25PHU103

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2026
(First Semester)

Branch – **PHYSICS**

MATHEMATICS – I FOR PHYSICS

Time: Three Hours | Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The curvature κ is defined as: (a) $1/\rho$ (b) ρ^2 (c) ρ (d) $\sqrt{\rho}$	K1	CO1
	2	For $y = f(x)$, if $\frac{d^2y}{dx^2} = 0$, then radius of curvature is: (a) 0 (b) ∞ (c) 1 (d) Undefined	K2	CO1
2	3	Bernoulli's formula is mainly used for: (a) $\int cos^n x\, dx$ (b) $\int e^x x^n\, dx$ (c) $\int sin^n x\, dx$ (d) $\int tan^n x\, dx$	K1	CO1
	4	The reduction formula for $\int cos^n x\, dx$ involves: (a) $cos^{n-2}x$ (b) $sec^{n-2}x$ (c) $sin^{n-2}x$ (d) $tan^{n-2}x$	K2	CO2
3	5	The Jacobian for transformation to polar coordinates $(x, y) \rightarrow (r, \theta)$ is: (a) r (b) $1/r$ (c) θ (d) 1	K1	CO1
	6	Value of $B(1,1)$ is: (a) 0 (b) 1 (c) 2 (d) ∞	K2	CO2
4	7	The gradient of a scalar field ϕ is: (a) Scalar (b) Vector (c) Constant (d) Matrix	K1	CO1
	8	Divergence of curl of a vector field is always: (a) 0 (b) 1 (c) ∞ (d) Equal to gradient	K2	CO2
5	9	Gauss divergence theorem converts: (a) Line integral to surface integral (b) Surface integral to volume integral (c) Volume integral to surface integral (d) Line integral to volume integral	K1	CO1
	10	Surface integral of $\vec{F} \cdot \hat{n}\, dS$ represents: (a) Circulation (b) Flux (c) Gradient (d) Curl	K2	CO2

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Find the radius of curvature at the point $x = y = \frac{3a}{2}$ to the curve $x^3 + y^3 = 3axy$.	K2	CO2
		(OR)		
	11.b.	Find the envelope of the family of lines $x cos\alpha + y sin\alpha = p$.		
2	12.a.	Obtain the reduction formula for $\int sin^n x\, dx$	K2	CO2
		(OR)		
	12.b.	Using Bernoulli's formula, evaluate $\int x^2 e^x dx$.		
3	13.a.	Find the area between the parabolas $y^2 = 9x$ and $x^2 = 9y$.	K3	CO3
		(OR)		
	13.b.	Express $\int_0^1 x^m (1 - x^n)^p\, dx$ in terms of Gamma functions.		
4	14.a.	If $\phi(x, y, z) = x^2 + y^2 + z^2$, find $\nabla\phi$ and the directional derivative at $(1,1,1)$ in the direction of $\vec{i} + \vec{j} + \vec{k}$.	K3	CO3
		(OR)		
	14.b.	Prove that $\nabla \cdot (\nabla \times \vec{F}) = 0$.		
5	15.a.	If $\vec{F} = x^2\vec{i} + xy\,\vec{j}$, evaluate $\int \vec{F}.d\vec{r}$ from $(0,0)$ to $(1, 1)$ along the line $y = x$.	K4	CO4
		(OR)		
	15.b.	If $\vec{F} = 2xy\vec{i} - x\,\vec{j} + y^2\vec{k}$, then evaluate $\iiint_V \vec{F} dV$, where V is the rejoin bounded by the surface $x = 0, y = 0, y = 6, z = x^2, z = 4$.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Find the centre of curvature of the curve xy at the point (2, 1).	K2	CO2
2	17	Derive an expression for $\int sin^m x cos^n x dx$ when both m and n are odd integers.	K2	CO2
3	18	Prove that $\beta(m, n) = \frac{\Gamma m\ \Gamma n}{\Gamma(m+n)}$.	K3	CO3
4	19	Find the angle of intersection at the point $(2, -1, 2)$ of the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$.	K3	CO3
5	20	Verify Gauss divergence theorem for $\vec{F} = 4xz\vec{i} - y^2\,\vec{j} + yz\vec{k}$ over the cube bounded by $x = 0, x = 1. Y = 0, y = 1, z = 0, z = 1$.	K4	CO4

Z-Z-Z END