<table>
<tr><td>Course Code: 1008</td><td colspan="2">Course Title : Modern Physics</td><td>TPC</td><td>3</td><td>2</td><td>4</td></tr>
<tr><td>Version No.</td><td colspan="6">2.0</td></tr>
<tr><td>Course Pre-requisites/ Co-requisites</td><td colspan="6">None</td></tr>
<tr><td>Course anti-requisites</td><td colspan="6">PHY1001, PHY1005, PHY1010</td></tr>
<tr><td>Objectives:</td><td colspan="6">1. To enrich knowledge in fundamentals of wave optics
2. To introduce and make appreciate the role of Quantum mechanics in microscopic devices and computation
3. To know the basics of semiconductor and magnetic devices</td></tr>
<tr><td colspan="7">CO-PO mapping</td></tr>
<tr><td>Course Outcomes (COs)</td><td colspan="2">Course Outcome Statement</td><td colspan="4">Programme Objectives (POs)</td></tr>
<tr><td>CO1</td><td colspan="2">Understanding the concepts of interference and diffraction and applying these conceptual knowledge to engineering applications</td><td colspan="4">PO1, PO2, PO3, PO4, PO5</td></tr>
<tr><td>CO2</td><td colspan="2">Understand the fundamental concepts and principles of quantum mechanics relevant to engineering applications such as quantum computing</td><td colspan="4">PO1, PO2, PO3, PO4, PO5</td></tr>
<tr><td>CO3</td><td colspan="2">Comprehend use of concepts of semiconductors and their applications in some electronic devices like solar cell, LED, thermistor etc</td><td colspan="4">PO1, PO2, PO3, PO4, PO5, PO6, PO7</td></tr>
<tr><td>CO4</td><td colspan="2">Understand the basics of magnetism and explore some of their technological applications</td><td colspan="4">PO1, PO2, PO3, PO4, PO5, PO6, PO7</td></tr>
<tr><td>CO5</td><td colspan="2">Explore important connections between theory, experiment, and current applications</td><td colspan="4">PO1, PO2, PO3, PO4, PO5, PO6, PO7</td></tr>
<tr><td colspan="3">Total Instructional hours</td><td colspan="4">45 hours</td></tr>
<tr><td colspan="2">Module No. 1</td><td>Wave Optics - Interference</td><td colspan="4">9 hours</td></tr>
<tr><td colspan="7">Interference- Interference of light, Conditions for sustained Interference, Interference in thin films, Newton's Rings, Determination of Wavelength. Engineering applications of Interference – thickness of film, testing of flatness of optical surfaces, the angle of beam splitter, testing of prism and lens for chromatic aberrations, anti-glare glasses and anti-reflective glasses, Interferometer: Michelson interferometer.</td></tr>
<tr><td colspan="2">Module No. 2</td><td>Wave Optics - Diffraction</td><td colspan="4">7 hours</td></tr>
<tr><td colspan="7">Diffraction-Fraunhofer Diffraction, Single and Double slits, Diffraction Grating, Grating Spectrum, Resolving power and dispersive power, Determination of Wavelength. Applications of diffraction - impact on resolution of telescope and microscope, X-ray, electron, and neutron diffraction, spectroscopy, Coherent diffraction imaging (CDI)</td></tr>
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Module No. 3	Elementary Quantum Mechanics	9 hours
Wave–particle duality, de-Broglie hypothesis, Matter waves: properties of matter waves, wave packet, group velocity, phase velocity and their relations. Application of matter waves: Scanning Electron Microscopy and Transmission Electron Microscopy. Uncertainty principle: Illustrations: Non-confinement of electron inside the nucleus and broadening of spectral lines. Wave function, physical significance of wave function, Eigen function, Eigen values; Application: Quantum Computer (Classical BITS *vs* QBITS). One dimensional time independent Schrodinger's wave equation - particle in a box. Application of Schrodinger's wave equation: STM, Tunnel diode		
Module No. 4	**Semiconductors**	**11 hours**
Semiconductors – Band formation, Direct and indirect band-gap, Intrinsic and extrinsic semiconductors, Variation of fermi energy level with doping, Mobility of charge carriers, Effect of temperature on mobility, Electrical conductivity of semiconductors, Thermistor, Junctions: Semiconductor-Semiconductor junctions, metal-semiconductor junctions, Ohmic and Schottky junctions, p-n junction diode - switch, Transducer, Carrier generation and recombination in Light emitting diode (LED), Solar cells, Thermistor, Photodetector, Sensors for medical diagnosis, Semiconductor memory devices.		
Module No. 5	**Magnetic materials**	**9 hours**
Magnetization, Dia, Para and Ferromagnetism, Orbital angular momentum of an electron in an atom, Magnetic susceptibility and permeability, Superparamagnetism, Electron spin resonance (ESR), Application to detect biological free radicals; Nuclear Magnetic Resonance (NMR), Application to Magnetic resonance imaging, Magnetic levitation, Power generators, types of memory devices. Loud speakers, MRAM, motors and transformers, maglev trains, magnetic separators, cyclotron/synchrotrons, detection higher energy particles, wireless chargers		

Text Books

1. Ghatak, Optics, 6th Edition, McGraw Hill Education India Private Limited (2019)
2. N. Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley India Private Ltd. (2016)
3. D.A. Neamen, D. Biswas, Semiconductor Physics and Devices, McGraw Hill Education; 4th edition (2017)
4. Nicola A. Spaldin, Magnetic Materials Fundamentals and Applications, 2nd edition, Cambridge University Press (2011)

References

1. E. Hecht, A.R. Ganesan, Optics, 4th edition, Pearson Education (2019)
2. R.H. Webb, Elementary Wave Optics, 2nd Dover Publications Inc. (2019)
3. D. J. Griffiths**,** Introduction to Quantum Mechanics**,** 2nd edition, Pearson Education (2018)
4. R. Shankar, Principles of Quantum Mechanics, 2nd edition, Springer India Private Ltd. (2016)
5. S. M. Sze, Physics of Semiconductor Devices, 4th Edition, Wiley (2021)
6. B. D. Cullity, C.D. Graham, Introduction to Magnetic Materials, 2nd edition Wiley-IEEE Press (2010)
7. Charles Kittel, Introduction to Solid State Physics, 8th edition, John Wiley (2018)
8. Sabrie Soloman, Sensors Handbook, 2nd edition, Mc Graw Hill (2018)

List of experiments:

1. Interaction of light with matter: Determination of Planck's constant by Photo Electric Effect
2. Interaction of charged particle with magnetic field: Estimation of e/m by Thomson method

3. Measurement of low dimensions by Laser Diffraction
4. Measurement of dielectric constant of different samples
5. Determination of Magnetic susceptibility of ferromagnetic materials by Quincke's method
6. Verification of Heisenberg's Uncertainty Principle
7. p-n junction characteristics - LED
8. Thermistor for band-gap measurement
9. Determination of energy band gap of a semiconductor by Four probe method
10. Magnetic field sensor: Hall effect
11. B-H loop: Estimation of coercively and retentively
12. Solar cell: I-V characteristics and determination of efficiency
13. Newton's ring experiment

Mode of Evaluation	CAT-1	Weightage (in %)	20
	CAT-2	Weightage (in %)	20
	FAT	Weightage (in %)	20
	Assignment/Quiz	Weightage (in %)	15
	Lab	Weightage (in %)	25
		Total	**100**

Recommended by the Board of Studies on	8th November 2021
Date of Approval by the Academic Council	9th November 2021