# B.N.M. Institute of Technology

## An Autonomous Institution under VTU

		Semester: I/II			
	COURSE: Applied Physics				
Con	waa Cadaa 22DIIC112/122	(for CSE stream)	NE Marks 5	)	
		CIE Marks: 50 EE Marks: 50			
·			Duration: 03 Hours		
	rse Learning Objectives: Th		EE Durauon.	03 Hours	
		ncepts of Quantum Mechanics ar	d its application	ons in various	
		ining practical knowledge to co			
	concepts.				
2	_	applications of Lasers and Option	cal Fibres by a	pplying basic	
		n through experimental approach	•		
3		cal properties of Metals and Sup		sing quantum	
	== :	ning practical knowledge to co			
	concepts.				
4	Understand the basic properti	ies of Nanomaterials and explore	their application	ns in modern	
		practical knowledge to correlate			
5		s of Quantum computing in engir			
	Module 1 – Qua	ntum Mechanics	RBT	Hrs	
applic prope Norm equati well c	cation (Non-existence of electraties and its physical signalization, Time independence ion (derivation), time dependence of infinite height (Eigen value)	nberg Uncertainty Principle and cons inside nucleus). Wave function ificance, probability density a nucleus one-dimensional Schroding of (qualitative), Particle in a potenties and Eigen functions), Finite walitative), Numerical problems.	on, ad er <b>Apply</b> al	08	
	Module 2 – Lasers	and Optical Fibers	RBT	Hrs	
2.1: LASER: Interaction of radiation with matter and characteristic properties of laser, Energy density of a photon at equilibrium in terms of Einstein's coefficients (derivation), Conditions for Laser action, Requisites of a Laser system, Construction and working of CO <sub>2</sub> Laser. Engineering Applications of Lasers: LIDAR (Measurement of pollutants in atmosphere), Numerical Problems.  2.2: Optical fibers: Introduction to optical fibers, Propagation mechanism in optical fibers, Acceptance angle and Numerical Aperture (derivation), Types of Optical fibers, Attenuation in optical fibers (no derivation) and its mechanisms, Engineering Applications of optical fibers – Point to point communication, Numerical problems.		ns on, er. of Apply on re no cal	08		
	Module 3 – Electrical 1	Properties of Materials	RBT	Hrs	
3.1 Metals: Quantum free electron theory – Assumptions, Density of states (qualitative), Fermi energy and Fermi factor, Effect of temperature on fermi factor, Expression for Fermi energy (derivation) at absolute zero temperature and at certain higher temperature (qualitative), effective mass (qualitative). Merits of quantum free electron theory, Numerical Problems.		of n) Apply re	08		

<b>3.2 Superconductors:</b> Temperature dependence of resistivity in metals (Matthiessen's rule) and superconducting materials. Effect of magnetic field (Meissner effect). Critical magnetic field and its temperature dependence, Type-I and Type-II superconductors, BCS theory (qualitative). High temperature superconductors. Applications of superconductors – Maglev vehicles, Numerical problems.		
Module 4 – Modern Engineering Materials	RBT	Hrs
<b>4.1 Nano Materials:</b> Introduction to Nano science and Nano materials, Surface to volume ratio, Quantum confinement — Quantum well, Quantum wire, Quantum dot. Synthesis of Nano materials — Top-down approach (Ball milling method) and bottom-up approach (Sol gel method). Carbon Nano tubes, types, properties and Applications. Scanning Electron Microscope (SEM), Application of SEM in analysis of Molecular size, Numerical problems. <b>4.2 Composite Materials:</b> Introduction to composite materials, Classification of composites based on reinforcement materials and matrix. Advantages and disadvantages of composite materials, Engineering Applications	Apply	08
Module 5 – Quantum Computing	RBT	Hrs
Introduction to quantum computing- Matrix form of wave function, Identity Operator, Determination of I 0> and I 1>, classical information and quantum information, Moorle's law, Superposition in quantum computation, concept of Qubit, properties- mathematical representation, representation of qubit by Bloch sphere, Quantum gate – Toffoli gate (qualitative) and difference between classical computing and quantum computing.	Apply	08

	Lab Experiments (2 Demo + 8 Lab sessions + 1 Repetition class + 1 Lab Test)		
Sl. No	List of Experiments		
1	Determination of Planck's constant		
2	Photo Diode Characteristics		
3	Determination of radius of curvature of a Plano convex lens using Newton's Rings		
4	Determination of wavelength of Laser using Diffraction		
5	Determination of Acceptance angle and Numerical Aperture of an Optical fiber		
6	Determination of Fermi energy of copper		
7	Determination of Resistivity of a metal		
8	Determination of size of a Nano particle using diffraction pattern		

Course Ou	Course Outcomes: After completing the course, the students will be able to		
22PHC112/122.1	Apply the concepts of Quantum Mechanics to physical situations and		
22F11C112/122.1	determine parameter related to the concepts.		
22PHC112/122.2	Apply principles of lasers and Optical Fibers to determine optical		
22F11C112/122.2	parameters in the field of engineering.		
227110112112	Apply the quantum concepts and determine parameters related to electrical		
22PHC112/122.3	properties of materials.		
22744424224	Apply the Concepts of Nano Science and determine parameters related to		
22PHC112/122.4	nano materials.		
22PHC112/122.5	Apply the principles of Quantum Mechanics in Quantum Computing.		

