



COURSE OUTLINE FOR THE SESSION MAY 23 to SEP 23

Faculty Name: Mr Anjan Kumar J & Mr Ramachandra M N

Course with code: Applied Physics for EE Stream - BPHYE202

Semester with section: II Sem A, B & C Sections

MODULE No	Class No	Date planned	Topics proposed to be covered	Portion to be covered in %	Remarks
MODULE 1	1		Quantum Mechanics: Statement of de-Broglie Hypothesis, Derivation of expression for de Broglie wavelength (λ) by analogy and different forms of expression for (λ).	20%	
	2		Wave Packets, Wave Velocity and Group Velocity (Definitions and Mention of Expression) Heisenberg's Uncertainty Principle, Nonexistence of electron inside the nucleus (Non-relativistic),		
	3		Principle of Complementarity, Correlation between de Broglie Wavelength, Heisenberg's Uncertainty principle and wave packet, Wave Function, Explanation, General Mathematical Form (Exponential),		
	4		Schrödinger Time Independent wave definition, Setting up of Time independent Schrödinger wave equation in 1D (derivation) and extension to 3D (mention)		
	5		Physical Significance of a wave function (Probability Density) and Born Interpretation, Expectation value, Eigen functions and Eigen Values,		
	6		One Dimensional Potential Well Explanation and Boundary conditions, Schrödinger Wave equation for a particle in 1 D infinite potential well,		
	7		General Solution, Applying Boundary Conditions, Energy Eigen Values (Quantization of Energy States),		
	8		Normalization and Eigen Function, Variation of wave functions and probability density distributions for $n = 1, 2, 3$ states		
	9		Numerical Problems on de Broglie Hypothesis, Heisenberg's Uncertainty Principle.		
	10		Numerical Problems on Heisenberg's Uncertainty Principle, Energy Eigen Values for a particle in 1D infinite potential well		



MODULE 3	11	LASER: Characteristics of LASER, Interaction of radiation with matter (induced absorption, spontaneous and stimulated emission in terms of Einstein Coefficients),	40%	
	12	Derivation of expression for energy density equation and its significance		
	13	Requisites of a Laser system (Excitation source, Active media and laser cavity) and pumping, Conditions for laser action(population inversion & meta stable state)		
	14	Principle, Construction and working of CO2 Laser with energy level diagram		
	15	Application of Lasers in Defense (Laser range finder) and Explanation of Laser printing.		
	16	Optical Fibers: Total Internal Reflection, Propagation mechanism, Angle of Acceptance, Numerical Aperture (NA), derivation of expression for NA, Fractional Index Change(Δ),		
	17	Relation between NA & Δ . Modes of propagation , mention of expression for number of modes and V number. Types of optical fibers		
	18	Types of attenuation, Mention of Expression for Attenuation coefficient, and Attenuation spectrum of an optical fiber with communication windows. Mention of expression for attenuation coefficient, Discussion of block diagram of point to point		
	19	Numerical Problems : Ratio of Population, Number of photons / sec in a LASER beam of certain power output,		
	20	Numerical Problems : Numerical Aperture, Acceptance angle and Attenuation Co-efficient		
MODULE 2	21	Conductors: Assumptions of Quantum Free Electron Theory of Metals, Fermi-energy, Fermi factor, Variation of Fermi Factor with Temperature and Energy	60%	
	22	Mention of expression for electrical conductivity. Dielectric Properties: Fundamentals of dielectrics. Polar and		
	23	Definition of internal field in case of solids and mention of its expression for one dimensional case. Mention of expressions for		
	24	Derivation of Clausius-Mossotti equation.		
	25	Description of solid, liquid and gaseous dielectrics with one example each. Qualitative explanation of applications of		
	26	Superconductivity: General Introduction about Superconductivity, Graphical approach of Temperature		
	27	Detailed explanation of Type-1 & Type-II Superconductors. BCS Theory: Phonon & Phonon field, cooper pairs, High Temperature Superconductors(qualitative).		



