Assignment-3
CHAPETR-20
Vector Algebra

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I. Section-D

1) Let a and b be two be non-collinear unit vectors. If $u = a - (a \cdot b)\, b$ and $v = a \times b$, then $|v|$ is (1999-3 Marks)
   a) $|u|$
   b) $|u| + |u \cdot a|$
   c) $|u| + |u \cdot b|$
   d) $|u| + u \cdot (a + b)$
2) Let $\mathbf{A}$ be vector parallel to line of intersection of planes P_1 and P_2. Plane P_1 is parallel to the vectors $2\hat{j} + 3\hat{k}$ and $4\hat{j} - 3\hat{k}$ and that P_2 is paral lel to $\hat{j} - \hat{k}$ and $3\hat{i} + 3\hat{j}$, then the angle between vector $\mathbf{A}$ and a given vector $2\hat{i} + \hat{j} - 2\hat{k}$ is (2006-5M,-1)
   a) $\frac{\pi}{2}$
   b) $\frac{\pi}{4}$
   c) $\frac{\pi}{6}$
   d) $\frac{3\pi}{4}$
3) The vector(s) which is/are coplanar with vectors $\hat{i} + \hat{j} + 2\hat{k}$ and $\hat{i} + 2\hat{j} + \hat{k}$, and perpendicular to the vector $\hat{i} + \hat{j} + \hat{k}$ is/are (2011)
   a) $\hat{j} - \hat{k}$
   b) $\hat{i} + \hat{j}$
   c) $\hat{i} - \hat{j}$
   d) $\hat{j} + \hat{k}$
4) If the straight lines $\frac{x-1}{2} = \frac{y+1}{k} = \frac{z}{2}$ and $\frac{x+1}{5} = \frac{y+1}{2} = \frac{z}{k}$ are coplanar,then the plane(s) containing these two lines is(are) (2012)
   a) $y + 2z = -1$
   b) $y + z = -1$
   c) $y - z = -1$
   d) $y - 2z = -1$
5) A line l passing through the origin is perpendicular to the lines
   $l_1 : (3 + t)\, \hat{i} + (1 + 2t)\, \hat{j} + (4 + 2t)\, \hat{k}, -\infty < t < \infty$
   $l_2 : (3 + 2s)\, \hat{i} + (3 + 2s)\, \hat{j} + (2 + s)\, \hat{k}, -\infty < s < \infty$
   Then, the coordinate(s) of the point(s) on l_2 at a distance of $\sqrt{17}$ from the point of intersection of l and l_1 is(are) (JEE Adv.2013)
   a) $\left(\frac{7}{3}, \frac{7}{3}, \frac{5}{3}\right)$
   b) $(-1, -1, 0)$
   c) $(1, 1, 1)$
   d) $\left(\frac{7}{9}, \frac{7}{9}, \frac{8}{9}\right)$
6) Two lines $L_1 : x = 5, \frac{y}{3-\alpha} = \frac{z}{-2}$ and $L_2 : x = \alpha, \frac{y}{-1} = \frac{z}{2-\alpha}$ are coplanar. Then α can take value(s) (JEE Adv.2013)
   a) 1
   b) 2
   c) 3
   d) 4
7) Let $\mathbf{x}, \mathbf{y}$ and $\mathbf{z}$ be three vectors each of magnitude $\sqrt{2}$ and the angle between each pair of them is $\frac{\pi}{3}$. If $\mathbf{a}$ is a non-zero vector perpendicular to $\mathbf{x}$ and $\mathbf{y} \times \mathbf{z}$ and $\mathbf{b}$ is a non-zero vector perpendicular to $\mathbf{y}$ and $\mathbf{z} \times \mathbf{x}$, then
   (JEE Adv.2014)
   a) $\mathbf{b} = (\mathbf{b} \cdot \mathbf{z})\, (\mathbf{z} - \mathbf{x})$
   b) $\mathbf{a} = (\mathbf{a} \cdot \mathbf{y})\, (\mathbf{y} - \mathbf{z})$
   c) $\mathbf{a} \cdot \mathbf{b} = -(\mathbf{a} \cdot \mathbf{y})\, (\mathbf{b} \cdot \mathbf{z})$
   d) $\mathbf{a} = -(\mathbf{a} \cdot \mathbf{y})\, (\mathbf{z} - \mathbf{y})$
8) From a point $P\,(\lambda, \lambda, \lambda)$, perpendicular PQ and PR are drawn respectively on the lines $y = x, z = 1$ and $y = -x, z = -1$. If P is such that $\angle QPR$ is a right angle, then t he possible value(s) of λ is/(are) (JEE Adv.2014)
   a) $\sqrt{2}$
   b) 1
   c) -1
   d) -$\sqrt{2}$
9) In R^3, consider the planes $P_1 : y = 0$ and $P_2 : x + z - 1$.Let P_3 be the plane different from P_1 and P_2 which passes through the intersection of P_1 and P_2. If the distance of

the point$(0,1,0)$ from P_3 is 1 and the distance of point (α,β,γ) from P_3 is 2, then which of the following relation is(are) true (JEE Adv.2015)

a) $2\alpha+\beta+2\gamma+2=0$
b) $2\alpha-\beta+2\gamma+4=0$
c) $2\alpha+\beta+2\gamma-10=0$
d) $2\alpha-\beta+2\gamma-8=0$