### **Reference Books**

- Principle of Quantum Mechanics: Concepts & Applications, Nouredine Zettili, Wiley, 2<sup>nd</sup> Edition, 2009.
- 2. Quantum Computation and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, Cambridge Universities Press, 2010 Edition.
- 3. Lasers and Non-linear optics, B.B. Laud, New Age International Publishers, 3<sup>rd</sup> Edition, 2011.
- 4. Lasers and Optical Instrumentation, S. Nagabhushana and B. Sathyanarayana, I.K. International Publishing House Pvt. Ltd, 2013.
- 5. Solid State Physics, S.O. Pillai, New Age International Publishers, 9<sup>th</sup> Edition, 2020.
- 6. Introduction to Nanoscience and Nanotechnology, Chris Binns, Wiley, 2010.
- 7. An Introduction to Composite Materials, T.W. Clyne and D. Hull, Cambridge University Press, 3<sup>rd</sup> Edition, 2019.
- 8. University Practical Physics by D.C. Tayal, Edited by ILA Agarwal, 2000, Himalaya Publishing House, Mumbai.
- 9. Engineering Physics Laboratory Manual (BNMIT).

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		Semester: I/II			
	COURSE: Applied Physics				
<u> </u>	C. L. 22DHE112/122	(for EE & EC stream			
	rse Code: 22PHE112/122	L:T:P:J: 2:2:2:0	CIE Marks: 50		
	dits:	4	SEE Marks: 50		
Hou		40 L &12 P	SEE Duration: 03 Ho	urs	
	rse Learning Objectives: Th				•
1	Understand and apply the con				
	fields of engineering by ga	ining practical knowle	age to correlate with t	the the	oretical
	concepts.	omuliactions of Lagran	and Ontical Eilens by	1	a basis
2	Demonstrate the engineering	= =	= -	appıyın	g basic
2	principles and their realizatio		**		4
3	Understand and apply electri	= =	<del>-</del>		
	mechanical concepts by gai	ming practical knowle	age to correlate with t	ne the	orencai
4	concepts.	ica of Noncomotorials an	d avalone their canticati		
4	Understand the basic properti				
	engineering fields by gaining				
5	Understand and apply the cor	<del>-</del>	rs in engineering applica	tions ar	ia their
	realization through experimen				
	Module 1 -	- Quantum Mechanics		RBT	Hrs
Need for Quantum mechanics, de-Broglie's hypothesis of Matter Waves and their properties, Heisenberg Uncertainty Principle and its application (Non-existence of electrons inside nucleus). Wave function, properties and its physical significance, probability density and Normalization, Time independent one-dimensional Schrodinger equation (derivation), time dependent (qualitative), Particle in a		Apply	08		
	atial well of infinite height (H				
poten	tial and Quantum Tunneling (qu				
		asers and Optical Fibe		RBT	Hrs
<b>2.1: LASER:</b> Interaction of radiation with matter and characteristic properties of laser, Energy density of a photon at equilibrium in terms of Einstein's coefficients (derivation), Conditions for Laser action, Requisites of a Laser system, Construction and working of CO <sub>2</sub> Laser. Engineering Applications of Lasers: LIDAR (Measurement of pollutants in atmosphere), Numerical Problems. <b>2.2: Optical fibers:</b> Introduction to optical fibers, Propagation mechanism in optical fibers, Acceptance angle and Numerical Aperture (derivation), Types of		Apply	08		
Engir	cal fibers, Attenuation in opti- neering Applications of opti- erical problems.	cal fibers – Point to	point communication,		
	Module 3 – Elect	rical properties of ma	terials	RBT	Hrs
(qual Expre highe free e	Metals: Quantum free electritative), Fermi energy and Fermi energy (derivative) for Fermi energy (derivative), extension theory, Numerical Prosecution theory, Numerical Prosecutions of Tampara	mi factor, Effect of tempation) at absolute zero te ffective mass (qualitatiblems.	perature on fermi factor, emperature and at certain ve). Merits of quantum	Apply	08
	<b>Superconductors:</b> Temperathiessen's rule) and superconductors	<u>=</u>	<u>-</u>		

