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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 23765

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

First Semester

Civil Engineering

MA 2111 — MATHEMATICS – I

(Common to all Branches except Marine Engineering)

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State any two properties of eigenvalues of a matrix.

2. Find the sum of the eigenvalues of the inverse of $A = \begin{bmatrix} 3 & 0 & 0 \\ 8 & 4 & 0 \\ 6 & 2 & 5 \end{bmatrix}$.

3. Find the equation of the sphere whose end points of the diameters are (1, 1, 0), (1, 2, 1).

4. Find the direction cosines of the line $\frac{2x+1}{3} = \frac{4y-3}{1} = \frac{2z-3}{0}$.

5. Find the radius of curvature at the point (1, 0) of the curve $\sqrt{x} + \sqrt{y} = 1$.

6. Find the envelope of $y = mx + a/m$ for different values of m.

7. If $u = f\left(\frac{y}{x}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0$.

8. State any two properties of Jacobian.

9. Evaluate : $\int_1^2 \int_1^3 xy^2 dx\, dy$.

10. Change the order of integration in $\int_0^2 \int_0^x f(x, y)\, dy\, dx$.

PART B — (5 × 16 = 80 marks)

11. (a) Reduce the quadratic form $x_1^2 + 2x_2^2 + x_3^2 - 2x_1 2x_2 + 2x_2 x_3$ to the canonical form through an orthogonal transformation. (16)

Or

(b) (i) Find the eigenvalues and eigenvectors of $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. (8)

(ii) Verify Cayley- Hamilton theorem for $A = \begin{bmatrix} 2 & -2 & 1 \\ -2 & 1 & 3 \\ 1 & 3 & 2 \end{bmatrix}$. (8)

12. (a) (i) Find the equation of the sphere for which the circle $x^2 + y^2 + z^2 + 2x - 4y + 2z + 5 = 0, x - 2y + 3z + 1 = 0$ is a great circle. (12)

(ii) Find the equation of tangent plane at the point (2, 1, –1) on the sphere $x^2 + y^2 + z^2 + 4x + 8y - 6z + 2 = 0$. (4)

Or

(b) (i) Find the equation of the cone whose vertex is (1,2,3) and guiding curve is the circle $x^2 + y^2 + z^2 = 4, x + y + z = 1$. (8)

(ii) Find the equation of the right circular cylinder which passes through the circle $x^2 + y^2 + z^2 = 9, x + y + z = 3$. (8)

13. (a) (i) Find the evolute of the parabola $y^2 = 4ax$. (8)

(ii) Find radius of curvature at the point $(3a/2, 3a/2)$ of $x^3 + y^3 = 3axy$. (8)

Or

(b) (i) Find the envelope of the family of ellipses $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ for which $a + b = c$. (8)

(ii) Show the evolute of cycolid $x = a(\theta - \sin\theta), y = a(1 - \cos\theta)$ is another Cycolid. (8)

14. (a) (i) Find the minimum value of $x^2 + y^2 + z^2$ subject to the condition $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$. (8)

(ii) If $u = f(x - y, y - z, z - x)$, show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$. (8)

Or

(b) A rectangular box open at the top is to have volume 32cc. Find the dimension of box requiring least material for its construction. (16)

15. (a) Evaluate: $\int_0^1 \int_{x^2}^{2-x} xy \, dy \, dx$ using change the order of integration. (16)

Or

(b) Find the volume of the sphere of radius 'a' by triple integrals. (16)

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