22PHU103N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(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)

Question No.	Question	K Level	CO
1	The locus of the centers of curvature is called: a) Tangent b) Normal c) Evolute d) Chord	K1	CO1
2	The evolute of a curve is a) The locus of the midpoints of normals b) The locus of the centres of curvature c) The locus of tangents d) The inverse curve	K2	CO1
3	The value of $\int_0^{\frac{\pi}{2}} sin^{10}x\, dx$ is a) 0.3863 b) $\frac{3}{120}$ c) $\frac{1}{120}$ d) 0.4863	K1	CO2
4	If $f(x)$ is an even function, then $\int_{-2}^{2} f(x)dx =$ a) $\int_0^2 f(x)dx$ b) $2\int_{-2}^{2} f(x)dx$ c) 0 d) $2\int_0^2 f(x)dx$	K2	CO2
5	The value of $\int_0^1 \int_0^1 (x+y)\, dxdy =$ a) 1/2 b) 3/2 c) 1 d) 2	K1	CO3
6	The region of integration for the double integral $\int_0^a \int_0^{\sqrt{(a^2-x^2}} f(x,y)\, dy\, dx$ in the xy-plane is a) A rectangle by $0 \le x \le a$ and $0 \le y \le a$ b) The entire circle $x^2+y^2=a^2$ c) The portion of the circle $x^2+y^2=a^2$ d) A triangle with vertices (0,0), (a,0), and (0,a).	K2	CO3
7	If $\vec{F} = xz^3\vec{i} - 2xyz\vec{j} + xz\vec{k}$, then $div\, \vec{F}$ at the point $(1,2,0)$ is a) 2 b) 1 c) 0 d) 3	K1	CO4
8	A vector field which has a vanishing *curl* is called a) solenoidal c) irrotational b) rotational d) potential	K2	CO4
9	The area bounded by a simple closed curve C is given by a) $\frac{1}{2}\int_C (xdy+ydx)$ c) $\frac{1}{2}\int_C (xdy-ydx)$ b) $\int_C (xdy+ydx)$ d) $\int_C (xdy-ydx)$	K1	CO5
10	If $\vec{A} = curl\, \vec{F}$, then for any closed surface S, $\int \int_S \vec{A}\cdot\hat{n}\, ds =$ a) 1 b) 2 c) 3 d) 0	K2	CO5

Cont...

SECTION - B (35 Marks)

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

Question No.	Question	K Level	CO
11.a.	Find the radius of curvature for the curve $\sqrt{x} + \sqrt{y} = 1$ at $(\frac{1}{4}, \frac{1}{4})$.	K2	CO1
	(OR)		
11.b.	Obtain the equation of the evolute of the curve $x = a(cos\theta + \theta sin\theta),\ y = a(sin\theta - \theta cos\theta)$.		
12.a.	Evaluate $\int \frac{x\, e^x}{(x+1)^2} dx$.	K3	CO1
	(OR)		
12.b.	Identify $\int sec^5 x\, dx$ by using reduction formula.		
13.a.	Evaluate the double integral $\int_1^2 \int_0^x \frac{1}{(x^2+y^2)}$ dy dx.	K3	CO2
	(OR)		
13.b.	Evaluate $\iint_R$ where R is the region bounded by the parabola $y^2 = x$ and the line y = x.		
14.a.	Find the constants a, b, c so that the vector $\vec{F} = (x + 2y + ax)\vec{i} + (bx - 3y - z)\vec{j} + (4x + cy + 2z)\vec{k}$ is irrotational.	K4	CO4
	(OR)		
14.b.	Find div curl $\vec{F}$ where $\vec{F} = x^2y\,\vec{i} + xz\,\vec{j} + 2yz\,\vec{k}$.		
15.a.	Evaluate $\int_C (xy + x^2)dx + (x^2 + y^2)dy$, where C is the square formed by the lines x = 1, x = -1, y = -1, y = 1 using greens theorem.	K5	CO5
	(OR)		
15.b.	Verify Stoke's theorem for $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ and C is the circular boundary on $z = 0$ plane.		

SECTION -C (30 Marks)

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

Question No.	Question	K Level	CO
16	Identify the center of curvature at any point (x,y) on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and show that the equation of the evolute is $(ax)^{\frac{2}{3}} + (by)^{\frac{2}{3}} = (a^2 - b^2)^{\frac{2}{3}}$	K3	CO1
17	Develop the reduction formula for $\int sin^n x\, dx$ where n is a positive integer, and use it to evaluate $\int sin^5 x\, dx$.	K3	CO2
18	Examine the volume of the region bounded by the surfaces $y^2 = 4ax$, $x^2 = 4ay$ and the planes $z = 0$ and $z = 3$.	K4	CO3
19	Evaluate the value of the arbitrary constant 'a' so that curl of the vector $\vec{F} = (axy - z^3)\vec{i} + (a-2)x^2\vec{j} + (1-a)xz^2\vec{k}$ is zero.	K5	CO4
20	Verify Gauss's Divergence Theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ taken over the cube bounded by the planes $x = 0, x = 1, y = 0, y = 1$, $z = 0$ and $z = 1$.	K5	CO5

Z-Z-Z END