SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-3

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belgavi, Approved by AICTE, New Delhi)

DEPARTMENT OF PHYSICS

SCHEME OF TEACHING AND EXAMINATION OF ENGINEERING PHYSICS

I / II Semester

Sl. No.	Subject code	Title	Teaching hours per week			Examination				Credits
			L	T	P	Duration	CIE Marks	End Exam Marks	Total	
1	1RPHY	Engineering Physics	4	--	--	3 hrs	50	50	100	4.0
2	1RPHYL	Engineering Physics Lab	--	--	2	3 hrs	50	50	100	1.0

L-Lecture, T-Tutorials, P- Practical, CIE-Continuous Internal Evaluation

Siddaganga Institute of Technology, Tumkur – 572 103

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ENGINEERING PHYSICS

(Common to all branches of B.E I/II Semester)

Sub Code	**:**	**1 RPHY**	**Credits**	**:**	**4.0**
Hrs/ Week	**:**	**4**	**Total Hrs.**	**:**	**52**

COURSE OVERVIEW

Engineering Physics deals with the study of combined disciplines of Physics, Engineering and Mathematics. It is devoted in creating and optimizing engineering solutions through enhanced understanding and integrated applications of scientific, mathematical and engineering principles. It is cross functional and bridges the gap between theoretical science and engineering. It provides thorough groundings in applied physics for the selected topics such as elasticity, lasers & optical fibers, quantum mechanics, electrical conductivity in metals, dielectric materials, semiconductor physics and shock waves.

COURSE OBJECTIVE:

The students will

- Study the relation between different moduli of elasticity, theory and experimental method for the determination of Young’s modulus by single cantilever and rigidity modulus by torsional pendulum.
- Comprehend theoretical background of laser, the working of CO_2 and semiconductor lasers and applications of laser. Also, study the nature of propagation of light in optical fiber, reasons for the fiber loss and optical fiber application in Point to point optical communication.
- Realize the wave particle dualism, Heisenberg’s uncertainty principle and its significance, mathematical formulation of Schrodinger equation and its applications, quantum mechanical tunneling effect with examples.
- Understand the electrical properties of metals based on classical and quantum free electron theory and dielectric properties solids.
- Get the concept of band formation in solids and Halle effect. Also, students will go through the concept of shock waves and realize the generation of shock waves in the laboratory and calibration of shock tube.

MODULE-1: ELASTIC PROPERTIES OF MATERIALS 10 hrs

Review of Stress and strain, Hooke's law, different types of elastic moduli, Poisson's ratio (α: longitudinal strain per unit stress, β: lateral strain per unit stress). Relation between elastic constants (Y, K, n and σ). Theoretical and practical limits of Poisson's ratio. Bending of beams, bending moment of a beam and its application in I – shaped girders, Cantilever loaded at the free end - expression for Young's modulus. Experimental determination of Young's modulus of the material of the beam by single cantilever method. Torsional pendulum - expression for rigidity modulus. Experimental determination of the rigidity modulus of wire. Numerical problems.

MODULE -2: LASERS AND OPTICAL FIBERS 10 hrs

Lasers: Concept of induced absorption, spontaneous emission and stimulated emission. Expression for energy density in terms of Einstein's coefficients and discussions. Requisites of lasers. Condition for laser action. Construction and working of laser sources: CO_2 and semiconductor lasers, applications of laser: drilling, welding, cutting, and measurement of pollutants in atmosphere.

Optical fibers: Working principle, structure of optical fiber, expression for numerical aperture, modes of propagation, classification of fibers, fiber loss and mechanisms for fiber loss. Block diagram and discussion of point-point optical communication, advantages and disadvantages, Numerical problems.

MODULE- 3: QUANTUM MECHANICS 10 hrs

Introduction to quantum mechanics, wave-particle duality, Concept of phase and group velocities. Heisenberg's uncertainty principle: statement, equations, explanation and significance. Wave function its significance and properties. Schrödinger's wave equation: Setting up of time independent Schrödinger's wave equation. Applications: Free particle,

Particle in a potential well of infinite height. Finite potential barrier (qualitative) and tunneling effect with examples (STM & Tunnel diode). Numerical problems.

