{nd} edition, 2014 Pragati Prakashan.

Unit-3 Nuclear physics

1. Text Book: Nuclear Physics - An Introduction by S.B. Patel, New Age International. Chapter-4: Article Nos.: 4.II-I to 4 II - 3, 4.III - 1 to 4.III – 6. 4. IV.1 to 4.IV.4

Reference Books: 1. Introduction to Nuclear Physics by H.Enge, Addison Wesley 2. Nuclear Physics by D. C. Tayal, Himalaya Publisher 3. Nuclear Physics by Irvin Kaplan

Unit-4 Electronics

Text Book: Electronic Devices and circuits – An Introduction by Allen Mottershead, Printice-Hall of India Private Limited . Chapetr-7-Article Nos. 7.1 - 7.16; Chapter-8: Article nos: 8.1 - 8.8