RollNo.

**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

**B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2024**
Semester I
**PH5151 - ENGINEERING PHYSICS**
(Regulation 2019)

Time:3hrs                                                     Max.Marks: 100

| CO1 | Understanding the importance of mechanics. |
| CO2 | Express the knowledge of electromagnetic waves. |
| CO3 | Know the basics of oscillations, optics and lasers. |
| CO4 | Understanding the importance of quantum physics. |
| CO5 | Apply quantum mechanical principles towards the formation of energy bands in crystalline materials. |

**BL – Bloom's Taxonomy Levels**
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

## PART- A (10 x 2 = 20Marks)
(Answer all Questions)

| Q. No. | Questions | Marks | CO | BL |
|--------|-----------|-------|-----|-----|
| 1 | Write the rotational analogies of mass, force, velocity and momentum in linear dynamics. | 2 | CO1 | L1 |
| 2 | A cricket ball of mass 0.2kg and radius 0.06m spins on its own axis with 30 rad/sec. What is its angular momentum? | 2 | CO1 | L2 |
| 3 | Sate the principle behind the cell phone reception. | 2 | CO2 | L2 |
| 4 | Define Intensity of an EM wave in vacuum. | 2 | CO2 | L1 |
| 5 | State Doppler effect. | 2 | CO3 | L1 |
| 6 | Distinguish between a standing and a traveling wave. | 2 | CO3 | L2 |
| 7 | Define correspondence principle | 2 | CO4 | L1 |
| 8 | Mention some physical significance of the wave function | 2 | CO4 | L2 |
| 9 | What are the types of electrons microscope? | 2 | CO5 | L1 |
| 10 | The ground state of energy of a harmonic oscillator is 3eV. Find the energy separation between adjacent quantum states. | 2 | CO5 | L2 |

## PART- B (5 x 13 = 65Marks)
(Restrict to a maximum of 2 subdivisions)

| Q. No. | Questions | Marks | CO | BL |
|--------|-----------|-------|-----|-----|
| 11 (a) (i) | State and prove parallel axis and Perpendicular axis theorems | 10 | CO1 | L3 |
| (ii) | A dumbbell shaped object consists of two equal masses m = 0.64 Kg on the ends of a massless rod of length L = 0.85 cm. Calculate its moment of inertia about an axis one fourth of the way from one end of the rod and perpendicular to it ? | 3 | CO1 | L4 |
| OR | | | | |
| 11 (b) (i) | Derive an expression for Couple per unit twist and how rigidity modulus of the material of the wire can be determined experimentally using torsional oscillations. | 10 | CO1 | L3 |
| (ii) | Consider a rod having length $L$ and mass $m$ which is pivoted at one end. Derive an expression for its time period of oscillations ? | 3 | CO1 | L4 |
| | | | | |
| 12 (a) (i) | Write down Maxwell's equations in the differential form and mention their significance and hence deduce the plane electromagnetic wave | 10 | CO2 | L3 |

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| | equation in a vacuum. | | | |
| (ii) | Calculate the frequency of the radio waves with wavelength ($\lambda$) (a) 6000 Å, (b) 3.2 m, (c ) 10 $\mu$m and (d) 3.0 cm | 3 | CO2 | L4 |
| | **OR** | | | |
| 12 (b) (i) | What is a dipole-antenna? Discuss about the mechanism of producing and detecting Electromagnetic waves with appropriate figures. | 10 | CO2 | L3 |
| (ii) | If a cell phone has a dipole antenna of length 1.5cm, estimate the wavelength of the radiowave and its operating frequency. | 3 | CO2 | L4 |
| 13 (a) (i) | Explain the principle, construction and working of Semiconductor laser with relevant energy level diagram? | 10 | CO3 | L3 |
| (ii) | Find the relative population of two states in a Nd : YAG laser that produces a light beam of wavelength 6943 Å at 300 K | 3 | CO3 | L4 |
| | **OR** | | | |
| 13 (b) (i) | Explain in detail the construction, working and energy levels of a $CO_2$ laser. | 10 | CO3 | L3 |
| (ii) | Calculate the wavelength of light emission from GaAs whose band gap is 1.44 eV. | 3 | CO3 | L4 |
| 14 (a) (i) | Derive an expression for Schrodinger's time independent wave equations | 10 | CO4 | L3 |
| (ii) | If the momentum of the particles (electron) are in the ratio1:0.25 compare their de Broglie wavelengths. | 3 | CO4 | L4 |
| | **OR** | | | |
| 14 (b) (i) | Explain in detail the nature of energy levels and wave function for a particle in an infinite potential well | 10 | CO4 | L3 |
| (ii) | An electron is trapped in a one dimensional box of length 0.1 nm calculate the energy required to excite the electron from its ground state of fifth excited state | 3 | CO4 | L4 |
| 15 (a) (i) | What is the principle of scanning tunneling microscope? Explain the construction and working scanning tunneling microscope with a suitable diagram. | 10 | CO5 | L3 |
| (ii) | Sketch the wave functions and the probability distribution for the n = 4 and n = 5 states for a particle trapped in a finite square well of width L | 3 | CO5 | L4 |
| | **OR** | | | |
| 15 (b) (i) | Describe the ground state energy of harmonic oscillator by quantum mechanical treatment. | 10 | CO5 | L3 |
| (ii) | Calculate the de-Broglie's wave length of an electron having a velocity of $10^6$ m/sec. | 3 | CO5 | L4 |

## PART- C (1 x 15 = 15Marks)
(Q.No.16 is compulsory)

| Q. No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 16. (i) | Discuss the origin of energy bands by stating Bloch's theorem and describing the kronig-Penney model | 12 | CO5 | L5 |
| (ii) | what happens to the ground state energy of particle in 3D box, When all the side of box is doubled | 3 | CO5 | L4 |