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B.Sc. I–MATHEMATICS (PAPER-THIRD), 2014
(GEOMETRY AND VECTOR CALCULUS)

Time : Three Hours *Maximum Marks : 50*

Note : Attempt questions from all the Sections.

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SECTION - A
(SHORT ANSWER TYPE QUESTIONS)

Note : Attempt any eight questions. Each question carries 2½ marks

(2½×8=20)

1. If PSP` and QSQ` ane two perpendicular focal chords of a conic, then show that.
$$\frac{1}{PP'}+\frac{1}{QQ'} = \text{constant}.$$

2. If PSP is a focal chord of a conic and l its semi latus-rectum, prove that $\frac{2}{l}=\frac{SP+SP'}{SP.SP'}$

3. Find the angle between two lines whose direction cosines are l_1, m_1, n_1 and l_2, m_2, n_2. http://www.upadda.com

4. Find the equation of the plane through the line of intersection of the planes $ax + by + cz + d = 0$ and $ax + \beta y + \gamma z + \delta = 0$ and parallel to the X- axis.

5. Find the co-ordinates of the point, where the line joining $(2, -3, 1)$ and $(3, -4, -5)$ cuts the plane $2x + y + z = 7$

6. Find the image of the point (2,1,3) in the plane $x + 2y - z + 2 = 0$

7. Prove that the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $4x - 3y + 1 = 0 = 5x - 3z + 2$ are coplanar and find the point of intersection.

8. Find the equation of sphere having the circle.
$x^2 + y^2 + z^2 + 10y - 4z - 8 = 0$
$x + y + z - 3 = 0$ as a great circle.

9. Prove that the angle between the lines of intersection of the plane $x + y + z = 0$ with the cone
$ayz + bzx + cxy = 0$ is $\frac{1}{2}\pi$ if $a + b + c = 0$ and $\frac{1}{3}\pi$ if $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=0$

10. Show that the plane $8x - 6y - z = 5$ touches the paraboloid $\frac{x^2}{2}+\frac{y^2}{3}=z$ and find the point of contact.

11. A particle moves along the curve $x = 4\cos t$, $y = 4\sin t$, $z = 6t$. Find the velocity and acceleration at time $t = 0$ and $t = \frac{\pi}{2}$

12. Prove that $\nabla X(\nabla\phi) = 0$

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SECTION - B

(LONG ANSWER TYPE QUESTIONS)

Note : Attempt any two questions. Each question carries 15 marks.

(15×2=30)

1. Trace the conic
   $f(x, y) = x^2 - 3xy + y^2 + 10x - 10y + 21 = 0$
2. Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ Hence show that the lines are coplanar.
3. (i) Find the equation of cone whose vertex is (1,2,3) and guiding curve the circle $x^2 + y^2 = z^2 = 4, x + y + z = 1$
   (ii) Find the equation to the right circular cylinder of radius 2 and having the axis line : $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{3}$
4. (i) If $\vec{a}$ is a constant vector, show that $\nabla.(\vec{r} \times \vec{a}) = 0$
   (ii) Given $\vec{F} = xy\hat{i} + (x^2+y^2)\hat{j}$, Find the value of $\int_c \vec{F}.d\vec{r}$, where C is the rectangle in the x y-plane bounded by the lines $y = 2, x = 4, y = 10, x = 1$

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