Reg. No. | | | | | | | | | | | | |

# B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2023

First Semester

## MA22151 – Applied Mathematics-I

*(Common to all branches except Marine Engineering)*

**(Regulation 2022)**

**TIME: 3 HOURS** **MAX. MARKS: 100**

| COURSE OUTCOMES | STATEMENT | RBT LEVEL |
|---|---|---|
| CO 1 | Solve eigen value problems in matrices. | 3 |
| CO 2 | Apply the basic notion of calculus in Engineering problems and to tackle different geometries. | 3 |
| CO 3 | Perform calculus for more than one variable and its applications in Engineering problems. | 3 |
| CO 4 | Apply definite integrals for design of three-dimensional components. | 3 |
| CO 5 | Evaluate multiple integrals in cartesian and polar coordinates. | 3 |

**PART- A (20 x 2 = 40 Marks)**

(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| 1. | Find the sum & product of the eigen values of the matrix $\begin{pmatrix} 8 & 1 & 6 \\ 3 & 5 & 7 \\ 4 & 9 & 2 \end{pmatrix}$ using the properties. | 1 | 2 |
| 2. | Find the eigen value of $\begin{pmatrix} 2 & 3 \\ 0 & 4 \end{pmatrix}$ corresponding to the eigen vector $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$. | 1 | 3 |
| 3. | The product of two eigen values of the matrix $\begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ is 16. Find the third eigen value. | 1 | 3 |
| 4. | Write down the quadratic form corresponding to the matrix $\begin{pmatrix} 0 & 5 & -1 \\ 5 & 1 & 6 \\ -1 & 6 & 2 \end{pmatrix}$ | 1 | 2 |
| 5. | Find the radius of curvature of $y = e^x at\ the\ po\ int\ w\ here\ it\ crosses\ the\ y\ axis.$ | 2 | 2 |
| 6. | Find the curvature of $x^2 + y^2 = 25\ at\ 3, -4)$. | 2 | 2 |
| 7. | Find the evolute of a curve whose centre of curvature at any point 't' is $(3at^2 + 2a, -2at^3)$. | 2 | 3 |
| 8. | Find the envelope of $y = mx + \frac{a}{m}$, m *being the parameter*. | 2 | 2 |
| 9. | Find the first order and second order partial derivatives of $z = x^3 + y^3 - 3axy$. | 3 | 2 |





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|---|---|---|---|
| 10. | If $u = e^x yz^2$ find du. | 3 | 2 |
| 11. | If $u = f(x-y, y-z, z-x)$ find $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. | 3 | 3 |
| 12. | If u, v, w are functions of x, y, z and $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$, find the value of $\frac{\partial(2u,2v,2w)}{\partial(x,y,z)}$. | 3 | 2 |
| 13. | Evaluate $\int_{-1}^{1} x^5 cosx\ dx$ | 4 | 2 |
| 14. | Evaluate: $\int_0^{\frac{\pi}{2}} cos^8 x\ dx$. | 4 | 2 |
| 15. | Evaluate $\int x\ logx\ dx$ | 4 | 2 |
| 16. | Find mean value of the function $f(x) = x^2 + 2$ over the interval [1,3]. | 4 | 2 |
| 17. | Evaluate $\int_2^a \int_2^b \frac{dxdy}{xy}$ | 5 | 2 |
| 18. | Find the value of $\int_0^{\pi} \int_0^{a\cos\theta} r\ sin\ \theta\ drd\theta$ | 5 | 2 |
| 19. | Find the area of a circle of radius 'a' by double integration in polar coordinates. | 5 | 2 |
| 20. | Evaluate $\int_0^1 \int_0^2 \int_0^3 xyzdxdydz$ | 5 | 2 |

**PART- B (5 x 10 = 50 Marks)**

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| 21. (a) | Find the eigen values and eigen vectors of the matrix $\begin{pmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{pmatrix}$. | (10) | 1 | 3 |
| | **(OR)** | | | |
| (b) | Diagonalize the matrix $A = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 3 & -1 \\ 1 & -1 & 3 \end{pmatrix}$ by orthogonal transformation. | (10) | 1 | 3 |
| 22. (a) | Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ | (10) | 2 | 3 |
| | **(OR)** | | | |
| (b) | Find the evolute of the curve $x = a(cos\ t + t\ sin\ t), y = a(sin\ t - t\ cos\ t)$. | (10) | 2 | 3 |
| 23. (a) | If $u = \log(x^3 + y^3 + z^3 - 3xyz)$, show that $(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z})^2 u = \frac{-9}{(x+y+z)^2}$. | (10) | 3 | 3 |
| | **(OR)** | | | |
| (b) | A rectangular box open at top is to have a capacity of 108cu.ms. Find the dimensions of the box requiring least material for its construction. | (10) | 3 | 3 |

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| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **24. (a)** | Find the volume of the solid generated by revolving the region between the y-axis and the curve $x = \frac{2}{y}, 1 \leq y \leq 4$ about the y-axis. Also draw the region and solid of revolution. | **(10)** | **4** | **3** |
| | **(OR)** | | | |
| **(b)** | Find the volume of the solid formed by revolving the region bounded by the graphs of $y = x^2 + 1, y = 0, x = 0$ and x = 1 about y-axis. Also draw the region and solid of revolution. | **(10)** | **4** | **3** |
| **25. (a)** | Change the order of integration and hence evaluate $\int_0^a \int_y^a \frac{x}{\sqrt{x^2+y^2}} dxdy$. | **(10)** | **5** | **3** |
| | **(OR)** | | | |
| **(b)** | Find the volume of the tetrahedron bounded by the planes $x = 0, y = 0, z = 0$ $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$. | **(10)** | **5** | **3** |

**PART- C (1 x 10 = 10 Marks)**

(Q.No.26 is compulsory)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **26.** | Verify Cayley –Hamilton Theorem for the matrix $A=\begin{pmatrix} 2 & -1 & 2 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$ and hence find $A^4$. | **(10)** | **1** | 3 |

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