Autumn-Semester Examination- 2020

Course code: PHYUGBS-01
Course title: Engineering Physics
Department of Appearing Students: CEN, CSE, ECE, EEN, MEN
Full marks: 80 **Time: 3 hrs**

Group-A

(Answer any four questions from below.)

$(10 \times 4 = 40)$

1. (a) Write down the first law of thermodynamics. (b) If the degree of freedom of a gas is n, then find the ratio of C_P and C_V . (c) State and prove the law of equipartition of enengy. (2+3+5)

2. (a) What do you mean by the 'thermodynamic equilibrium', 'macroscopic parameter'? (b) An ideal gas expands adiabatically but quasistically from the state $i(P_i, V_i, T_i)$ to the state $f(P_f, V_f, T_f)$. What is the change in its internal energy ? What would this change be if the expansion were isothermal? (3+7)

3. (a) Write down the second law of thermodynamics (Kelvin-Plank Statement). (b) Find out the entropy of the steam. (c) If the equation of state for a gas with internal energy U is $PV = \frac{U}{3}$, then find out the equation for an adiabatic process. (2+4+4)

4. (a)What is refrigerator? Find out the co-efficient of performance of a refrigerator. (b) Discuss the four basis postulates of the kinetic theory of gases. (6+4)

5. Prove the thermodynamics relations;
   (a)$TdS = C_V dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$
   (b) $TdS = C_P dT - T\left(\frac{\partial V}{\partial T}\right)_P dP$
   (c) For homogeneous fluid, $C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$ (3+3+4)

Group-B

(Answer any four questions from below.)

$(10 \times 4 = 40)$

6. (a) Define unit vector and null vector. (b) Show that $\vec{\nabla} \times \vec{F} = 0$, where $\vec{F} = (2xy + z^3)\hat{i} + x^2 y\hat{j} + 3xz^2\hat{k}$. (c) Find out $\vec{\nabla} \cdot \vec{r}$, where r is the position vector. (d) Find out $\vec{A} \cdot (\vec{B} \times \vec{C})$,where $\vec{A} = 2\hat{i} - 5\hat{j}$, $\vec{B} = 3\hat{j}$, $\vec{C} = 5\hat{j} + 6\hat{k}$. (e) Can the scalar product of two vectors be negative? (2+2+2+2+2)

7. (a) If $\vec{A}$ and $\vec{B}$ are two length vectors, then what is the geometrical significance of $|\vec{A} \times \vec{B}|$? (b) Find a vector which is perpendicular to each vectors: $\vec{A} = 2\hat{i} - 3\hat{j} + 6\hat{k}$ and $\vec{B} = \hat{i} + \hat{j} - \hat{k}$. (c) Calculate the area of the parallelogram where two adjacent sides are formed by the vectors $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 7\hat{j}$. (d) Find the condition for two vectors to be parallel and perpendicular to each other. (e) Find the workdone in moving a paricle along a vector $\vec{S} = (4\hat{i} - \hat{j} + 7\hat{k})$ if the applied force is $\vec{F} = (\hat{i} + 2\hat{j} - \hat{k})$ newton, $\vec{S}$ is meter. (2+2+2+2+2)

8. (a) Define electric field at a point? (b) Write down the unit and dimension of electric field? (c) Find the electric field at a distance z above the centre of a flat circular disk of radius $\vec{R}$ that carries a uniform surface charge σ. What does your formula give in the limit $R \to \infty$? Also check the case $z \gg R$. (d) Wriite down the diffenrential form of Gauss's law? (2+2+4+2)

9. (a)Define lattice, Basis and Crystral structure? (b) What is the maximum number of possible Bravis lattice in 3D? (c) Derive the expression of interplanar spacing in 3D. (d) Find the lattice indices of a plane that makes intercepts of 1 on a-axis, 2 on b-axis and is parallel to c-axis. (e) What is the number of effective atom present in a Diamond structure in a unit cell? Draw (101) and (111) planes in a cubic unit cell. (3+1+2+2+2)

10. (a) Write down Biot-Savart law? Express it in vector form. (b) A current is set up in a long copper pipe. Is there a magnetic field inside and outside the pipe? (c) Find the magnetic field at point P for each of the steady current configurations shown in fig(a) and fig(b).

(4+4+2)