**22PHU103N**

**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 reciprocal of curvature is called<br>(i) Evolute (ii) Radius of curvature<br>(iii) Involute (iv) Chord of curvature | K1 | CO1 |
| | 2 | Chord of curvature parallel to $x$-axis is given by<br>(i) $\frac{2y_1}{y_2}(1+y_1^2)$ (ii) $\frac{2y_1}{y_2}(1-y_1^2)$<br>(iii) $\frac{y_1}{y_2}(1+y_1^2)$ (iv) $\frac{2}{y_2}(1+y_1^2)$ | K2 | CO1 |
| 2 | 3 | If $f(x)$ is an even function, then $\int_{-2}^{2} f(x)dx =$<br>(i) $\int_0^2 f(x)dx$ (ii) $2\int_{-2}^{2} f(x)dx$<br>(iii) 0 (iv) $2\int_0^2 f(x)dx$ | K1 | CO2 |
| | 4 | The value of $\int_0^{\pi/2} sin^7 x cos^5 x\, dx$ is<br>(i) $\frac{1}{12}$ (ii) $\frac{3}{120}$ (iii) $\frac{1}{120}$ (iv) $\frac{8}{693}$ | K2 | CO2 |
| 3 | 5 | The moment of inertia of a mass $M$ in the region $R$ in the $(x,y)$ plane about $x$ and $y$ axis are given by<br>(i) $I_x = \int\int_R y^2 f(x,y)\, dxdy,\ I_y = \int\int_R x^2 f(x,y)\, dxdy$<br>(ii) $I_x = \int\int_R y f(x,y)\, dxdy,\ I_y = \int\int_R x f(x,y)\, dxdy$<br>(iii) $I_x = \int\int_R f(x,y)\, dxdy, I_y = \int\int_R f(x,y)\, dxdy$<br>(iv) $I_x = \int\int_R y^2\, dxdy,\ I_y = \int\int_R x^2\, dxdy$ | K1 | CO3 |
| | 6 | The value of $\int_0^{\frac{\pi}{2}}\int_0^{\frac{\pi}{2}} \sin(x+y)\, dx =$<br>(i) 2 (ii) 0 (iii) 1 (iv) 3 | K2 | CO3 |
| 4 | 7 | A vector field which has a vanishing *curl* is called<br>(i) solenoidal (ii) irrotational<br>(iii) rotational (iv) potential | K1 | CO4 |
| | 8 | If $\vec{F} = xz^3\vec{i} - 2xyz\vec{j} + xz\vec{k}$, then $div\,\vec{F}$ at the point (1,2,0) is<br>(i) 2 (ii) 1 (iii) 0 (iv) 3 | K2 | CO4 |
| 5 | 9 | The area bounded by a simple closed curve $C$ is given by<br>(i) $\frac{1}{2}\int_C (xdy + ydx)$ (ii) $\frac{1}{2}\int_C (xdy - ydx)$<br>(iii) $\int_C (xdy + ydx)$ (iv) $\int_C (xdy - ydx)$ | K1 | CO5 |
| | 10 | If $\vec{A} = curl\,\vec{F}$, then for any closed surface $S$, $\int\int_S \vec{A}\cdot\hat{n} ds =$<br>(i) 1 (ii) 2 (iii) 3 (iv) 0 | K2 | CO5 |

**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 $\theta$ on the curve $x = a(\theta + sin\theta)$, y= $a(1-\cos\theta)$. | K2 | CO1 |
| | | (OR) | | |
| | 11.b. | Obtain the equation of the evolute of the curve $x = a(cos\theta + \theta sin\theta), y = a(sin\theta - \theta cos\theta)$. | | |

**Cont...**

| | | | | |
|---|---|---|---|---|
| 2 | 12.a. | Evaluate $\int \frac{x^2 tan^{-1}x}{1+x^2} dx$. | K2 | CO2 |
| | | (OR) | | |
| | 12.b. | Evaluate $\int_0^{\pi/2} \frac{\sqrt{sinx}}{\sqrt{sinx}+\sqrt{cosx}} dx$. | | |
| 3 | 13.a. | Evaluate $\iint xydxdy$ over the region in the positive quadrant for which $x + y = 1$. | K3 | CO3 |
| | | (OR) | | |
| | 13.b. | Evaluate $\int_0^{\frac{\pi}{2}} \int_0^{asin\theta} \int_0^{\frac{a^2-r^2}{2}} rdzdrd\theta$. | | |
| 4 | 14.a. | Find the constants $a, b, c$ so that the vector $\vec{F} = (x + 2y + ax)\vec{\imath} + (bx - 3y - z)\vec{\jmath} + (4x + cy + 2z)\vec{k}$ is irrotational. | K3 | CO4 |
| | | (OR) | | |
| | 14.b. | Prove that $\vec{F} = (2xy + z^3)\vec{\imath} + x^2\vec{\jmath} + 3xz^2\vec{k}$ is a conservative force. Find $\phi$ so that $\nabla\phi = \vec{F}$. | | |
| 5 | 15.a. | Find the work done when the force $\vec{F} = (x^2 - y^2 + x)\vec{\imath} - (2xy + y)\vec{\jmath}$ moves a particle in the $xy$ plane from (0,0) to (1,1) along the curve $y^2 = x$. Is this work done different when the path is the straight line $y = x$. | K3 | CO5 |
| | | (OR) | | |
| | 15.b. | Verify Stoke's theorem for $\vec{F} = (2x - y)\vec{\imath} - yz^2\vec{\jmath} - y^2z\vec{k}$ 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)

| Module No. | Question No. | Question | K Level | CO |
|---|---|---|---|---|
| 1 | 16 | Find 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 $(ax)^{2/3} + (by)^{2/3} = (a^2 - b^2)^{2/3}$. | K2 | CO1 |
| 2 | 17 | Derive the reduction formula for $\int_0^{\pi/2} cos^n x dx$. | K2 | CO2 |
| 3 | 18 | Find the volume of the region bounded by the surfaces $y^2 = 4ax$, $x^2 = 4ay$ and the planes $z = 0$ and $z = 3$. | K3 | CO3 |
| 4 | 19 | Determine $f(r)$ so that the vector $f(r)\vec{r}$ is both solenoidal and irrotational. | K3 | CO4 |
| 5 | 20 | Verify Gauss's Divergence Theorem for $\vec{F} = x^2\vec{\imath} + y^2\vec{\jmath} + z^2\vec{k}$ taken over the cube bounded by the planes $x = 0, x = 1, y = 0, y = 1, z = 0$ and $z = 1$. | K3 | CO5 |

Z-Z-Z END