



**BTECH**  
**(SEM I) THEORY EXAMINATION 2021-22**  
**ENGINEERING MATHEMATICS-I**

**Time: 3 Hours****Total Marks: 100****Notes:**

- Attempt all Sections and Assume any missing data.
- Appropriate marks are allotted to each question, answer accordingly.

SECTION-A	Attempt All of the following Questions in brief	Marks(10X2=20)	CO
Q1(a)	If the matrix $A = \begin{bmatrix} -1 & 2 & 3 \\ 0 & 3 & 5 \\ 0 & 0 & -2 \end{bmatrix}$ , then find the eigen value of $A^3 + 5A + 8I$ .		1
Q1(b)	Reduce the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ into normal form and find its rank.		1
Q1(c)	Find the envelope of the family of straight line $y = mx + \frac{a}{m}$ , where m is a parameter.		2
Q1(d)	Can mean value theorem be applied to $f(x) = \tan x$ in $[0, \pi]$ .		2
Q1(e)	State Euler's Theorem on homogeneous function.		3
Q1(f)	Find the critical points of the function $f(x, y) = x^3 + y^3 - 3axy$ .		3
Q1(g)	Find the area bounded by curve $y^2 = x$ and $x^2 = y$ .		4
Q1(h)	Find the value of $\int_0^1 \int_0^x \int_0^{x+y} dx dy dz$ .		4
Q1(i)	Find a unit normal vector to the surface $z^2 = x^2 + y^2$ at the point $(1, 0, -1)$ .		5
Q1(j)	State Stoke's Theorem.		5

SECTION-B	Attempt ANY THREE of the following Questions	Marks(3X10=30)	CO
Q2(a)	Find the characteristic equation of the matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ , compute $A^{-1}$ and prove that $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I = \begin{bmatrix} 8 & 5 & 5 \\ 0 & 3 & 0 \\ 5 & 5 & 8 \end{bmatrix}$ .		1
Q2(b)	State Rolle's theorem and verify Rolle's theorem for the function $f(x) = \frac{\sin x}{e^x}$ in $[0, \pi]$ .		2
Q2(c)	If u, v and w are the roots of $(\lambda - x)^3 + (\lambda - y)^3 + (\lambda - z)^3 = 0$ , cubic in $\lambda$ , find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ .		3
Q2(d)	Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the plane $y + z = 4$ and $z = 0$ .		4
Q2(e)	Apply Green's theorem to evaluate $\int_C [(2x^2 - y^2)dx + (x^2 + y^2)dy]$ , where C is the boundary of the area enclosed by the x-axis and the upper half of the circle $x^2 + y^2 = a^2$ .		5

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q3(a)	Find the value of k for which the system of equations $(3k - 8)x + 3y + 3z = 0$ , $3x + (3k - 8)y + 3z = 0$ , $3x + 3y + (3k - 8)z = 0$ has a non-trivial solution.		1
Q3(b)	Find the eigen values and eigen vectors of matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{bmatrix}$ .		1

Roll No: 

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**BTECH**  
**(SEM I) THEORY EXAMINATION 2021-22**  
**ENGINEERING MATHEMATICS-I**

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q4(a)	If $f(x) = \frac{x}{1+e^{\frac{1}{x}}}$ ; $x \neq 0$ and $f(0) = 0$ , then show that the function is continuous but not differentiable at $x = 0$ .	2	2
Q4(b)	If $y = (x + \sqrt{1+x^2})^m$ , find $y_n(0)$ .	2	2

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q5(a)	Expand $x^y$ in powers of $(x - 1)$ and $(y - 1)$ up to the third-degree terms and hence evaluate $(1.1)^{1.02}$ .	3	3
Q5(b)	A rectangular box which is open at the top having capacity 32c.c. Find the dimension of the box such that the least material is required for its constructions.	3	3

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q6(a)	Change the order of integration in $I = \int_0^1 \int_{x^2}^{2-x} xydydx$ and hence evaluate the same.	4	4
Q6(b)	Find the position of the C.G. of a semicircular lamina of radius, $a$ if its density varies as the square of the distance from the diameter.	4	4

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)	CO
Q7(a)	Find the directional derivative of $\nabla(\nabla f)$ at the point $(1, -2, 1)$ in the direction of the normal to the surface $xy^2z = 3x + z^2$ where $f = 2x^3y^2z^4$ .	5	5
Q7(b)	Find the constants $a, b, c$ so that $\vec{F} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is irrotational and hence find function $\phi$ such that $\vec{F} = \nabla\phi$ .	5	5