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BTECH
(SEM I) THEORY EXAMINATION 2023-24
ENGINEERING MATHS-I

TIME: 3HRS   **M.MARKS: 70**

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

SECTION A

1. **Attempt** *all* **questions in brief.**   **2 x 7 = 14**

a.	Define Leibnitz theorem.
b.	If $u = \tan^{-1}(x^2 + y^2)$, then find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$.
c.	If $x = uv, y = \frac{u+v}{u-v}$, Find $\frac{\partial(u,v)}{\partial(x,y)}$
d.	Find the Eigen values of matrix $\begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$.
e.	Find the value of $\Gamma - 1/2$.
f.	State Green's theorem.
g.	Find the Value of k for which a vector $\vec{F} = (kx + 4y^2z)i + (x^3 \sin z - 3y)j - (e^x + 4\cos x^2 y)k$ is a Solenoidal Vector.

SECTION B

2. **Attempt any** *three* **of the following:**   **7 x 3 = 21**

a.	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 $y_n(0)$.
b.	If u, v, w are the roots of the equation $(\lambda - x)^3 + (\lambda - y)^3 + (\lambda - z)^3 = 0$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.
c.	Find the Eigen values and Eigen vectors of the following matrix $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$.
d.	Evaluate $\iiint x^{l-1} y^{m-1} z^{n-1}\, dx\, dy\, dz$, where x, y, z are all positive but limited by the condition $\left(\frac{x}{a}\right)^p + \left(\frac{y}{b}\right)^q + \left(\frac{z}{c}\right)^r \leq 1$
e.	Verify the Greens theorem to evaluate the line integral $\int (2^{y^2} dx + 3x\, dy)$, where C is the boundary of the closed region by $y = x$ and $y = x^2$.

SECTION C

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

a.	If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$ prove that $(x^2 - 1)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$
b.	Verify Euler theorem for $u = \log\left(\frac{x^4+y^4}{x+y}\right)$.

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

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.
b.	In estimating the number of bricks in a pile which is measured to be (5 m × 10 m × 5 m), the count of bricks is taken as 100 bricks per m³. 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.

PAPER ID-311462

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

a.	Using Cayley - Hamilton Theorem find A^{-1} $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$
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.

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

a.	Change the order of integration $\int_1^2 \int_{x2}^{2-x} f(x,y)\, dx dy$
b.	Prove that $\beta(m,n) = \beta(n,m)$.

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

a.	Suppose that $\overline{U}, \overline{V}$ and f are continuously differentiable fields then Prove that $\text{div}(\overline{U} \times \overline{V}) = \overline{V}.\,\text{Curl}\,\overline{U} - \overline{U}.\,\text{Curl}\,\overline{V}$.
b.	A vector field is given by F=$(x^2 - y^2 + x)\hat{\imath} - (2xy + y)\hat{\jmath}$. Is this field irrotational? If so find scalar potential.