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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 λ and μ 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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M.MARKS: 100

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 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 |