(Meissner effect). Critical magnetic field and its temperature dependence, Type-I and Type-II superconductors, BCS theory (qualitative). High temperature superconductors. Applications of superconductors – Maglev vehicles, Numerical problems.		
Module 4 – Modern Engineering Materials	RBT	Hrs
4.1 Nano Materials: Introduction to Nano science and Nano materials, Surface to volume ratio, Quantum confinement – Quantum well, Quantum wire, Quantum dot. Synthesis of Nano materials – Top-down approach (Ball milling method) and bottom-up approach (Sol gel method). Carbon Nano tubes, types, properties and Applications. Scanning Electron Microscope (SEM), Application of SEM in analysis of Molecular size, Numerical problems.  4.2Composite Materials: Introduction to composite materials, Classification of composites based on reinforcement materials and matrix. Advantages and disadvantages of composite materials, Engineering Applications	Apply	08
Module 5 – Semiconductors and Semiconductor Devices	RBT	Hrs
<b>5.1 Semiconductors:</b> Fermi energy and Fermi level, Fermi level in intrinsic semiconductors, Expression for concentration of electrons in conduction band & holes concentration in valance band (only mention the expression), Law of mass action, Electrical conductivity of a semiconductor (derivation), Hall effect, Expression for Hall coefficient (derivation) and its application. <b>5.2 Semiconductor Devices:</b> Photodiode and Power responsivity, Construction and working of Semiconducting Laser and Numerical problems.	Apply	08

	Lab Experiments (2 Demo + 8 Lab sessions + 1 Repetition class + 1 Lab Test)		
Sl. No	List of Experiments		
1	Determination of Planck's constant		
2	Determination of radius of curvature of a Plano convex lens using Newton's Rings		
3	Determination of wavelength of Laser using Diffraction		
4	Determination of Acceptance angle and Numerical Aperture of an Optical fiber		
5	Determination of Fermi energy of copper		
6	Determination of size of a Nano particle using diffraction pattern		
7	Series and Parallel LCR circuits		
8	Photo Diode Characteristics		

Course Ou	Course Outcomes: After completing the course, the students will be able to		
22PHE112/122.1	Apply the concepts of Quantum Mechanics to physical situations and		
	determine parameter related to the concepts.		
22PHE112/122.2	Apply principles of lasers and Optical Fibers to determine optical		
221 1121 12/122:2	parameters in the field of engineering.		
22745412422	Apply the quantum concepts and determine parameters related to electrical		
22PHE112/122.3	properties materials.		
	Apply the Concepts of Nano Science to determine parameters related to		
22PHE112/122.4	nano materials.		
	Apply the concepts of semiconductors to determine parameters related to		
22PHE112/122.5	engineering applications.		

### **Reference Books**

- Principle of Quantum Mechanics: Concepts & Applications, Nouredine Zettili, Wiley, 2<sup>nd</sup> Edition, 2009.
- 2. Lasers and Non-linear optics, B.B. Laud, New Age International Publishers, 3<sup>rd</sup> Edition, 2011.
- 3. Lasers and Optical Instrumentation, S. Nagabhushana and B. Sathyanarayana, I.K. International Publishing House Pvt. Ltd, 2013.
- 4. Solid State Physics, S.O. Pillai, New Age International Publishers, 9<sup>th</sup> Edition, 2020.
- 5. Introduction to Nanoscience and Nanotechnology, Chris Binns, Wiley, 2010.
- 6. An Introduction to Composite Materials, T.W. Clyne and D. Hull, Cambridge University Press, 3rd Edition, 2019.
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- 8. Engineering Physics Laboratory Manual (BNMIT).

