



Roll No:

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BTECH
(SEM I) THEORY EXAMINATION 2024-25
ENGINEERING MATHS-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 nth differential of $y = (\sin x)^2$	1	K3
b.	Find the Jacobian $J\left(\frac{x,y}{r,\theta}\right)$ for $x = r \cos \theta$ and $y = r \sin \theta$.	2	K3
c.	What error in the common logarithm of a number will be produced by an error of 1% I the number?	2	K1
d.	Define Hermitian matrix with example.	3	K2
e.	Examine the following vectors for linearly independent $X_1 = [1, 2, -2]$, $X_2 = [-1, 3, 0]$, $X_3 = [0, -2, 1]$	3	K3
f.	Evaluate $\int_0^2 \int_1^3 \int_1^2 xy^2z dz dy dx$.	4	K3
g.	Find the unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at the point (1,2,-1).	5	K3

SECTION B

2. Attempt any three of the following:

07 x 3 = 07

Q no.	Question	CO	Level
a.	Trace the curve $y^2(a+x) = x^2(3a-x)$.	1	K6
b.	Show that the rectangular solid of maximum volume that can be inscribed in a sphere is a cube.	2	K3
c.	Find the Eigen values and corresponding Eigen vectors of the matrix $A = \begin{bmatrix} -5 & 2 \\ 2 & -2 \end{bmatrix}$	3	K3
d.	State and prove Duplication formula.	4	K3
e.	Verify Green's theorem in the plane for $\int_C [(xy + y^2)dx + x^2dy]$ where C is the closed curve of the region bounded by $y = x$ and $y = x^2$.	5	K3

SECTION C

3. Attempt any one part of the following:

07 x 1 = 07

Q no.	Question	CO	Level
a.	If $x = \sin \sqrt{y}$ Find $y_n(0)$	1	K3
b.	If $u = \sin^{-1} \frac{x+y}{\sqrt{x}-\sqrt{y}}$, then prove that (i) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{1}{2} \tan u$ (ii) $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = -\frac{\sin u \cos 2u}{4 \cos^3 u}$	1	K3



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

07 x 1 = 07

Q no.	Question	CO	Level
a.	Show that: $\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{1-4(xy+yz+zx)+16xyz}{(2-3(u^2+v^2+w^2)+27u^2v^2w^2)}$, If $u^3 + v + w = x + y^2 + z^2$, $u + v^3 + w = x^2 + y + z^2$, $u + v + w^3 = x^2 + y^2 + z$.	2	K3
b.	Expand x^y in powers of $(x-1)$ and $(y-1)$ up to the third degree terms and hence evaluate $(1.1)^{1.02}$.	2	K3

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

07 x 1 = 07

Q no.	Question	CO	Level
a.	Find the characteristic equation of the symmetric matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ and hence compute A^{-1} using Cayley-Hamilton Theorem. Also find the matrix represented by $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$.	3	K3
b.	Test the consistency and hence, solve the following set of linear equations : $10y + 3z = 0$; $3x + 3y + z = 1$; $2x - 3y - z = 5$; and $x + 2y = 4$	3	K3

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

07 x 1 = 07

Q no.	Question	CO	Level
a.	Evaluate by change of variable, $\iint_R (x+y)^2 dx dy$ where R is the region bounded by the parallelogram $x+y=0$, $x+y=2$, $3x-2y=0$ and $3x-2y=3$	4	K3
b.	Evaluate the integral $\iiint x^{l-1} y^{m-1} z^{n-1} dx dy dz$ where x, y, z are all positive but limited by the condition $\left(\frac{x}{a}\right)^p + \left(\frac{y}{b}\right)^q + \left(\frac{z}{c}\right)^r \leq 1$	4	K3

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

07 x 1 = 07

Q no.	Question	CO	Level
a.	If a vector field is given by $F \rightarrow (x^2 - y^2 + x)\mathbf{i} - (2xy + y)\mathbf{j}$ is this field irrotational? If so, find its scalar potential.	5	
b.	Find $\text{div } \bar{F}$ and $\text{curl } \bar{F}$, where $\bar{F} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$	5	