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

Question Paper Code: 31002

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

First Semester

Civil Engineering

01UMA102 - ENGINEERING MATHEMATICS – I

(Common to ALL branches)

(Regulation 2013)

Duration: Three hours — Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. Two of the Eigen values of $A=\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ are 3 and 6. Find the Eigen value of A^{-1}.

2. State Cayley – Hamilton theorem and its uses.

3. Find the equation of the sphere with centre (2, 3, 5) and touches the XoY – plane.

4. Define the right circular cylinder.

5. Find the curvature of the curve $2x^2+2y^2+5x-2y+1=0$.

6. Find the envelope of the family of curve $y = mx + \frac{a}{m}$.

7. If $u = \frac{x}{y} + \frac{y}{z} + \frac{z}{x}$, then find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$.

8. If $x = r\cos\theta$ and $y = r\sin\theta$, then find $\frac{\partial(r,\theta)}{\partial(x,y)}$.

9. Evaluate $\int_0^1\int_0^{x^2} (x^2 + y^2)\,dy\,dx$

10. Evaluate $\int_0^1 \int_0^2 \int_0^e dz\, dy\, dx$.

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PART - B (5 x 16 = 80 Marks)

11. (a) Find the Eigen values and Eigenvectors of the matrix A= $\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$. (16)

Or

(b) Reduce the quadratic form $2x^2 + y^2 + z^2 + 2xy - 2xz - 4yz$ to canonical form by orthogonal reduction. Also find the nature of the quadratic form. (16)

12. (a) Find the centre and radius of the circle in which the sphere $x^2+y^2+z^2+2x-2y-4z-19=0$ is cut by the plane $x+2y+2z+17 = 0$. Also find the equation of the sphere having the above circle as great circle. (16)

Or

(b) (i) Find the equation of the right circular cylinder of radius 2 whose axis is the line $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{2}$. (8)

(ii) Find the equation of the right circular cylinder whose axis is the line x = 2y = -z and radius 4. (8)

13. (a) (i) Find the radius of curvature at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on the curve $x^3 + y^3 = 3axy$. (8)

(ii) Find the evolute of the parabola $x^2=4ay$. (8)

Or

(b) (i) Find the evolute of $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, considering it as the envelope of normals. (8)

(ii) Find the envelope of the straight line $\frac{x}{a} + \frac{y}{b} = 1$, where a and b are connected by $a^2 + b^2 = c^2$, c being a constant. (8)

14.(a) (i) If $u = 2xy$, $\vartheta = x^2 - y^2$ where if $x = r\cos\theta$, $y = r\sin\theta$ find $\frac{\partial(u,\vartheta)}{\partial(r,\theta)}$ (8)

(ii) Expand $e^x \cos y$ in powers of x and y as far as the terms of third degree using Taylor's expansion. (8)

Or

(b) (i) Examine $f(x, y) = x^3 + y^3 - 12x - 3y + 20$ for its extreme values. (8)

(ii) Find the dimensions of the rectangular box without a top of maximum capacity, whose surface is 108 *sq.cm.*. (8)

15. (a) (i) Evaluate $\iint y\, dx\, dy$ over the region bounded by $x^2 = y$ and $x + y = 2$ in the positive quadrant. (8)

(ii) Evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2}\, dx\, dy$ by changing the order of integration. (8)

Or

(b) (i) Find, using a double integral, the area of the cardioids. $r = a(1 + \cos\theta)$. (8)

(ii) Find the volume of that portion of the ellipsoid $\frac{x^2}{a^2} + \frac{x^2}{b^2} + \frac{z^2}{c^2} = 1$, which lies in the first octant using triple integration. (8)
