

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 — $(10 \times 2 = 20 \text{ marks})$

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 — $(5 \times 16 = 80 \text{ marks})$

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 $x^3 + y^3 = 3a xy$. (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.

- 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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