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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

II Semester B.Tech. – END SEMESTER EXAMINATION - JUNE 2018

**SUBJECT: ENGINEERING PHYSICS (PHY1001)**

Time: 3 Hrs. 18-06-2018 Max. Marks: 50

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**Note:**

Answer **ALL** the questions. Each question carries **10** marks
Answer all the sub questions of a main question in a continuous sequence.
Write specific and precise answers. Any missing data may suitably be assumed.
Write question number on the margin only. Draw neat sketches wherever necessary.

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**Physical Constants:**

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|---|---|---|---|
| Speed of light in vacuum | $= 3.00 \times 10^{8}$ m/s | Electron charge | $= 1.60 \times 10^{-19}$ C |
| Electron mass | $= 9.11 \times 10^{-31}$ kg | Avogadro number | $= 6.023 \times 10^{23}$ /mol |
| Boltzmann constant | $= 1.38 \times 10^{-23}$ J/ K | Planck's constant | $= 6.63 \times 10^{-34}$ J.s |

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**1A.** Obtain an expression for the intensity of light in double-slit interference using phasor-diagram. **[5]**

**1B.** A certain grating has $10^4$ slits with a spacing of 2100 nm. It is illuminated with yellow sodium light (wavelength = 589 nm). Find the angular position of all principal maxima observed and the angular width of the largest order maximum. **[3]**

**1C.** The wall of a large room is covered with acoustic tile in which small holes are drilled 5.20 mm from center to center. How far can a person be from such a tile and still distinguish the individual holes, assuming ideal conditions? Assume the diameter of the pupil of the observer's eye to be 4.60 mm and the wavelength to be 542 nm. **[2]**

**2A.** Explain construction and operation of He-Ne laser with necessary diagrams. **[5]**

**2B.** A ruby laser emits light at a wavelength of 694.4 nm. If a laser pulse is emitted for 12.0 ps and the energy release per pulse is 150 mJ. How many photons are there in each pulse? **[3]**

**2C.** A glass optical fibre of refractive index 1.450 is to be clad with another to ensure total internal reflection that will contain light traveling within 5° of the fibre-axis. What maximum index of refraction is allowed for the cladding? **[2]**

**3A.** Explain the experiment on compton effect. **[5]**

**3B.** A 2.0- kg block is attached to a spring that has a force constant of 25 N/m. The spring is stretched 0.40 m from its equilibrium position and released. Find the total energy of the system and the frequency of oscillation according to classical calculations. Assuming that the energy is quantized, find the quantum number $n$ for the system oscillating with this amplitude. **[3]**

**3C.** Consider a freely moving quantum particle with mass $m$ and speed $u$. Its energy is $E = K = mu^2/2$. Determine the phase speed of the quantum wave representing the particle and show that it is different from the speed at which the particle transports mass and energy. **[2]**

**4A.** Sketch the potential-well diagram of finite height $U$ and length $L$, obtain the general solution of the schrodinger equation for a particle of mass $m$ in it. **[5]**

**4B.** The ground state wave function for an electron in H-atom is $\psi(r) = \frac{1}{\sqrt{\pi a_o^3}} \exp\left(-\frac{r}{a_o}\right)$ where $a_o$ is the Bohr radius. Calculate the most probable value of $r$ (= distance from nucleus) for an electron in the ground state of the H-atom. **[3]**

**4C.** An electron is confined between two impenetrable walls 0.10 nm apart. Determine its energy and its de Broglie wavelength in the ground state. **[2]**

**5A.** Distinguish between conductors, insulators and semiconductors on the basis of band theory. **[5]**

**5B.** Consider a cube of gold 1.00 mm on edge. Calculate the approximate number of conduction electrons in this cube at zero K, whose energies lie in the range 3.000 eV to 3.010 eV, which are less than the Fermi energy. **[3]**

**5C.** Find the typical speed of conduction electrons in copper, taking the kinetic energy as equal to the fermi energy, 7.05 eV. **[2]**

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