C.V. Raman Global University
Bhubaneswar - 752 054 (Odisha)

PHYSICS	
SUBJECT: Physics	
Course Code	**PH101**
Teaching Hours/Week(L-P-T-E)	(3-0-1-0)
Credits	03
Course offering department	Department of Physics
Total Contact Hours	42 + 14(T)

Course objectives:

This course aims to

1. To demonstrate the various types of oscillations and properties of waves
2. To explain the basic principle of electromagnetism
3. To discuss the elementary concept of quantum mechanics and its application
4. To explain the fundamentals of semiconducting material and semiconductor devices
5. To understand basic principle of Laser and superconductors.

Module–1 (10hrs.)

Oscillations: Simple harmonic oscillation Damped harmonic oscillation, Forced vibration, Resonance, Applications of SHM.

Wave Optics: Superposition principle**,** Newton's ring experiment & its applications, Fresnel and Fraunhofer Diffraction, Diffraction due to single slit and multiple slit, Applications (X-ray diffraction), Polarization of waves, polarization by reflection, refraction, Brewster's law, Double refraction, Nicol prism , Quarter-wave plate and Half-wave plate.

Module–2 (8hrs.)

Electromagnetism: Grad, Div, Curl, Gauss's law of electrostatics, Gauss's law of magnetostatics, electric displacement(D), Amperes circuital law, displacement current, Faraday's law of electromagnetic induction, Maxwell's equations, plane-electromagnetic waves, wave equation (free space ,conducting, non conducting media), Relationship between E and B, Boundary conditions, transverse nature of EM waves, Equation of continuity, Poynting Vector, Poynting Theorem and applications to waveguides

Module–3 (8 hrs.)

Elementary Quantum mechanics: Historical overview, matter waves, Heisenberg's Uncertainty principle, wave function and properties, Schrödinger's equation - Time dependent and time independent, operators, Eigen value and Eigen functions, Expectation values.

Application of Quantum Mechanics: Solutions of one dimensional problems, Free particles, Infinite deep potential well (particle in a box), Quantum mechanical tunneling (concept only), Nanoparticles, quantum confinement, Applications to Nanoscience.

Module–4 (8 hrs.)

Semiconductor Physics and Devices: Band theory of solids, Fermi-Dirac distribution function, Fermi level and its dependence on temperature and carrier concentration, Density of States, carrier concentration in intrinsic and extrinsic semiconductors, , Carrier generation – recombination, mobility, drift-diffusion current. Hall effect, applications: P-N Junctions and I-V characteristics, Bipolar Junction Transistors (BJT) and I-V characteristics.

Module-5 (8 Hrs.)

Lasers and Fiber optics : Laser , principle and its Properties, amplification of light by population inversion, Types of lasers, He-Ne laser, Ruby laser, Application of LASER, Principle of optical fiber and its application to communication, medical industry etc.

Superconductivity: Introduction and properties of superconductors (zero resistance, Meissner effect, critical field, London penetration depth), BCS theory of superconductivity, applications of superconductors.

Text Books:

1. Engineering Physics, H.K.Malik and A.K.Singh, Tata McGraw Hill, 1st edition, 2019.
2. Optics, A.K. Ghatak, Tata McGraw Hill Publishing Company Limited, New Delhi., 7th Edition, 2021
3. Engineering Physics, D. Joshi, Tata McGraw –Hill, 1st Edition, 2010.

Reference Books

1. Semiconductor Physics and Devices, Donald A. Neamen, 4th Edition, Tata McGraw-Hill, 2011.
2. Introduction to Quantum Mechanics, M. Das and P. K. Jena, Srikrishna Prakashan, 2010.
3. Concepts of Modern Physics, Arthur Beiser, Tata McGraw- Hill, 7thedition, 2015.
4. Fundamentals of Physics, Resnick and Halliday, John Wiley and Sons, 10th edition, 2013.
5. Lectures on Physics", Volume 1, 2 and 3 by Richard P. Feynman, Narosa Publisers , Pearson Education, 2012.

Open Sources:

https://nptel.ac.in/courses/122/107/122107035/
https://archive.nptel.ac.in/courses/108/108/108108112/
https://archive.nptel.ac.in/courses/122/107/122107035/

Reference : IIT Guwahati, IIT Bhubaneswar, BIT Mesra, NIT Durgapur, SRM university

COURSE OUTCOME:

Outcome	At the end of the course, the learner will be able to	Bloom's Level	Expected proficiency percentage	Expected Attainment percentage
CO-1	Demonstrate the fundamental of oscillations and wave properties of light.	**2**	**70%**	**65%**
CO-2	Estimate the basic characteristics of electromagnetic waves.	**2**	**70%**	**65%**
CO-3	Apply the quantum mechanical principle for boundary value problems	**3**	**65%**	**60%**
CO-4	Illustrate the V~I characteristics of semiconductor devices.	**4**	**65%**	**60%**
CO-5	Summarize the working of Laser, fundamentals of superconductivity and fiber optics	**2**	**70%**	**65%**

C.V. Raman Global University
Bhubaneswar - 752 054 (Odisha)

MAPPING OF COURSE OUTCOME ONTO PROGRAM OUTCOME (CO –PO MAPPING)

Course Outcome	PO1-Engineering knowledge	PO2- Problem analysis	PO3-Design/development of solutions	PO4-Conduct investigations of complex problems	PO5-Modern tool usage	PO6-The engineer and society	PO7-Environment andsustainability	PO8-Ethics	PO9-Individual and team work	PO10-Communication skill	PO11-Project management and finance	PO12 Life-long learning
CO-1	3	1	0	0	0	0	0	0	0	0	0	0
CO-2	3	2	0	0	0	0	0	0	0	0	0	0
CO-3	3	3	1	0	0	0	0	0	0	0	0	0
CO-4	3	3	1	0	0	0	0	0	0	0	0	0
CO-5	3	2	0	0	0	0	0	0	0	0	0	0