MODULE -4: MATERIAL SCIENCE 11 hrs

Electrical conductivity of metals: Review of free electron theory of metals. Quantum free electron theory of metals –assumptions, drift velocity, relaxation time, collision time, electrical conductivity in terms of collision time and mobility of electrons (no derivation), Fermi energy, Fermi velocity, Fermi temperature. Relation between Fermi energy and resistivity of the metal. Experimental determination of Fermi energy of copper by four point probe method. Fermi factor-dependency of Fermi factor on temperature and energy of the electron in the metal. Significance of Fermi energy, Numerical problems.

Dielectric materials: Polar and non-polar dielectrics, polarization, dielectric susceptibility, dielectric constant, dielectric polarisability. Types of polarization in dielectric materials (qualitative), Expression for internal fields in a solid, Clausius-Mossotti equation, Dielectric loss. Mention of solid, liquid and gaseous dielectrics with examples. Applications of dielectric materials: in capacitor, in transformer. Numerical problems.

MODULE - 5: SEMICONDUCTOR PHYSICS AND SHOCK WAVES 11 hrs

Semiconductor physics: Classification of solids based on the formation of bands due to splitting of energy levels at equilibrium inter-nuclear distance: metal (Na & Mg), insulator(diamond) and semiconductor (Si and Ge). Concept of holes, doping and impurity levels in semiconductors, Fermi level in intrinsic and extrinsic semiconductor. Expression for electrical conductivity for intrinsic and extrinsic semiconductor. Hall Effect, Expression for Hall coefficient, Applications of Hall effect, Numerical problems.

Shock waves: Mach number, distinctions between –acoustic, ultrasonic, subsonic, transonic and supersonic waves. Shock waves characteristics and applications. Normal shock relationships – Rankine-Hugoniot equations (qualitative). Methods of producing shock waves- Reddy shock tube and its characterization by experimental technique. Numerical problems.

COURSE OUTCOME

Upon completion of this course, students will be able to

CO1 Apply the knowledge of theory of elasticity to find Young's modulus and rigidity modulus of the materials experimentally.

CO2 Elucidate the working of CO_2, semiconductor lasers, types of optical fibers, reasons for the fiber loss and their applications in engineering.

CO3 Comprehend the wave particle dualism, significance Heisenberg's uncertainty principle, mathematical formulation of Schrodinger equation and its applications, quantum mechanical tunneling effect with examples.

CO4 Analyze the material properties such as electrical properties of metals based on classical and quantum free electron theory, dielectric and semiconducting properties solids. Also, students are able to demonstrate determination of type semiconductor by Hall effect, the generation of shock waves in the laboratory and calibration of shock tube.

CO5 Identify and apply the appropriate analytic, numerical and other mathematical tools necessary to solve Physics and engineering problems.

TEXT BOOKS:

1. S. O. Pillai, Solid State Physics, 8th edition, New Age International Publishers, New Delhi, 2018.
2. R. K. Gaur and S. L. Gupta, Engineering Physics, Dhanpath Rai and Sons, New Delhi, 2016.

REFERENCE BOOKS:

1. Hitendra K. Singh and A. K. Singh, Engineering Physics, Tata McGraw Hill, New Delhi. 2010
2. Marikani, Engineering Physics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi., 2014.
3. Arthur Beiser, Concepts of Modern Physics, 6th edition, Tata McGraw Hill publishing company Ltd., New Delhi, 1998.
4. M. N. Avadhanulu and P. G. Kshirsagar, Engineering Physics, S. Chand & Company Ltd., New Delhi. 2008
5. K. Ghatak and Thyagarajan, Optical Electronics, Cambridge University Press (UK), 1989.
6. Chintoo S Kumar, K. Takayama and K P J Reddy, Shock Waves Made Simple, Wiley India Pvt. Ltd. New Delhi, 2014.

QUESTION PAPER PATTERN:

Answer any FIVE questions choosing ONE full question carrying 20 marks from each unit.

