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	Reg. No.:
	Question Paper Code: 30234
	B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.
	First Semester
	MA 3151 — MATRICES AND CALCULUS
	(Common to : All Branches (Except Marine Engineering))
	(Regulations 2021)
	Time: Three hours Maximum: 100 marks
	Answer ALL questions.
	PART A — $(10 \times 2 = 20 \text{ marks})$
	1. If two eigen values of the matrix $A = \begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$ are equal to 1 each, find the
	eigen value of A^{-1} .
	2. Write the uses of Cayley-Hamilton Theorem.
	3. If $y = x \log \left(\frac{x-1}{x+1} \right)$, then find $\frac{dy}{dx}$.
	4. Find the point of inflection of $f(x)=x^3-9x^2+7x-6$.
	5. Write Euler's theorem on homogeneous functions.
	6. If $x = r\cos\theta$, $y = r\sin\theta$, find $\frac{\partial(x, y)}{\partial(r, \theta)}$.
	7. Evaluate $\int \theta \cos \theta d\theta$ using integration by parts.
	8. Find the value of $\int_{0}^{\pi/2} \sin^6 x dx$.
	9. Evaluate $\int_{0}^{1} \int_{0}^{x} dy dx$.
	10. Transform the double integral $\int_{0}^{2} \int_{y}^{2} \frac{x dx dy}{x^{2} + y^{2}}$ into polar coordinates.
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PART B — $(5 \times 16 = 80 \text{ marks})$

- 11. (a) (i) Find the eigen values and eigen vectors of $A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$. (8)
 - (ii) Verify Cayley-Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{pmatrix}$. (8)

Or

- (b) Reduce the quadratic form $2x_1x_2 2x_2x_3 + 2x_3x_1$ into the canonical form and hence find its nature. (16)
- 12. (a) (i) Find the values of a and b that make f continuous on $(-\infty, \infty)$ if

$$f(x) = \begin{cases} \frac{x^3 - 8}{x - 2}, & \text{if } x < 2\\ ax^2 - bx + 3, & \text{if } 2 \le x < 3\\ 2x - a + b, & \text{if } x \ge 3 \end{cases}$$
 (8)

- (ii) Find $\frac{dy}{dx}$ if $y = x^2 e^{2x} (x^2 + 1)^4$. (4)
- (iii) If $x^y = y^x$, Prove that $\frac{dy}{dx} = \frac{y(y x \log y)}{x(x y \log x)}$ using implicit differentiation. (4)

Or

- (b) (i) Show that $\sin x(1+\cos x)$ is maximum when $x=\pi/3$. (6)
 - (ii) A window has the form of a rectangle surmounted by a semicircle. If the perimeter is 40 ft., find its dimensions so that greatest amount of light may be admitted. (10)
- 13. (a) (i) Given the transformations $u = e^x \cos y$ and $v = e^x \sin y$ and that f is a function of u and v and also of x and y, prove that $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial v^2} = \left(u^2 + v^2\right) \left(\frac{\partial^2 f}{\partial u^2} + \frac{\partial^2 f}{\partial v^2}\right). \tag{8}$
 - (ii) Expand $e^x \log(1+y)$ in powers of x and y up to terms of third degree.

Or

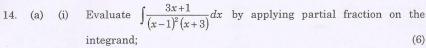
- (b) (i) Examine for extreme values of $f(x, y)x^4 + y^4 2x^2 + 4xy 2y^2$. (8)
 - (ii) A rectangular box, open at the top, is to have a volume of 32 c.c. Find the dimensions of the box, that requires the least material for its construction. (8)

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Evaluate $\int_{0}^{\pi/2} \log \sin x \, dx$ and hence find the value of $\int_{0}^{1} \frac{\sin^{-1} x}{x} \, dx$. (10)

(b) (i) Evaluate
$$\int \frac{\sqrt{9-x^2}}{x^2} dx$$
 using trigonometric substitution. (6)

Determine whether the integral $\int_{-\infty}^{\infty} \frac{1}{x} dx$ is convergent or divergent.

Find the volume of the reel shaped solid formed by the revolution about the y-axis, of the part of the parabola $y^2 = 4\alpha x$ cut off by its

Find the area between the curves $y^2 = 4x$ and $x^2 = 4y$. 15. (a) (i) (8)

> Change the order of integration in $\int \int ye^{-y^2/x} dx dy$ and then (8) evaluate it.

Find the volume of the sphere of radius 'a'.

Or

(8)

Find the moment of inertia of the area bounded by the curve $r^2 = a^2 \cos 2\theta$ about its axis.

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