# Question Paper

Exam Date & Time: 18-Aug-2022 (10:00 AM - 01:00 PM)

## MANIPAL ACADEMY OF HIGHER EDUCATION

**SECOND SEMESTER B.TECH. EXAMINATIONS (MIT MANIPAL) - AUGUST 2022**
**SUBJECT : PHY 1051 - ENGINEERING PHYSICS**
**(MAKEUP)**

**Marks: 50** **Duration: 180 mins.**

**Answer all the questions.**

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|---|---|---|
| 1A) | Discuss qualitatively, the diffraction at a single slit and obtain the condition for diffraction minima and maxima. | (4) |
| 1B) | An oil film (n = 1.45) floating on water is illuminated by white light at normal incidence. The film is 280 nm thick. Find (a) the wavelength and color of the light in the visible spectrum most strongly reflected and (b) the wavelength and color of the light in the spectrum most strongly transmitted. | (4) |
| 1C) | Mention the mathematical features of wavefunction. | (2) |
| 2A) | Explain:<br>i) Stefan Boltzmann law.<br>ii) Wien's Displacement law.<br>iii) What are the assumptions of Planck's quantum theory of radiation? | (4) |
| 2B) | In an experiment, tungsten cathode which has a threshold of 230 nm is irradiated by the ultraviolet light of wavelength 180 nm. Calculate (i) maximum energy of emitted photoelectrons, and (ii) work function for tungsten (in eV). | (4) |
| 2C) | The particle in the box always has zero energy in the ground state. State TRUE or False and justify your answer. | (2) |
| 3A) | Find the wavelength of a particle in a one-dimensional box for the first three allowed states, in terms of the length of the box L. Draw the wave functions and probability densities of the first three allowed states. | (4) |
| 3B) | A bismuth target is struck by electrons, and x-rays are emitted. Estimate (a) the M to L-shell transitional energy for bismuth and (b) the wavelength of the x-ray emitted when an electron falls from the M shell to the L shell. | (4) |
| 3C) | Explain the origin of characteristic x-ray spectra. | (2) |
| 4A) | Describe the principle of a laser using the necessary schematic design and energy level diagram. | (4) |
| 4B) | An HCl molecule is excited to its second rotational energy level, corresponding to J=2. If the distance between its nuclei is 0.1275 nm, what is the angular speed of the molecule about its center of mass? | (4) |
| 4C) | What are the essential assumptions made in the free electron theory of metals? | (2) |
| 5A) | Deduce the expression for Fermi energy $E_F$ in metal at zero K from the density-of-states function.<br>Given: the density-of-states function,<br>$$g(E)\,dE = \frac{8\sqrt{2}\,\pi\,m^{\frac{3}{2}}}{h^3}\,E^{\frac{1}{2}}\,dE.$$ | (4) |
| 5B) | Taking the effective force constant of a vibrating HCl molecule as 480 N/m, find the energy | (4) |

difference (in eV) between the ground state and the first excited vibrational energy level. The atomic masses of H and Cl are $1_u$ and $35_u$ respectively. (Given: $1\ _u = 1.66 \times 10^{-27}$ kg).

5C) The spectral energy of pure rotational spectra of a diatomic molecule is higher than vibrational spectral energy and is of the order of 1 eV. State whether this statement is TRUE or FALSE; Justify your answer. (2)

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