CIE Scheme for theory:

Assessment	Marks
Quiz-1	03
Quiz-2	03
I Midsem exam	17
Quiz-3	03
II Midsem exam	17
Quiz -4	03
Assignments	04
Total	**50**

Course Unitization for Midsem Exams and Semester End Examination

Module	Chapter	No. of Questions in		No. of Questions in SEE
		Mid Sem I	Mid Sem II	
I	Elastic properties of materials	1.5	---	2
II	Lasers and Optical Fibers	1.5	---	2
III	Quantum Mechanics	---	1.5	2
IV	Material Science	---	1.5	2
V	Semiconductor Physics and Shock Waves	---	--	2
		All questions are compulsory	All questions are compulsory	Answer any 5 questions choosing ONE full question from each unit.

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ENGINEERING PHYSICS LABORATORY

(Common to all branches of B.E I/II Semester)

Sub Code	**: 1R PHYL**	**Credits**	**: 1.0**
Contact Hrs / Week	**: 02**	**Total Hrs.**	**: 26**

Course Objective:

The objective of this course is to make the students to co-relate experimental knowledge with theory of Physics in the topics such as optics, quantum mechanics, material properties and shock waves. The perfectness in the experimental skills will bring more confidence, intellectual communication and ability to impart practical knowledge in real time solution of engineering studies.

List of experiments

1. Rigidity modulus by Torsional pendulum
2. Determination of Young's modulus of steel/composite material
3. Wavelength of laser light by diffraction method.
4. Determination of numerical aperture and fiber loss.
5. Determination of Planck's constant
6. Verification of Stefan's law
7. Interference at an air wedge
8. Fermi energy of copper wire by four point probe method
9. Determination of dielectric constant by charging and discharging method
10. I-V characteristics of Zener diode
11. Band gap of semiconductor
12. Reddy Shock tube calibration.

Note: All the twelve experiments are to be conducted.

Course Outcomes (COs)

After completing the course, the students are able to

1) Record the data with precision using different measuring devices and meters.
2) Apply the knowledge of theory of elasticity to determine elastic moduli using cantilever and torsion pendulum methods.
3) Apply the concept of diffraction, interference and reflection of light to find thickness of the object (paper), wavelength of laser, numerical aperture and fiber loss.
4) Find the Fermi energy, energy gap and dielectric constant of the materials.
5) Formulate simple circuits to verify Stefan’s law, I-V characteristics of a diode and Planck’s constant and determine the Mach number & speed of shockwaves generated by the Reddy shock tube.

Assessment methods:

1. Write-up
2. Conduction of experiment with accuracy of the result
3. Viva-voce
4. Record Writing

Scheme of Continuous Internal Evaluation (CIE):

<table>
<tr><td>Criteria</td><td>Write-up</td><td>Conduction of experiment</td><td>Record writing and Viva-voce</td><td>Lab Test</td><td>Total Marks</td></tr>
<tr><td>Marks</td><td>05</td><td>20</td><td>10</td><td>15</td><td>50</td></tr>
<tr><td colspan="6">Submission and certification of lab manual and record is compulsory to attend SEE.
Minimum marks required to attend semester end practical exam : 20
Viva-voce will be conducting individually.</td></tr>
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<tr><td colspan="4">Scheme of Semester End Examination (SEE):</td></tr>
<tr><td>1.</td><td colspan="3">Exam will be conducted for 50 marks of 3 hours duration
Two experiments will be allotted for each student</td></tr>
<tr><td>2</td><td colspan="3">Minimum marks required in SEE to pass: 20 out of 50 marks</td></tr>
<tr><td>3</td><td>Write up</td><td>10 marks</td><td rowspan="4">50 Marks</td></tr>
<tr><td>4</td><td>Conduction of experiment</td><td>20 marks</td></tr>
<tr><td>5</td><td>Calculations, Result with Unit, Accuracy</td><td>10 Marks</td></tr>
<tr><td>6</td><td>Viva- voce</td><td>10 Marks</td></tr>
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