Autumn Semester Examnination - 2021

Subject: Engineering Physics   **Subject Code: PHYUGBS01**

Full Marks: 80   **Time: 3 hrs**

- Each question carries 10 marks and answer any eight questions from the following.

1. (a) Find the unit vector which is along the direction of the vector $\vec{A} = \hat{i} + \hat{j} + 2\hat{k}$. (b) A force $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ is acting on a body of mass m and the corresponding position vector is given by $\vec{r} = 2\hat{i} + 3\hat{j} + 5\hat{k}$. Find the torque ($\vec{\tau}$) of the system. (c) Prove that $\vec{a} \times (\vec{b} \times \vec{c}) + \vec{b} \times (\vec{c} \times \vec{a}) + \vec{c} \times (\vec{a} \times \vec{b}) = 0$. (d) Define the coefficient of viscosity of a liquid. What is its dimension? (e) Write down Hooke's law. $(2+2+2+2+2)$

2. (a) What is a *central force* ? (b) Show that a *central force* is conservative. (c) Verify whether the force $\vec{F} = -\frac{\hat{r}}{r^n}$ is conservative or not, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$. $(2+3+5)$

3. (a) Define the *centre of mass* (CM) of a system of N-particles. (b) Show that in case of a system of N-particles, the linear momentum ($\vec{P}$), angular momentum ($\vec{L}$) and total energy (E) of the system remain conserved. $(1+9)$

4. (a) What do you mean by the nuclear fusion and fission? Give examples. (b) Distinguish between isotopes, isobars and isotones. (c) From the following find out the groups of isotopes and isobars: Ge_{32}^{76}, K_{19}^{39}, C_6^{14}, Ca_{20}^{40}, Ge_{32}^{77}, N_7^{14}. (d) Find X from the following equation: $C_6^{14} \rightarrow N_7^{14} + \bar{\nu}_e + X$. $(4+2+2+2)$

5. (a) State the de-Broglie's hypothesis and hence calculate the wavelength associed with a body of mass 10 gm moving with a velocity 0.5 m/sec. (b) What is the photo electric effect? Write down the Einstein's photoelectric equation. (c) Write down the time independent Schrödinger equation corresponding to a body of mass m and momentum p, and explain each term. $(4+4+2)$

6. (a) State the Coulomb's law of electrostatics. (b) Find the electric field outside a sphere having uniform volume distribution of charge. (c) Determine the ammount of charge stored on either plate of a capacitor (4×10^{-6} F) when connected accross a 12 V battery. $(3+5+2)$

7. (a) What is an electric dipole? (b) Define dipole moment and calculate it's SI unit. (c) What is an ideal or point dipole? (d) Derive an expression for the electric field at any point on the equatorial line of an electric dipole. $(1+2+2+5)$

8. (a) State the fundamental postulates of kinetic theory of gasses. (b) Calculate the *r.m.s* velocity of hydrogen gas (H_2) at NTP. Given $R = 8.31 \times 10^7$ erg/deg/mol, $M_H = 2$. (c) Find the number of degrees of freedom of a diatomic gas molecule. (d) State the principle of equipartion of energy of gasses. $(4+2+2+2)$

9. (a) Define the latice and basis of a crystal. (b) Determine the relationship between the latice parameter and the atomic radius r for the monoatomic sc, bcc and fcc structures. (c) Derive the packing fraction of a sc and a bcc latice. $(2+4+4)$