Roll No.	[redacted]

SHAMBHUNATH INSTITUTE OF ENGINEERING AND TECHNOLOGY, PRAYAGRAJ

Subject Code: BAS 103 — **Subject: Engineering Mathematics- I**

Course: B.Tech. — **SEMESTER: I**

SECOND SESSIONAL EXAMINATION, ODD SEMESTER, (2024-2025)

Common To All

Time –2hrs — **Maximum Marks – 45**

1. Attempt any *FIVE* questions.

Q N	QUESTION	Marks	CO	BL
a.	Expand 5^x up to the first three non-zero terms of the series.	2	CO3	L2
b.	Find the stationary points of $xy(a-x-y)$.	2	CO3	L1
c.	Verify $JJ'=1$ for the function: $x=u(1-v),\ y=uv$.	2	CO3	L2
d.	Determine whether the following functions are functionally dependent or not. If so, find the relation between them. $u=e^x\sin y,\ v=e^x\cos y$	2	CO3	L1
e.	The diameter and height of a right circular cylinder are measured to be 5 and 8 inches respectively. If each of these dimensions were in error by 0.1 inch, find the % error in the volume of cylinder.	2	CO3	L2
f.	Find the possible % error in computing the parallel resistance R of two resistances R_1 and R_2 if R_1, R_2 are each in error by 2%.	2	CO3	L1

2. Attempt any *ONE* of the following

Q N	QUESTION	Marks	CO	BL
a.	Find Taylor's expansion of $f(x,y)=\cot^{-1}xy$ in power $(x+0.5)$ and $(y-2)$ up to second degree terms. Hence compute $f(-0.4,\ 2.2)$ approximately.	5	CO3	L3
b.	A rectangular box open at the top is to have a volume of 32 cubic units. Find the dimensions of the box requiring least material for its construction.	5	CO3	L4
c.	If u, v and w are the roots of the equations $(\lambda-x)^3+(\lambda-y)^3+(\lambda-z)^3=0$ in λ, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.	5	CO3	L3

3. Attempt any *FIVE* questions.

Q N	QUESTION	Marks	CO	BL
a.	Evaluate $\iint \frac{xy}{\sqrt{1-y^2}}dx\,dy$ over the first quadrant of the circle $x^2+y^2=1$.	2	CO4	L2
b.	Evaluate $\int_0^2\int_1^z\int_0^{yz} xyz\,dx\,dy\,dz$.	2	CO4	L2
c.	Change the order of integration $\int_0^1\int_{x^2}^{2-x} f(x,y)\,dx\,dy$.	2	CO4	L1
d.	Given $\Gamma\left(\frac{8}{5}\right)=0.8935$, find the value of $\Gamma\left(-\frac{12}{5}\right)$.	2	CO4	L1
e.	Prove that $B(m,n)=B(n,\ m)$.	2	CO4	L2
f.	Evaluate $\int_0^1 x^3(1-\sqrt{x})^5dx$.	2	CO4	L2

4. Attempt any *ONE* of the following

Q N	QUESTION	Marks	CO	BL

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a.	Change the order of integration and evaluate $\int_0^{\infty}\int_0^{x} xe^{-\frac{x^2}{y}}\,dydx$.	5	CO4	L3
b.	Prove that $\int_0^{\pi/2}\tan^n x\,dx.=\frac{\pi}{2}\sec\left(\frac{n\pi}{2}\right)$.	5	CO4	L4
c.	The plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ meets the axes in A, B and C. Apply Dirichlet's integral to find the volume of the tetrahedron OABC. Also find its mass if the density at any point is kxyz.	5	CO4	L4

5. Attempt any *FIVE* questions.

Q N	QUESTION	Marks	CO	BL
a.	Find unit vector normal to the surface $x^2y+2xz^2=8$ at the point (1,0,2)	2	CO5	L2
b.	Find curl curl $\vec{F}=(x^2y)\hat{i}-(2xz)\hat{j}+(2yz)\hat{k}$ at the point (1,0,2).	2	CO5	L2
c.	If $\vec{F}=(x^2-yz)\hat{i}+(y^2-zx)\hat{j}+(z^2-xy)\hat{k}$ is conservative, find its scalar potential ϕ.	2	CO5	L1
d.	Evaluate $\int_c (x^2\hat{i}+xy\hat{j})d\vec{r}$ along the parabola $y^2=x$ between the point (0,0) and (1,1).	2	CO5	L2
e.	Write the statement of Green's theorem.	2	CO5	L1
f.	Write the statement of Gauss' divergence s theorem.	2	CO5	L1

6. Attempt any *ONE* of the following

Q N	QUESTION	Marks	CO	BL
a.	Find the directional derivative of $\phi=x^2-y^2+2z^2$ at the point P (1, 2, 3) in the direction of the line PQ where Q is the point (5, 0, 4). In what direction it will be maximum? Find the maximum value of it.	5	CO5	L3
b.	Show that $\vec{F}=(y^2-z^2+3yz-2x)\hat{i}+(3xz+2xy)\hat{j}+(3xy-2xz+2z)\hat{k}$ is both solenoidal and irrotational.	5	CO5	L3
c.	Verify Stoke's theorem for the vector field $\vec{F}=(x^2-y^2)\hat{i}+(2xy)\hat{j}$ in the rectangular region in the xy-plane bounded by the lines x = -a, x = a, y = 0, y = b.	5	CO5	L4

Bloom's Taxonomy Level (BL):-
Remember (L1), Understanding (L2), Apply (L3), Analyze (L4), Evaluating (L5), Creating (L6)