	28		Brief explanation of SQUID & mention its applications, The construction and working of MAGLEV vehicle.		
	29		Numerical Problems : Fermi factor, Electrical Conductivity, Polarization,		
	30		Numerical Problems : Clausius-Mossotti relation, Variation critical field with temperature		
MODULE 4	31		Maxwell's equations: Fundamentals of vector calculus: Briefly explain scalar product, vector product,	80%	
	32		Concept of divergence, gradient and curl along with physical significance and examples like Div and curl of E and B		
	33		Discuss the three different types of integrations viz linear, surface and volume integrations		
	34		Derivation of Gauss divergence theorem, mention Stokes' theorem		
	35		Explain briefly Gauss flux theorem in electrostatics and magnetism, Ampere's law, Biot-Savart's law and Faraday's laws		
	36		Discuss continuity equation, definition of displacement current(I_d), expression for displacement current, Maxwell- Ampere's law,		
	37		EM Waves: Derive Wave equation for EM waves in vacuum in terms of electric field using Maxwell's Equations. Explanation of		
	38		Explain the transverse nature of electromagnetic waves (Linear, Circular, Elliptical Polarization)		
	39		Numerical Problems on Divergence and Curl		
	40		Numerical Problems on gradient and Curl		
MODULE 5	41		Semiconductors: Explanation of Fermi level in intrinsic semiconductor and Explanation of Fermi level in n-type & p-type semiconductors, Carrier concentration (only expression),	100%	
	42		Relation between Fermi energy & Energy gap in intrinsic semiconductors (derivation)..		
	43		Law of mass action: to show $n_e \cdot n_h = a$, Derivation of Electrical conductivity of a semiconductor and also Mention expression for		
	44		Explanation of Hall Effect, Hall Voltage, Hall field ,		
	45		Derivation of Expression for Hall coefficient and Hall Voltage. Applications.		
	46		Devices: Photo Diode: Construction, working & power responsivity by graphical approach and applications.		
	47		Phototransistor: Construction & working of phototransistor & its applications.		



	48		Four probe: Resistivity measurement and Temperature dependence of resistivity of semiconductor using four probe & its applications.		
	49		Semiconductor Laser Diode: Construction & working with energy level diagram, applications		
	50		Numerical Problems on Electrical conductivity, Hall Effect.		
Lab Experiments	1	Week 1	Wavelength of LASER using Grating	10%	
	2	Week 2	Numerical Aperture using optical fiber	20%	
	3	Week 3	Series and Parallel LCR Circuits	30%	
	4	Week 4	Magnetic Field at any point along the axis of a circular coil	40%	
	5	Week 5	Black Box	50%	
	6	Week 6	Plank's Constant using LEDs	60%	
	7	Week 7	Dielectric Constant of a Capacitor	70%	
	8	Week 8	Photo-Diode Characteristics	80%	
	9	Week 9	PHET Interactive Simulations	90%	
	10	Week 10	Study of Electrical quantities using spreadsheet	100%	

List of Text Books

Suggested Learning Resources: Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. A Textbook of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & Company Ltd, New Delhi.
2. An Introduction to Lasers theory and applications by M.N.Avadhanulu and P.S.Hemne revised Edition 2012. S. Chand and Company Ltd -New Delhi.
3. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017.
4. Concepts of Modern Physics-Arthur Beiser: 6th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006.
5. Fundamentals of Fibre Optics in Telecommunication & Sensor Systems, B.P. Pal, New Age International Publishers.
6. Introduction to Electrodynamics, David Griffith, 4th Edition, Cambridge University Press 2017.
7. Lasers and Non-Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011.
8. LASERS Principles, Types and Applications by K.R. Nambiar-New Age International Publishers.
9. Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018.

Web links and Video Lectures (e-Resources):

Laser: <https://www.britannica.com/technology/laser.k>

Laser:<https://nptel.ac.in/courses/115/102/115102124/>



Quantum mechanics:<https://nptel.ac.in/courses/115/104/115104096/> Physics:<http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html>
Numerical Aperture of fiber:<https://bop-iitk.vlabs.ac.in/exp/numerical-aperture-measurement>
NPTEL Superconductivity:<https://archive.nptel.ac.in/courses/115/103/115103108/>