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## P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

**Second Semester, B.E. - Semester End Examination; Sep. / Oct. - 2023**

### Applied Physics

(Civil Stream)

Time: 3 hrs

Max. Marks: 100

#### Course Outcomes

The Students will be able to:

CO1: Apply the fundamental concepts of physics to understand advanced principles of oscillations, waves, quantum mechanics, materials properties, photonics, electrical and thermal conductivity of materials.

CO2: Identify the engineering applications of oscillations, waves, quantum mechanics, dielectric and superconducting properties of materials, photonics, electrical and thermal conductivity of materials with basic knowledge of physics.

CO3: Formulate the needed mathematical expressions to answer advanced engineering problems using theoretical knowledge of applied physics.

CO4: Solve the numerical problems related to engineering field in quantum mechanics, materials properties, photonics and acoustics by the knowledge of mathematics.

CO5: Analyze the experimental results with theory by constructing the circuit/Setting up the experiment related to applied physics.

**Note: I) PART - A is compulsory. Two marks for each question.**

**II) PART - B: Answer any Two sub questions (from a, b, c) for a Maximum of 18 marks from each unit.**

**Physical constants:** Electron mass,  $m = 9.11 \times 10^{-31}$  kg, Electron charge,  $e = 1.602 \times 10^{-19}$  C; Velocity of light,  $c = 3 \times 10^8$  ms<sup>-1</sup>; Planck's constant,  $h = 6.626 \times 10^{-34}$  Js; Boltzmann constant,  $K = 1.38 \times 10^{-23}$  JK<sup>-1</sup>; Avogadro number,  $N = 6.025 \times 10^{23}$ /mole; Permittivity of free space,  $\epsilon_0 = 8.85 \times 10^{-12}$  Fm<sup>-1</sup>.

Q. No.	Questions	Marks	BLs	COs	POs
<b>I : PART - A</b>		<b>10</b>			
1 a.	Mention any two characteristics of simple harmonic motion.	2	L1	CO1	PO1
b.	Define phase velocity and group velocity.	2	L1	CO1	PO1
c.	State Hooke's law.	2	L1	CO1	PO1
d.	What is population inversion?	2	L1	CO1	PO1
e.	Define reverberation.	2	L1	CO1	PO1
<b>II : PART - B</b>		<b>90</b>			
<b>UNIT - I</b>		<b>18</b>			
2 a.	What is spring constant? Obtain the expression for effective force constant for two springs in parallel combination.	9	L2	CO1,3	PO1
b.	Explain construction and working of Reddy's shock tube. Mention any two applications of shock waves.	9	L1	CO2	PO1
c. i)	Find the magnitude of force required to stretch two springs of constants 100 N/m and 300 Nm by 6 cm when springs are in series and parallel.	5	L1	CO4	PO2
ii)	The distance between two pressure sensors is 150 mm. The time taken by a shock wave to travel this system is 0.3 ms if the velocity of sound under the same condition is 340 m/s, find Mach number of shock wave.	4	L2	CO4	PO2

<b>UNIT - II</b>						<b>18</b>
3 a.	State and explain Heisenberg's uncertainty principle and show that electron does not exist inside the nucleus.	9	L1	CO2,3	PO1	
b.	Derive an expression for energy Eigen value and Eigen functions for an electron present in one dimensional potential well of infinite height	9	L1	CO3	PO1	
c. i)	A particle of mass $8.9 \times 10^{-31}$ kg has kinetic energy 100 eV. Find its de-Broglie wave length where $C$ is velocity of light in space.	4	L2	CO4	PO2	
ii)	The inherent uncertainty in the measurement of time spent by Iridium-191 nuclei in the excited state is found to be $1.4 \times 10^{-10}$ s. Calculate the uncertainty that results in its energy in the excited state.	5	L2	CO4	PO2	
<b>UNIT - III</b>						<b>18</b>
4 a.	Derive the relation between Young's modulus ( $y$ ), Rigidity modulus ( $n$ ), Bulk modulus ( $k$ ) and Poisson's ratio ( $r$ ).	9	L1	CO3	PO1	
b.	Derive an expression for couple per unit twist of a solid cylinder.	9	L1	CO3	PO1	
c. i)	Calculate the force required to produce an extension of 1 mm in a steel wire of length 2 m and diameter 1 mm. (Given $y = 2 \times 10^{11} \text{ N m}^{-2}$ )	5	L2	CO4	PO2	
ii)	Calculate the couple per unit twist for a wire of length 1.5 m radius $0.0425 \times 10^{-2}$ m, through an angle $(\pi/45)$ radian. (Given rigidity modulus = $8.3 \times 10^{10} \text{ N/m}^2$ )	4	L2	CO4	PO2	
<b>UNIT - IV</b>						<b>18</b>
5 a.	Derive an expression for energy density of radiation at equilibrium in terms of Einstein's coefficients.	9	L1	CO3	PO1	
b.	Explain different types of optical fibers.	9	L1	CO2	PO1	
c. i)	The average output power of a laser source emitting a laser beam of wavelength $6328 \text{ \AA}$ is SMW. Find the number of photons emitted per second by Laser.	5	L2	CO4	PO2	
ii)	Calculate numerical aperture, V-number and number of modes in an optical fiber of core diameter $50 \mu\text{m}$ . Refractive index core and cladding are 1.41 and 1.4 and wavelength of light used is 820 nm.	4	L2	CO4	PO2	

## UNIT - V

18

- 6 a. Explain the factors affecting acoustics of buildings and their remedies. 9 L1 CO2 PO1
- b. Explain with a neat diagram how flaws in a solid material are detected by non-destructive method using ultrasonics. 9 L1 CO2 PO1
- c. i) A mild steel plate has a thickness of 18 mm. An ultrasonic pulse travels in it with velocity of  $5.9 \times 10^3 \text{ ms}^{-1}$ . Calculate the echo time of the pulse. 3 L2 CO4 PO2
- ii) A hall has a volume of  $2265 \text{ m}^3$  and its total absorption is equivalent to  $92.9 \text{ m}^2$  of open window. What will be the effect on reverberation time, if audiences fill the hall and thereby increase the absorption by audience  $92.9 \text{ m}^2$ ? 6 L2 CO4 PO2

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