COURSE TITLE	**ENGINEERING PHYSICS**
COURSE CODE	**01GS0104**
COURSE CREDITS	**4**

Objective:

1 To provide fundamental knowledge of Physics and its basic concepts to solve engineering problems.

Course Outcomes: After completion of this course, student will be able to:

1 Analyze electrical, mechanical, and thermal properties of materials using fundamental laws.
2 Explain the electrostatic principles in dielectric medium.
3 Apply the fundamental laws related to magnetostatics and electromagnetic waves.
4 Evaluate the validity and applicability of Schrödinger's equation for various systems.
5 Describe the principles and applications of semiconductors chips and optoelectronic devices.

Pre-requisite of course: None

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Structure and Properties of Matter** Crystal Structure, Lattice and Basis, Unit cell, Material strength, metallic bonding, and alloy formation, Free electron theory of metals, Fermi level, density of states, Bloch's theorem for particles in a periodic potential, Electrical Conductivity in Solids, Wiedemann–Franz law, phonon transport, and electron–phonon interactions	8
2	**Electrostatics in Vacuum and Dielectric Medium** Electric field and electrostatic potential for a charge distribution, Electrostatic field and potential of a dipole. Polarizations in Dielectric Materials, Clausius–Mossotti relation, Ferroelectric and Piezoelectric Materials, SiO2 and HfO2 as gate dielectrics; dielectric thin films and interlayer dielectrics, Applications: Transformers, capacitors, sensors, and memory devices	8

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Contents : Unit	Topics	Contact Hours
3	**Magnetostatics and Electromagnetic Waves** Bio-Savart law, Divergence and curl of static magnetic field, Vector potential and its derviation using Stokes' theorem, Faraday's law in terms of EMF produced by changing magnetic flux, Lenz's law; Magnetic Sensors and Hall Effect Devices, Soft and Hard Magnetic Materials in Electrical Machines, Magnetic Storage Devices and Spintronics: MRAM and quantum computing	10
4	**Quantum Mechanics and Schrodinger Equation** Introduction to Quantum mechanics, Wave nature of Particles, Time- dependent and time independent Schrodinger equation, Schrodinger equation for one dimensional problem - particle in a box, Quantum Tunneling through Potential Barriers, Franck–Hertz Experiment — Discrete Atomic Energy Levels	8
5	**Semiconductor Chips and Optoelectronics** Introduction to Semiconductor Chips. Synthesis, manufacturing, and application of semiconductor chips, Advanced Photovoltaics: Perovskite and Multi-Junction Solar Cells, Tandem cells, Optoelectronic Modulators and Detectors, Electro-optic, acousto-optic, and all-optical modulation techniques, avalanche photodiodes, Optical communication, high-speed data transmission	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiement No. 01** To verify the voltage-current appearances of a solar cell under varying illumination and determine its efficiency and fill factor.	2
2	**Experiement No. 02** To determine the variation of photocurrent with intensity and applied voltage, and calculate the responsivity of the photodiode.	2
3	**Experiement No. 03** To analyze ferroelectric P–E loop to evaluate coercive field and polarization for a given material.	2
4	**Experiement No. 04** To calculate the divergence angle and beam waist of a laser beam using geometric methods.	2
5	**Experiement No. 05** Analyze antenna impedance and reflection variation using network analyzer performance.	2
6	**Experiement No. 06** To trace the B–H curve and determine magnetic retentivity, coercivity, and hysteresis loss.	2
7	**Experiement No. 07** To study the induced emf generated due to change in magnetic flux and verify Faraday's and Lenz's laws.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	**Experiement No. 08** To determine the resonant frequency of an LC circuit and verify the relation.	2
9	**Experiement No. 09** To study the variation of current with frequency in a series LCR circuit determining resonant frequency, quality factor (Q), and bandwidth.	2
10	**Experiement No. 10** To determine the refractive index of the material of a prism using the angle of minimum deviation method, verifying Snell's law.	2
11	**Experiement No. 11** To apply refraction principles to analyze the deviation of light through a prism and evaluate the refractive index using the minimum deviation method.	2
12	**Experiement No. 12** To measure the dielectric constant (relative permittivity) of a solid or liquid using a capacitor setup.	2
Total Hours		**24**

Textbook :

1 Engineering Physics, A.B. Bhattacharya, Khanna Book Publishing Co. P Ltd, 2021
2 Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg and R. Resnick, Wiley, 2006
3 Quantum mechanics, D. J. Griffith, Cambridge University Press, 2024
4 Introduction to Electrodynamics, D. J. Griffith, Cambridge University Press, 2021
5 Physics of Semiconductor Devices, S.M. Sze and Kwok K. Ng, Willey, 2008
6 Solid State Electronic Devices, Ben G. Streetman & Sanjay Banerjee, Pearson, 2015
7 The Physics of Solar Cells, Jenny Nelson, Imperial College Press, 2003
8 Optoelectronics: An Introduction, J. Wilson & J.F.B. Hawkes, Prentice-Hall, 1989

References:

1 Concepts of Modern Physics, Concepts of Modern Physics, Arthur Beiser, McGraw Hill Education, 2017
2 Optical Electronics, Optical Electronics, Ajoy Ghatak & K. Thyagarajan, Cambridge University Press, 2017
3 Engineering Physics, Engineering Physics, R.K. Gaur & S.L. Gupta, Dhanpat Rai Publications, 2012
4 Introduction to Solid State Physics, Introduction to Solid State Physics, C. Kittel, Willey, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	0.00	40.00	40.00	20.00	0.00

Instructional Method:

1. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the class- room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in classroom.
4. Students will use supplementary resources such as online videos.

Supplementary Resources:

1. https://nptel.ac.in/
2. https://ocw.mit.edu/courses/physics/
3. https://phet.colorado.edu/
4. http://hyperphysics.phy-astr.gsu.edu/
5. https://www.feynmanlectures.caltech.edu/
6. https://www.allaboutcircuits.com/
7. https://www.coursera.org/courses?query=modern%20physics
8. https://link.springer.com/

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