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**BTECH**  
**(SEM I) THEORY EXAMINATION 2023-24**  
**ENGINEERING MATHEMATICS-I**

TIME: 3HRS

M.MARKS: 100

**Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

1. Attempt all questions in brief.

2 x 10 = 20

Qno.	Question	Marks	CO
a.	Find the Rank of the matrix $\begin{bmatrix} 10 & 101 \\ 20 & 202 \end{bmatrix}$ .	2	1
b.	Define singular and non singular matrix.	2	1
c.	Define Rolle's theorem.	2	2
d.	If $y = x^2 e^x$ , find $y_n$ .	2	2
e.	Find the stationary point of $f(x,y) = x^3 + y^3 + 3axy$ .	2	3
f.	If $u = \sin^{-1}(x^2 + y^2)^{\frac{1}{5}}$ , then find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ .	2	3
g.	Evaluate $\int_0^1 \int_0^{x^2} x^2 y^2 dx dy$ .	2	4
h.	Write the formula of area and volume by integration.	2	4
i.	Find the unit normal vector at the surface $z = x^2 + y^2$ at $(1, 2)$ .	2	5
j.	State Stokes theorem.	2	5

**SECTION B**

2. Attempt any three of the following:

10x 3 = 30

a.	Find the Eigen values and Eigen vectors of the following matrix: $\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$ .	10	1
b.	If $y = e^{m \cos^{-1} x}$ show that $(1-x^2) y_{n+2} - (2n+1) x y_{n+1} - (n^2+m^2) y_n = 0$ , also calculate $y_n(0)$ .	10	2
c.	If $u, v, w$ are the roots of the equation $(\lambda - x)^3 + (\lambda - y)^3 + (\lambda - z)^3 = 0$ , find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ .	10	3
d.	Change the order of integration $\int_1^2 \int_{x^2}^{2-x} f(x,y) dx dy$ .	10	4
e.	Verify the Greens theorem to evaluate the line integral $\int (2y^2 dx + 3x dy)$ , where C is the boundary of the closed region by $y = x$ and $y = x^2$ .	10	5

**SECTION C**

3. Attempt any one part of the following:

10x 1 = 10

a.	Find inverse by elementary transformation $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$	10	1
b.	Investigate for what values of $\lambda$ and $\mu$ do the system of the equation $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ has i) no solution ii) unique solution iii) infinite no. of solution.	10	1



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**4. Attempt any one part of the following:****10x 1 = 10**

a.	If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$ prove that $(x^2 - 1)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$	10	2
b.	Verify Lagrange's Mean value theorem for the function $f(x) = x^3$ in $[-2, 2]$	10	2

**5. Attempt any one part of the following:****10x 1 = 10**

a.	Expand $x^2 + 3y^2 - 9x - 9y + 26$ in powers of $(x - 1)$ and $(y - 2)$ by Taylor's theorem up to second degree term.	10	3
b.	In estimating the number of bricks in a pile which is measured to be $(5 \text{ m} \times 10 \text{ m} \times 5 \text{ m})$ , the count of bricks is taken as 100 bricks per $\text{m}^3$ . Find the error in the cost when the tape is stretched 2 % beyond its standard length. The cost of bricks is 2000 Rs. per thousand bricks.	10	3

**6. Attempt any one part of the following:****10x 1 = 10**

a.	Evaluate $\int_0^{2a} \int_0^{\sqrt{2ax-x^2}} (x^2 + y^2) dx dy$ by changing into polar Co-ordinates.	10	4
b.	Calculate the volume of solid bounded by the surface $x=0, y=0, x+y+z=0$ and $z=0$ .	10	4

**7. Attempt any one part of the following:****10x 1 = 10**

a.	Prove that $(y^2 - z^2 + 3yz - 2x)i + (3xz + 2xy)j + (3xy - 2xz + 2z)k$ is both solenoidal and irrotational.	10	5
b.	Using Green's Theorem evaluate $\int_C (x^2 + xy)dx + (x^2 + y^2)dy$ , where C is the square formed by the lines $x = \pm 1, y = \pm 1$ .	10	5