Course utilization Plan/Lesson Plan

Module No	Module Name	Required contact Hours	COs addressed	References book Used
Module-1	**Oscillations& Wave Optics:**	**10**		
	Concepts of harmonic oscillation, Derivation of eqn. of motion and solution of SHM and	1	1,	1-3
	Derivation of eqn. of motion and solution Damped harmonic oscillation	1		
	Derivation of eqn. of motion and solution of Forced vibration, Concept of Resonance and its sharpness	1	1	1-3
	Demonstration of Superposition principle, explanation of Interference phenomenon, Description Newton's ring experiment	1	1	1-3
	Derivation of diamtere of dark and bright ring, determination of refractive index of unknown liquid.	1		
	Demonstration Fresnel and Fraunhofer Diffraction	1	1	1-3
	Explanation of Diffraction due to single slit and derivation for maxima and minimum position,	1	1	1-3
	Explanation diffraction due to multiple slit and derivation for maxima and minimum position , Applications of diffraction due to multiple slit (X-ray diffraction)	1	1	1-3
	Define Polarization of waves, Explanation of Polarization by reflection, refraction, Derivation of Brewster's law, Concept of Double refraction	1	1	1-3
	Construction and working of Nicol prism, Definition of Quarter-wave plate and Half-wave	1	1	1-3

	plate			
Module-2	**Electromagnetism:**	**8**		
	Expression and significance of Grad, Div, Curl with suitable examples	1	2	1-3
	Definition of Gauss's law of electrostatics, Gauss's law of magnetostatics, Amperes circuital law, Faraday's law of electromagnetic induction	1	2	1-3
	Concept of electric displacement, displacement current, Description of Maxwell's equations (differential and integral form)	1	2	1-3
	Explanation of plane-electromagnetic waves	1	2	1-3
	Derivation of wave equation (free space ,conducting, non conducting media)	1	2	1-3
	Description of relationship between E and B, Boundary conditions, Proof of transverse nature of EM waves, Equation of continuity (only expression and significance of the terms)	1	2	1-3
	Explanation of Poynting Vector, Derivation of Poynting Theorem and applications to waveguides.	2	2	1-3
MODULE-3	**Elementary Quantum mechanics & Application of Quantum Mechanics:**	**8**		
	Historical overview, Explanation of matter waves	1	3	1-3
	Concept of Heisenberg's Uncertainty principle with example of absence of electron in nucleus	1	3	1-3
	Explanation of wave function and its properties	1	3	1-3
	Definition of Eigen value and Eigen functions, Expectation values, quantum mechanical operators	1	3	1-3
	Derivation Schrödinger's equation - Time dependent and time independent (derivation)	1	3	1-3
	Solutions of one dimensional problems, Free particles (equation, energy eigen values)	1	3	1-3
	Derivation of energy eigen values Infinite deep potential well	1	3	1-3
	Concept of Quantum mechanical tunneling Nanoparticles, quantum confinement, Applications to Nanoscience.	1	3	1-3
MODULE-4	**Semiconductor Physics and Devices:**	**8**		
	Formation of energy bands of solids	1	4	1-3
	Definition and significance of Fermi-Dirac distribution function	1	4	1-3
	Description of Fermi level and derivation of variation of its dependence on temperature and carrier concentration	1	4	1-3
	Definition of Density of States, Derivation of carrier concentration in intrinsic and extrinsic semiconductors (procedure & expressions)	1	4	1-3
	Expression of Carrier generation – recombination, mobility, drift-diffusion current	1	4	1-3
	Demonstration of Hall effect, Derivation for Hall Voltage & Applications	1	4	1-3
	Construction & Working P-N Junctions and explanation of I-V characteristics	1	4	1-3

	Construction & Working Bipolar Junction Transistors and explanation of I-V characteristics	1	4	1-3
MODULE-5	**Lasers, Fiber optics & Superconductivity**	**8**		
	Principle of Laser and its Properties,		5	1-3
	Amplification of light by population inversion,	1	5	1-3
	Types of lasers, lasing action of Ruby laser	1	5	1-3
	Lasing action of He-Ne laser, Application of LASER	1	5	
	Introduction to optical fiber, types of optical fiber and light guidance principle of optical fiber,	1	5	1-3
	Numerical aperture, acceptance angle of optical fiber and application of Fiber optics to communication, medical industry etc.			
	Introduction of superconductivity, properties of superconductors,	2	5	1-3
	Concept of Meissner effect, critical field, London penetration depth	1	5	1-3
	Explanation BCS theory of superconductivity, applications of superconductors	1	5	1-3
	TOTAL	**42 HOURS**		

Learning Assessments

Bloom's Level of Cognitive Task		Teacher Assessment / Formative Assessment (40 %)				Summative Assessment (60 %)	
		Quiz (10%)	Assignment (10%)	Experiential learning * (10%)	Attendance (10%)	Mid Sem (20%)	End Sem (40%)
Level-1	Remember	40%	20%	30%		40%	30%
	understand						
Level-2	Apply	60%	40%	40%		60%	50%
.							
	Analyze						
Level-3	Evaluate		40%	30%			20%
	Create						
Total		100%	100%	100%		100%	100%

***NOTE: Experiential Learning : class test/simulation project/survey paper/ case study presentation/team project**

Course Prepared By: Dr. Tanmaya Badapanda
Course Verified By: Prof. Hiranmayee Mohapatra, Asso. Professor