Subject Code: BAS103

PAPER ID-311667

Roll No:

BTECH
(SEM I) THEORY EXAMINATION 2024-25
ENGINEERING MATHEMATICS-I

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

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 07 = 14**

Q no.	Question	CO	Level
a.	Find the eigen values of the matrix $\begin{bmatrix} cos\theta & -sin\theta \\ -sin\theta & -cos\theta \end{bmatrix}$.	1	K2
b.	If $u = \frac{x^2+y^2}{x+y}$, find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$.	2	K3
c.	What is the difference between total derivatives and partial derivatives?	2	K1
d.	What are the applications of Jacobians	3	K4
e.	Write the statement of Liouville's Theorem.	4	K2
f.	Evaluate $\int_1^2 \int_1^3 x^2y^2dxdy$.	4	K3
g.	Prove that $curl\,\vec{r} = 0$.	5	K2

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 07**

Q no.	Question	CO	Level
a.	Find two non-singular matrices P and Q such that PAQ is in normal form, Where $A = \begin{bmatrix} 1 & 3 & 6 & -1 \\ 1 & 4 & 5 & 1 \\ 1 & 5 & 4 & 3 \end{bmatrix}$	1	K2
b.	Find the n^{th} derivative of $tan^{-1}\left(\frac{x}{a}\right)$	2	K3
c.	Find the volume of the largest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	3	K4
d.	Apply Dirichlet's theorem to evaluate $\iiint xyzdxdxdz$ taken throughout the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} \leq 1$	4	K3
e.	Show that the vector $f(r)\vec{r}$ is irrotational. Where $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$	5	K5

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Find the eigen values and eigen vectors of the following matrices: $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.	1	K4
b.	Discuss for all values of K for the system of equations	1	K2

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	$x+y+4z=6, x+2y-2z=6, Kx+y+z=6$ as regards existence and nature of solution.		

4. Attempt any *one* part of the following:

Q no.	Question	CO	Level
a.	Trace the curve $y^2(a+x)=x^2(3a-x)$.	2	K1
b.	If $u=f(r), where\ r^2=x^2+y^2$, prove that $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=f''(r)+\frac{1}{r}f'(r)$.	2	K1

5. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	If $u=xyz, v=x^2+y^2+z^2 and$ $w=x+y+z. Find\ the\ jacobian\ \frac{\partial(x,y,z)}{(u,v,w)}$	3	K3
b.	Find the maxima and minima of the function $sinx+siny+\sin(x+y)$.	3	K3

6. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Find the area inside the circle $r=2acos\theta$ and outside the circle $r=a$	4	K4
b.	Change the order of integration and then evaluate $\int_0^{2a}\int_{\frac{x^4}{4a}}^{3a-x}(x^2+y^2)\,dydx$	4	K2

7. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Show that div (gradr^n) $=n(n+1)r^{n-2}$. Where $\vec{r}=x\hat{\imath}+y\hat{\jmath}+z\hat{k}$	5	K4
b.	Verify Stokes theorem for $\vec{F}=(x^2+y^2)\hat{\imath}-2xy\hat{\jmath}$ taken round the rectangle bounded by the lines $x=0, x=a, y=0, y=b$.	5	K5