MATHEMATICS Paper–I

(Solid Geometry)

Time Allowed : Three Hours **Maximum Marks : 30**

Note : Attempt **five** questions, selecting at least **two** questions from each section. All questions carry equal marks.

Section – A

1. (a) Shift the origin to a suitable point so that the equation $x^2+y^2+z^2-4x-8y+6z-4=0$ is transformed into an equation in which the first degree terms are absent.

(b) Transform the equation $13x^2+13y^2+10z^2+8xy-4yz-4zx-144=0$ when the axes are rotated to the axes having direction cosines

$$\left\langle -\frac{1}{3},\frac{2}{3},\frac{1}{3}\right\rangle,\left\langle \frac{2}{3},-\frac{1}{3},\frac{2}{3}\right\rangle \text{ and } \left\langle \frac{2}{3},\frac{2}{3},-\frac{1}{3}\right\rangle.$$

2. (a) Find the equation of the sphere passing through (1, 0, 0), (0, 1, 0), (0, 0, 1) and whose centre lies on the plane $3x-y+z=2$.

(b) Find the centre and radius of the circle given by $x^2+y^2+z^2=49$, $2x+3y+6z=14$.

3. (a) Show that the plane $2x-2y+z+12=0$ touches the sphere $x^2+y^2+z^2-2x-4y+2z=3$ and find the point of contact.

(b) Find the equation of the tangent planes to sphere $x^2+y^2+z^2+6x-2z+1=0$ which pass through the lines $x+z-16=0$, $2y-3z+30=0$.

4. (a) Find the equation of right circular cylinder of radius 3 and having for its axis the line :

$$\frac{x-1}{2}=\frac{y-3}{2}=\frac{5-z}{7}.$$

(b) Find the equation of cylinder whose generatixes are parallel to the line $\frac{x-1}{1}=\frac{y+1}{-2}=\frac{z-3}{4}$ and whose guiding curve is the parabola $x^2+2y=0, z=0$.

Section – B

5. (a) Find the equation of the right circular cone whose vertex is at the point (2, 1, –3), semivertical angle 30° and the direction cosines of whose axis are 3 : 4 : –1.

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(b) Find the equation of the quadric cone which passes through the three coordinates axes and the three mutually perpendicular lines

$$\frac{x}{1}=\frac{y}{-2}=\frac{z}{3}, \frac{x}{1}=\frac{y}{-1}=\frac{z}{-1}, \frac{x}{5}=\frac{y}{4}=\frac{z}{1}.$$

6. (a) Find the equation of the cone whose vector is (2, –3, 1) and whose guiding curve is $4x^2 + y^2 = 1, z = 0$.

(b) Find the equation of the cone circumscribing the sphere $x^2 + y^2 + z^2 + 2x - 2y - 2 = 0$ and having its vertex at (1, 1, 1).

7. (a) Prove that the equation $4x^2 - y^2 + 2z^2 + 2xy - 3yz + 12x - 11y + 6z + y = 0$ represents a cone whose vector is (–1, –2, –3).

(b) Find the lines in which the plane $x - 2y - z = 0$ cuts cone $3x^2 + 4y^2 - z^2 = 0$. Find the angle between them.

8. (a) Show that the equation $x^2 + y^2 + z^2 - 6yz - 2zx - 2xy - 6x - 2y - 2z + 2 = 0$ represents a hyperboloid of two sheets.

(b) Reduce the equation

$6y^2 - 18yz - 6zx + 2xy - 9x + 5y - 5z + 2 = 0$ to the standard form.

MATHEMATICS Paper-II

(Calculus – II)

Time Allowed : Three Hours **Maximum Marks : 30**

Note: 1. Attempt **five** questions in all, selecting at least **two** questions from each section.

2. Each question carries **6** marks.

Section – I

1. (a) Show that the line joining the two points of inflexion of the curve :

$y^2(x - a) = x^2(x + a), x \neq \pm a$

subtends an angle $\pi/3$ at the origin.

(b) Trace the curve $y^2 = (x + 1)^3$. 3, 3

2. (a) Find the asymptotes of the curve :

$x^2y + xy^2 + 2x^2 - 2xy - y^2 - 6x - 2y - 2y + 2 = 0$

and show that they cut the curve in at most three points which lie on the straight line $2x - 3y - 4 = 0$.

(b) Determine the position and nature of the double points on the curve:

$x^3 - y^2 - 7x^2 + 4y + 15x - 13 = 0$. 3, 3

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3. (a) Define circle of curvature. Find the equation of the curve

$$\sqrt{x}+\sqrt{y}=\sqrt{a}.$$

(b) Show that the points of intersection of the curve $xy(x^2-y^2)-25x^2-9y^2+144=0$ and its asymptotes lie on ellipse whose eccentricity is 4/5. 3,3

4. (a) If C_o, C_p denote the lengths of chord of curvatures of the cardioid $r=a(1+\cos\theta)$ along and perpendicular to the radius vector through any point respectively. Prove that :

$$3(C_o^2+C_p^2)=8aC_o.$$

(b) Find the interval in which the curve $y=(x^2+4x+5)e^{-x}$ is concave upwards or downwards. 4,2

Section – II

5. (a) If $\int_0^{\pi/4}\tan^n x\,dx$, show that, for $n>1$, $I_n+I_{n-2}=\dfrac{1}{n-1}$. Hence deduce the value of I_3.

