

SHAMBHUNATH INSTITUTE OF ENGINEERING AND TECHNOLOGY

Subject Code: BAS 103

Subject: ENGINEERING MATHEMATICS-I

Course: B. Tech.

Semester: 1st

Branch: Common To ALL

SECOND SESSIONAL EXAMINATION, ODD SEMESTER, (2022-2023)

Time – 2 hrs.

Maximum Marks – 45

SECTION – A

1. Attempt ALL questions in brief.

Q N	QUESTION	Marks	CO	BL
a.	Find the values of k such that the system of equations $4x + 9y + z = 0, kx + 3y + kz = 0, x + 4y + 2z = 0$ has a trivial solution.	2	CO1	L3
b.	Find the eigen values of $A^3 + 2A^2 - 3I$ if $A = \begin{bmatrix} -1 & 0 \\ 0 & 4 \end{bmatrix}$	2	CO1	L2
c.	Find the value of $\int_0^{\frac{\pi}{2}} \sqrt{\sin x} dx$	2	CO4	L1
d.	Evaluate $\int_0^a \int_0^{\sqrt{a^2-y^2}} dx dy$	2	CO4	L2
e.	Find a unit normal vector to the surface $z^2 = x^2 + y^2$ at the point $(1, 0, -1)$	2	CO5	L1
f.	Find the value of ' a ' for which the vector field $\vec{V} = a(x + y)\hat{i} + 4y\hat{j} + 3\hat{k}$ is solenoidal.	2	CO5	L1

SECTION - B

2. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	BL
a.	Find the inverse of the following matrices by using elementary row operations $\begin{bmatrix} 2 & 3 & 4 \\ 4 & 3 & 1 \\ 1 & 2 & 4 \end{bmatrix}$	5	CO1	L3
b.	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & -1 & 4 \\ 2 & 3 & 3 & 4 \\ 1 & 2 & 3 & 4 \\ -1 & -2 & 6 & -7 \end{bmatrix}$	5	CO1	L2

3. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	BL
a.	Evaluate $\iint xy dx dy$ over the area bounded by $y^2 = 4x$ and $y = 2x - 4$	5	CO4	L3
b.	Using Beta and Gamma function, evaluate $\int_0^1 \left(\frac{x^3}{1-x^3} \right)^{\frac{1}{2}} dx$	5	CO4	L2

4. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	BL
a.	Find the directional derivative of the scalar function $f = xyz$ in the direction of the outer normal to the surface $z = xy$ at the point $(3, 1, 3)$.	5	CO5	L3
b.	Use Green's Theorem in a plane to evaluate the integral $\int_c [(2x^2 - y^2)dx + (x^2 + y^2)dy]$, where c is the boundary in the xy plane of the area enclosed by the x - axis and the semi-circle $x^2 + y^2 = 1$ in the upper half xy plane.	5	CO5	L4

SECTION - C

5. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	BL
a.	Find the eigen values and eigen vectors of the following matrix $\begin{pmatrix} 1 & 2 & 2 \\ 0 & 2 & 1 \\ -1 & 2 & 2 \end{pmatrix}$	6	CO1	L3
b.	If $N = \begin{bmatrix} 0 & 1 + 2i \\ -1 + 2i & 0 \end{bmatrix}$, obtain the matrix $(I - N)(I + N)^{-1}$, and show that it is unitary.	6	CO1	L2

6. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	B
a.	By changing the order of integration, evaluate $\int_0^3 \int_{y^2}^{\sqrt{10-y^2}} dx dy$	6	CO4	I
b.	Evaluate $\iiint \frac{dx dy dz}{(x+y+z+1)^2}$, the integral being taken throughout the volume bounded by the planes $x = 0, y = 0, z = 0$ and $x + y + z = 1$.	6	CO4	I

7. Attempt any ONE part of the following:

Q N	QUESTION	Marks	CO	B
a.	If \vec{a} is a constant vector, show that $\vec{a} \times (\vec{\nabla} \times \vec{b}) = \vec{\nabla}(\vec{a} \cdot \vec{b}) - (\vec{a} \cdot \vec{\nabla})\vec{b}$	6	CO5	I
b.	Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$, where $\vec{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ and S is the surface of the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$	6	CO5	L