Note:-
   1. All Questions are compulsory.
   2. Numbers on the right indicate full marks.

Section A

Q.1 Select and write the correct answer. **(4)**

1. If $\cos\alpha$, $\cos\beta$, $\cos\gamma$ are the direction cosines of a line then the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ is ___

   A) 1   B) 2
   C) 3   D) 4

2. If l, m, n are direction cosines of a line then $l\hat{i} + m\hat{j} + n\hat{k}$ is_____
   A) null vector   B) the unit vector along the line
   C) any vector along the line   D) a vector perpendicular to the line

Q.2 Answer the following. **(3)**

1. If $\overline{OA} = \bar{a}$ and $\overline{OB} = \bar{b}$ then show that the vector along the angle bisector of angle AOB is given by $\bar{d} = \lambda\left(\dfrac{\bar{a}}{|\bar{a}|} + \dfrac{\bar{a}}{|\bar{b}|}\right)$.

2. Prove that $(\bar{a} \times \bar{b}) \cdot (\bar{c} \times \bar{d}) \begin{vmatrix} \bar{a}\cdot\bar{c} & \bar{b}\cdot\bar{c} \\ \bar{a}\cdot\bar{d} & \bar{b}\cdot\bar{d} \end{vmatrix}$

3. Determine whether $\bar{a} = -9\hat{i} + 6\hat{j} + 15\hat{k}, \bar{b} = 6\hat{i} - 4\hat{j} - 10\hat{k}$ are orthogonal, parallel or neither.

Section B
Attempt any Four

Q.3   If $\hat{p}, \hat{q}$ and $\hat{r}$ are unit vectors, find i) $\hat{p} \cdot \hat{q}$ ii) $\hat{p} \cdot \hat{r}$ **(2)**

Q.4   Using properties of scalar triple product, prove that   **(2)**
$\left[\bar{a} + \bar{b} \quad \bar{b} + \bar{c} \quad \bar{c} + \bar{a} \right] = 2\left[\bar{a} \quad \bar{b} \quad \bar{c} \right]$

Q.5   The position vectors of three consecutive vertices of a parallelogram are $\hat{i} + \hat{j} + \hat{k}$,   **(2)**
$\hat{i} + 3\hat{j} + 5\hat{k}$ and $7\hat{i} + 9\hat{j} + 11\hat{k}$. Find the position vector of the fourth vertex.

Q.6   Find $|\bar{u} \times \bar{v}|$ if $|\bar{u}| = 10, |\bar{v}| = 2, \bar{u}\cdot\bar{v} = 12$ **(2)**

Q.7   Show that $\bar{a} \times (\bar{b} \times \bar{c}) + \bar{b} \times (\bar{c} \times \bar{a}) + \bar{c} \times (\bar{a} \times \bar{b}) = 0$ **(2)**

Q.8   Prove that a quadrilateral is a parallelogram if and only if its diagonals bisect each other.   **(2)**

Section C
Attempt any Two

Q.9 Find the length of the side of the triangle and also determine the type of a triangle. L(3, –2, –3), **(3)** M(7, 0,1), N (1, 2, 1)

Q.10 Find the angle P of the triangle whose vertices are P(0, -1, -2), Q(3, 1, 4) and R(5, 7, 1) **(3)**

Q.11 Prove by vector method that the angle subtended on semicircle is a right angle. **(3)**

Section D
Attempt any One

Q.12 Find the component form of if $\bar{a}$ if **(4)**
(i) It lies in YZ plane and makes 60º with positive Y-axis and $|\bar{a}| = 4$
(ii) It lies in XZ plane and makes 45º with positive Z-axis and $|\bar{a}| = 10$

Q.13 If A(1, 2, 3) and B(4, 5, 6) are two points, then find the foot of the perpendicular from the point B **(4)** to the line joining the origin and point A.