(b) Evaluate $\int \cosh^{-1}\left(\dfrac{1+x^2}{1-x^2}\right)dx.$ 6

6. (a) Find the length of the curve $x^{2/3}+y^{2/3}=a^{2/3}$ measured from (0, a) to any point (x, y).

(b) Find the volume of the solid obtained by revolving the area included between the curves $y^2=x^3$ and $x^2=y^3$ about X-axis. 6

7. (a) Find the surface area of the solid obtained by revolving the curve $y=2x+1+\dfrac{1}{x^2}$ about x-axis for $1\le x\le 2$.

(b) Use Simpson's rule with n = 4 to approximate $\int_{-1}^{1}(x^3+1)dx$. Also find the error. 3,3

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8. (a) Evaluate :

$$\lim_{n\to\infty} \frac{1}{n^{16}}(1^{15} + 2^{15} + \ldots\ldots\ldots + n^{15}).$$

(b) Derive the reduction formula for $\int x^n \sin(ax)\, dx$. Hence evaluate

$$\int_0^{\pi/2} x^3 \sin(x)\, dx.$$ 2, 4

MATHEMATICS Paper-III

(Theory of Equations)

Time Allowed : 3 Hours **Maximum Marks : 30**

Note : Attempt **five** questions in all selecting at least **two** questions from each unit. **All** questions carry equal marks.

Unit – I

1. (a) Find a polynomial of least degree having –2, 1, 3 as its zeros and having value –8 at x = 2.

 (b) Find g.c.d. of two polynomials $f(x) = x^3 + 6x^2 + 11x + 6$ and $g(x) = x^2 + 7x + 10$. Express the g.c.d as $a(x)f(x) + b(x)g(x)$.

2. (a) Solve the equation $x^4 + 2x^3 - 2x - 1 = 0$ given that it has multiple roots.

 (b) Prove that the complex roots of a real polynomial equation occur in conjugate pairs.

3. (a) Solve the equation $x^4 + 2x^3 - 21x^2 - 22x + 40 = 0$ given that its roots are in A.P.

 (b) Solve the equation $x^4 - 8x^3 + 14x^2 + 8x - 15 = 0$ given that two of its roots are equal in magnitude but opposite in sign.

4. (a) Transform the equation $2x^3 - 9x^2 + 13x - 6 = 0$ into one in which second term is missing and hence solve the equation.

 (b) If α, β, γ are roots of $2x^3 + x^2 + x + 1 = 0$ form an equation whose roots are

$$\frac{1}{\beta^2} + \frac{1}{\gamma^2} - \frac{1}{\alpha^2},\ \frac{1}{\gamma^2} + \frac{1}{\alpha^2} - \frac{1}{\beta^2},\ \frac{1}{\alpha^2} + \frac{1}{\beta^2} - \frac{1}{\gamma^2}$$

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Unit – II

5. (a) Find the equation whose roots are squared differences of the roots of the equation $x^3 + 6x^2 + 9x + 4 = 0$. Hence show that given equation has a double roots.

   (b) Let $f(x) = a_0 + a_1 x + a_2x^2 + \ldots\ldots\ldots + a_n x^n$ be a real polynomial of degree n and $a_0 \neq 0$. Let r and s be the number of variations in sign of $f(x)$ and $f(-x)$ respectively. Show that $n - r - s$ is even.

6. (a) Show that the real roots of the equation $x^4 - 10x^3 - 13x^2 + 60x + 65 = 0$ lie between –4 and 12.

   (b) Use Newton's method of divisor to find the integral roots of the equation :
   $3x^4 - 23x^3 + 35x^2 + 31x - 30 = 0.$

7. (a) Use Cardon's method to solve : $x^3 + x^2 - 16x + 20 = 0$.

   (b) For the equation $x^3 - 6x^2 - 6x - 14 = 0$, find $G^2 + 4H^3$ and hence discuss the nature of roots.

8. (a) Solve the biquadratic $x^4 - 6x^3 + 3x^2 + 22x - 6 = 0$ by Descarte's Method.

   (b) Solve by Ferrori's Method, the equation $2x^4 + 6x^3 - 3x^2 + 2 = 0$.

COMPUTER SCIENCE

Paper : CS03 : Theory - A, Operating System Concepts

Time Allowed : Three Hours **Maximum Marks : 30**

Note: Attempt **five** questions in all, including Q-**9** in Section - E, which is compulsory, taking **one** each from Section-A to Section - D.

Section – A

1. Describe the objectives and functions of Operating System. Also explain the different services provided by the operating system. Describe the structure of an Operating System. 6

2. Describe the different types of Operating Systems and their salient features with examples. 6

Section – B

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