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		Semester: I/II				
	COURSE: Applied Physics					
		(for ME stream)				
Cou	Course Code: 22PHM112/122 L:T:P:J: 2:2:2:0 CIE Marks: 50					
Cre	dits:	4	SEE Marks: 50			
Hou		40 L &12 P	<b>SEE Duration:</b> 03	Hours		
Cou	rse Learning Objectives: Th	e students will be able	e to			
<ol> <li>Understand and apply the concepts of Quantum Mechanics and its applications in various fields of engineering by gaining practical knowledge to correlate with the theoretical concepts.</li> <li>Demonstrate the engineering applications of Lasers and Optical Fibres by applying basic principles and their realization through experimental approach.</li> <li>Understand and apply electrical properties of Metals and Superconductors using quantum mechanical concepts by gaining practical knowledge to correlate with the theoretical concepts.</li> <li>Understand the basic properties of Nanomaterials and explore their applications in modern engineering fields by gaining practical knowledge to correlate with the theoretical concepts.</li> <li>Understand and apply the concepts of Elastic Properties of Materials in engineering</li> </ol>						
	applications and their realizat  Module 1 – 0	Quantum Mechanics	ш ирргоасп.	RBT	Hrs	
NT1	for Quantum mechanics, de-		C M - 44 - 11 XX 1			
existe signit dime Partic	properties, Heisenberg Unce ence of electrons inside nucleus ficance, probability density a nsional Schrodinger equation the in a potential well of infinite well potential and Quantum Tu	s). Wave function, prop nd Normalization, Tir (derivation), time de te height (Eigen values)	erties and its physical ne independent one- pendent (qualitative), and Eigen functions),	Apply	08	
	Module 2 – La	sers and Optical Fiber	rs	RBT	Hrs	
<b>2.1: LASER:</b> Interaction of radiation with matter and characteristic properties of laser, Energy density of a photon at equilibrium in terms of Einstein's coefficients (derivation), Conditions for Laser action, Requisites of a Laser system, Construction and working of CO <sub>2</sub> Laser. Engineering Applications of Lasers: LIDAR (Measurement of pollutants in atmosphere), Numerical Problems. <b>2.2: Optical fibers:</b> Introduction to optical fibers, Propagation mechanism in optical fibers, Acceptance angle and Numerical Aperture (derivation), Types of Optical fibers, Attenuation in optical fibers (no derivation) and its mechanisms, Engineering Applications of optical fibers – Point to point communication, Numerical problems.			08			
Module 3 – Electrical properties of materials			RBT	Hrs		
factor at cer quant 3.2 (Matt	3.1 Metals: Quantum free electron theory — Assumptions, Density of states (qualitative), Fermi energy and Fermi factor, Effect of temperature on fermi factor, Expression for Fermi energy (derivation) at absolute zero temperature and at certain higher temperature (qualitative), effective mass (qualitative). Merits of quantum free electron theory, Numerical Problems.  3.2 Superconductors: Temperature dependence of resistivity in metals (Matthiessen's rule) and superconducting materials. Effect of magnetic field (Meissner effect). Critical magnetic field and its temperature dependence, Type-			08		

I and Type-II superconductors, BCS theory (qualitative). High temperature superconductors. Applications of superconductors – Maglev vehicles, Numerical problems.		
Module 4 – Modern Engineering Materials	RBT	Hrs
4.1 Nano Materials: Introduction to Nano science and Nano materials, Surface to volume ratio, Quantum confinement — Quantum well, Quantum wire, Quantum dot. Synthesis of Nano materials — Top-down approach (Ball milling method) and bottom-up approach (Sol gel method). Carbon Nano tubes, types, properties and Applications. Scanning Electron Microscope (SEM), Application of SEM in analysis of Molecular size, Numerical problems.  4.2Composite Materials: Introduction to composite materials, Classification of composites based on reinforcement materials and matrix. Advantages and disadvantages of composite materials, Engineering Applications	Apply	08
Module 5 – Mechanical Properties of Materials	RBT	Hrs
<b>Teaching Component:</b> Stress-Strain diagram, Types of stress & strain, Types of elastic moduli, Poisson's ratio, Relations between Y, $\eta$ , K and $\sigma$ (derivation). Types of beams, concept of Bending moment, Expression for bending moment (qualitative), Applications: Single cantilever - Young's modulus of cantilever (derivation), Concept of torsion, Rigidity modulus of a solid cylinder (derivation), Numerical problems.	Apply	08

	Lab Experiments (2 Demo + 8 Lab sessions + 1 Repetition class + 1 Lab Test)		
Sl. No	List of Experiments		
1	Determination of Planck's constant		
2	Photo Diode Characteristics		
3	Determination of wavelength of Laser using Diffraction		
4	Determination of Acceptance angle and Numerical Aperture of an Optical fiber		
5	Determination of Fermi energy of copper		
6	Determination of size of a Nano particle using diffraction pattern		
7	Young's Modulus of material of a beam using Single Cantilever		
8	Rigidity modulus of material of a wire using Torsional Pendulum		

Course Ou	Course Outcomes: After completing the course, the students will be able to		
22PHM112/122.1	Apply the concepts of Quantum Mechanics to physical situations and determine parameter related to the concepts.		
22PHM112/122.2 Apply principles of lasers and Optical Fibers to determine optical parameters in the field of engineering.			
22PHM112/122.3	Apply the quantum concepts and determine parameters related to electrical properties materials.		
22PHM112/122.4	Apply the Concepts of Nano Science to determine parameters related to nano materials.		
22PHM112/122.5	Apply the theory of elasticity to determine mechanical parameters related to engineering applications.		

#### **Reference Books**

- Principle of Quantum Mechanics: Concepts & Applications, Nouredine Zettili, Wiley, 2<sup>nd</sup> Edition, 2009.
- 2. Lasers and Non-linear optics, B.B. Laud, New Age International Publishers, 3<sup>rd</sup> Edition, 2011.
- 3. Lasers and Optical Instrumentation, S. Nagabhushana and B. Sathyanarayana, I.K. International Publishing House Pvt. Ltd, 2013.
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