10) In R^3, let L be a straight line passing through the origin. Suppose that all the points on L are at a costant distance from two planes $P_1 : x+2y-z+1=0$ and $P_2 : 2x-y+z-1=0$. Let M be the locus of the foot of the perpendicular drawn from the points on L to plane P_1. Which of the following points lie(s) on M? (JEE Adv.2015)

a) $\left(0,-\frac{5}{6},-\frac{2}{3}\right)$
b) $\left(-\frac{1}{6},-\frac{1}{3},\frac{1}{6}\right)$
c) $\left(-\frac{5}{6},0,\frac{2}{3}\right)$
d) $\left(-\frac{1}{3},0,\frac{2}{3}\right)$

11) Let $\triangle PQR$ be a triangle. Let $\mathbf{a}=\overrightarrow{QR}$,$\mathbf{b}=\overrightarrow{RP}$ and $\mathbf{c}=\overrightarrow{PQ}$. If $|\mathbf{a}|=12$, $|\mathbf{b}|=4\sqrt{3}$, $b\cdot c=24$, then which of the following is(are)true? (JEE Adv.2015)

a) $\frac{|\mathbf{c}|}{2}-\mid\mathbf{a}\mid=2$
b) $\frac{|\mathbf{c}|}{2}+\mid\mathbf{a}\mid=30$
c) $\mid\mathbf{a}\times\mathbf{b}\mid=\sqrt[48]{3}$
d) $\mathbf{a}\cdot\mathbf{b}=-42$

12) Consider a pyramid OPQRS located in the first octant $(x\geq 0, y\geq 0, z\geq 0)$ with O as origin, and OP and OR along the x-axis and the y-axis respectively. The base OPQR of the pyramid is a square with OP=3. The point S is directly above the mid-point, T of diagonal OQ such that TS=3. Then (JEE Adv.2016)

a) the acute angle between OQ and OS is $\frac{\pi}{3}$
b) the equation of the plane containg the triangle OQS is $x-y=0$
c) the length of the perpendicular from P to the plane containing the triangle OQS is $\frac{3}{\sqrt{2}}$
d) the perpendicular distance from O to the staright line containing RS is $\sqrt{\frac{15}{2}}$

13) Let $\hat{u}=u_1\hat{i}+u_2\hat{j}+u_3\hat{k}$ be a unit vector in R^3 and $\hat{w}=\frac{1}{\sqrt{6}}\left(\hat{i}+\hat{j}+2\hat{k}\right)$. Given that there exists a vector $\mathbf{v}$ in R^3 such that $|\hat{u}\times\mathbf{v}|=1$ and $\hat{w}\left(\hat{u}\times\mathbf{v}\right)=1$. Which of the following statement(s) is(are) correct? (JEE Adv.2016)

a) there is exactly one choice for such $\mathbf{v}$
b) There are infinitely many choices for such $\mathbf{v}$
c) If $\hat{u}$ lies in the xy-plane then $|u_1|=|u_2|$
d) If $\hat{u}$ lies in the xz-plane then $2|u_1|=|u_3|$

14) Let $P_1 : 2x+y-z=3$ and $P_2 : x+2y+z=2$ be two planes. Then,which of the following statement(s) is(are) TRUE? (JEE Adv.2018)

a) The line of intersection ofP_1 and P_2 has direction ratios 1,2,-1
b) The line $\frac{3x-4}{9}=\frac{1-3y}{9}=\frac{z}{3}$ is perpendicular to the line of intersection of P_1 and P_2
c) The acute angle between P_1 and P_2 is 60$\circ$.
d) If P_3 is the plane passing through the point $(4,2,-2)$ and perpendicular to the line of intersection of P_1 and P_2,then the distance of the point $(2,1,1)$ fro m the plane P_3 is $\frac{2}{\sqrt{3}}$

15) Let L_1 and L_2 denote the lines
$\mathbf{r}=\hat{i}+\lambda\left(-\hat{i}+2\hat{j}+2\hat{k}\right),\lambda\in R$ and
$\mathbf{r}=\mu\left(2\hat{i}-\hat{j}+2\hat{k}\right),\mu\in R$
respectively. If L_3 is a line which is perendicular to both L_1 and L_2 and cuts both of them, then which of the following option describe(s) L_3? (JEE Adv.2019)

a) $\mathbf{r}=\frac{2}{9}\left(4\hat{i}+\hat{j}+\hat{k}\right)+t\left(2\hat{i}+2\hat{j}-\hat{k}\right),t\in R$
b) $\mathbf{r}=\frac{2}{9}\left(2\hat{i}-\hat{j}+2\hat{k}\right)+t\left(2\hat{i}+2\hat{j}-\hat{k}\right),t\in R$
c) $\mathbf{r}=t\left(2\hat{i}+2\hat{j}-\hat{k}\right),t\in R$
d) $\mathbf{r}=\frac{1}{3}\left(2\hat{i}+\hat{k}\right)+t\left(2\hat{i}+2\hat{j}-\hat{k}\right),t\in R$