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## First/Second Semester B.E. Degree Examination, Dec.2023/Jan.2024 Engineering Physics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Physical constants : Planck's constant =  $6.625 \times 10^{-34}$  J-S, Boltzmann's constant =  $1.38 \times 10^{-23}$  J/K,  $e = 1.6 \times 10^{-19}$  C,  $C = 3 \times 10^8$  m/s,  $g = 9.8$  m/sec<sup>2</sup>,  $m_e = 9.1 \times 10^{-31}$  Kg

### Module-1

- 1 a. What are damped oscillations? Deduce the differential equation for damped oscillations arrive at the solutions give graphical representations of all the three cases. (08 Marks)
- b. What are shock waves? With a neat diagram, explain the construction and working of Reddy shock tube. (08 Marks)
- c. A mass of 0.8Kg causes an extension of 0.06m in a spring and mass system which is set for oscillations. Calculate force constant of the spring and time period of oscillations. (04 Marks)

### OR

- 2 a. Discuss the theory of forced vibrations and hence obtain the expression for amplitude by solving the differential equation of forced oscillation. (08 Marks)
- b. What is spring constant? Mention its significance. Deduce the expression for equivalent spring constants, when two springs are connected in series and parallel. (08 Marks)
- c. While using a Reddy shock tube, it is found that the time taken to travel between two pressure sensors is 15 $\mu$ s. If the distance between two sensors is 10mm, find the Mach number. Assume that the velocity of sound in the medium is 340m/sec. (04 Marks)

### Module-2

- 3 a. State and explain Plank's law of radiation. Explain how it changes to Wein's law and Rayleigh-Jeans law. (08 Marks)
- b. Mention the properties of wave function. Deduce Schrodinger's time independent wave equation. (08 Marks)
- c. The inherent uncertainty in the measurement of the time spent by iridium - 191 nuclei in the excited state is found to be  $2.5 \times 10^{-10}$  sec. Calculate the uncertainty that results in its energy in the excited state. (04 Marks)

### OR

- 4 a. Solve the Schrodinger wave equation for the case of a particle in an infinite potential well and discuss its solutions? (08 Marks)
- b. Explain the spectrum of black body radiation. Prove that an electron does not exist inside the nucleus using Heisenberg's uncertainty principle. (08 Marks)
- c. Compute momentum and de-Broglie wavelength associated with an electron moving with kinetic energy 2KeV. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

**Module-3**

- 5 a. Derive an expression for energy density of incident radiation in terms of Einstein's coefficients. (08 Marks)
- b. What is angle of acceptance and numerical aperture of an optical fiber? Deduce the expression for Numerical aperture of optic fiber and mention the condition for ray propagation. (08 Marks)
- c. Find the attenuation in an optic fiber of length 600m when a light of power 150mW incident and emerges out with 140mW power. (04 Marks)

OR

- 6 a. Describe construction and working of CO<sub>2</sub> laser with a neat energy level diagram. (08 Marks)
- b. Explain different modes of propagation in optic fiber. Explain the optic fiber as temperature sensor. (08 Marks)
- c. Ratio of population of two energy levels is  $1.06 \times 10^{-30}$ . Find the wavelength of light emitted by spontaneous emission at 310K. (04 Marks)

**Module-4**

- 7 a. Explain Hall effect. Deduce the expression for Hall voltage and Hall coefficient. (08 Marks)
- b. Explain different polarization mechanisms in dielectrics. Briefly explain internal fields in solid dielectrics. (08 Marks)
- c. The resistivity of intrinsic germanium at 27°C is equal to 0.47Ωm. Assuming electron and hole mobilities as 0.36 and 0.17m<sup>2</sup>V<sup>-1</sup>S<sup>-1</sup> respectively, calculate intrinsic carrier density. (04 Marks)

OR

- 8 a. Derive the expression for electrical conductivity in metals using quantum free electron theory. Explain any two success of quantum free theory. (08 Marks)
- b. State and explain Fermi energy? Deduce the expression for Fermi energy at zero Kelvin (08 Marks)
- c. Find the temperature at which there is 1% probability that a state with an energy 0.5eV above Fermi energy is occupied. (04 Marks)

**Module-5**

- 9 a. With a neat diagram, explain the principle, construction and working of Atomic force microscope. (08 Marks)
- b. Explain the principle, construction and working of transmission electron microscope using a neat labelled diagram. (08 Marks)
- c. Write a note on nano-composites. Give two examples. (04 Marks)

OR

- 10 a. Give the principle instruction and working of X-ray diffraction meter. (08 Marks)
- b. Explain the principle, construction and working of scanning electron microscope with a neat labelled diagram. (08 Marks)
- c. Determine the crystal size ; given, the wavelength of X-rays 10nms, the peak width of 0.5° and peak position of 25° and K = 0.94 for a cubic crystal? (04 Marks)

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