# PSG COLLEGE OF ARTS & SCIENCE
## (AUTONOMOUS)

## BSc DEGREE EXAMINATION DECEMBER 2025
(First Semester)

### Branch - STATISTICS

## MATHEMATICS - I FOR STATISTICS

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 | A square matrix A which is satisfied the relation $A^2 = A$ is called <br> a) Idempotent     b) Nilpotent <br> c) Symmetric     d) skew Symmetric | K1 | CO1 |
| 2 | If $\lambda_1, \lambda_2, \lambda_3, \ldots, \lambda_n$ are the eigen values of A, the inverse of A has the eigen values <br> a) $1/\lambda_1, 1/\lambda_2, 1/\lambda_3, \ldots 1/\lambda_n$     b) $\lambda_1^2, \lambda_2^2, \lambda_3^2, \ldots, \lambda_n^2$ <br> c) $k\lambda_1, k\lambda_2, k\lambda_3, \ldots, k\lambda_n$     d) $k+\lambda_1, k+\lambda_2, k+\lambda_3, \ldots, k+\lambda_n$ | K2 | CO1 |
| 3 | The sum of the roots of the equation $2x^2 + 3x + 5 = 0$ is <br> a) 3/2     b) 5/2 <br> c) -3/2     d) -5/2 | K1 | CO2 |
| 4 | If one root of the equation $x^3 + 6x + 20 = 0$ is $1 + 3i$, then the other roots are <br> a) $1 + 3i, 2$     b) $1 + 3i, -2$ <br> c) $1 - 3i, 2$     d) $1 - 3i, -2$ | K2 | CO2 |
| 5 | The $n^{th}$ derivative of $e^{ax}$ is <br> a) $a^{n-1} e^{ax}$     b) $a^n e^{ax}$ <br> c) $a^3 e^{ax}$     d) $a e^{ax}$ | K1 | CO3 |
| 6 | Leibniz rule gives the <br> a) $n^{th}$ derivative of addition of two functions <br> b) $n^{th}$ derivative of division of two functions <br> c) $n^{th}$ derivative of multiplication of two functions <br> d) $n^{th}$ derivative of subtraction of two functions | K2 | CO3 |
| 7 | Find the radius of curvature of the curve $y = c \log \sec \varphi$ is <br> a) $c \sin \varphi$     b) $c \cos \varphi$ <br> c) $c \tan \varphi$     d) $c \cot \varphi$ | K1 | CO4 |
| 8 | The locus of center of curvature is called <br> a) radius of curvature     b) chord of curvature <br> c) envelope     d) evolute | K2 | CO4 |
| 9 | The integral value of cot x is <br> a) tan x     b) cot x <br> c) log(tan x)     d) log(sin x) | K1 | CO5 |
| 10 | The value of $\int \frac{dx}{\sqrt{a^2-x^2}}$ is <br> a) $\sin^{-1}\frac{x}{a}$     b) $\cos^{-1}\frac{x}{a}$ <br> c) $\tan^{-1}\frac{x}{a}$     d) $\cot^{-1}\frac{x}{a}$ | K2 | CO5 |

## SECTION – B (35 Marks)
### Answer ALL questions
ALL questions carry EQUAL Marks       (5 × 7 = 35)

| Question No. | Question | K Level | CO |
|---|---|---|---|
| 11.a. | Identify the rank of the matrix A = $\begin{pmatrix} 1 & 2 & 5 \\ 2 & 3 & 4 \\ 3 & 5 & 7 \end{pmatrix}$. | K3 | CO1 |
| | (OR) | | |
| 11.b. | Verify that A = $\begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}$ satisfies its own characteristics equation and hence find $A^4$. | | |
| 12.a. | Solve the equation $x^4 + 2x^3 - 16x^2 - 22x + 7 = 0$ which has a root $2 + \sqrt{3}$. | K3 | CO2 |
| | (OR) | | |
| 12.b. | Solve $x^3 + x^2 - 16x + 20 = 0$, the difference between two of its roots being 7. | | |
| 13.a. | If $y = ae^{mx} + be^{-mx}$, show that $\frac{d^2y}{dx^2} - m^2y = 0$. | K4 | CO3 |
| | (OR) | | |
| 13.b. | If $u = sin^{-1}\left(\frac{x^2+y^2}{x+y}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = tan\,u$. | | |
| 14.a. | Find the radius of the curvature for the curve $y^2 = x^3 + 8$ at (-2, 0). | K5 | CO4 |
| | (OR) | | |
| 14.b. | Prove that the radius of curvature at any point of the cycloid $x = a(\theta + sin\,\theta), y = a(1 - cos\,\theta)$ is $4a\,cos\frac{\theta}{2}$. | | |
| 15.a. | Evaluate $\int \frac{dx}{x^2-a^2}$. | K5 | CO4 |
| | (OR) | | |
| 15.b. | Evaluate $\int_0^{\frac{\pi}{2}} sin^7 x\,cos^5 x\,dx$. | | |

## SECTION -C (30 Marks)
### Answer ANY THREE questions
ALL questions carry EQUAL Marks       (3 × 10 = 30)

| Question No. | Question | K Level | CO |
|---|---|---|---|
| 16 | Examine the eigenvalues and eigenvectors of $\begin{pmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{pmatrix}$. | K4 | CO1 |
| 17 | If $\alpha, \beta, \gamma$ are the roots of the equation $x^3 - px^2 + qx - r = 0$, find the value of (i) $\sum \alpha^2$, (ii) $\sum \alpha^3$, (i) $\sum \alpha^2\beta$, (i) $\sum \alpha^2\beta^2$. | K4 | CO2 |
| 18 | Evaluate $\frac{\partial u}{\partial x}$ if $u = tan^{-1}\left(\frac{x}{y}\right)$ where $x^2 + y^2 = a^2$. | K5 | CO3 |
| 19 | Analyze the equation of the evolute of the parabola $y^2 = 4ax$. | K4 | CO4 |
| 20 | Determine the reduction formula for $\int sin^n x\,dx$ where n being a positive integer. | K5 | CO5 |

Z-Z-Z       END