

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: BARCH
BRANCH: BARCH

SEMESTER : 1
SESSION : MO/2025

SUBJECT: MA104 MATHEMATICS FOR ARCHITECTS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Reduce the matrix A to row reduced echelon form and then find the rank. [5] CO 1,3 BL L1
- $$A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$$
- Q.1(b) Show that the given matrix A satisfies its characteristic equation and also compute A^{-1} (if exists) [5] 1,3 L1
- $$A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$
- Q.2(a) Find the n^{th} derivative of $x^3 \sin x + \cos x$. [5] 1,3 L1
- Q.2(b) Find all critical points and also find the maximum and minimum values of $f(x) = \frac{1}{4}x^4 - \frac{4}{3}x^3 + \frac{5}{2}x^2 - 2x$. [5] 2,3,4 L2
- Q.3(a) Find first and second order partial derivatives for the following functions: [5] 1,3 L1
- (i) $f(x, y) = (x^2 - 1)(y + 2)$ (ii) $f(x, y) = e^{x+y+1}$
- Q.3(b) If $u = \sin^{-1} \frac{x+2y+3z}{x^8+y^8+z^8}$, find the value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$. [5] 1,3 L1
- Q.4(a) If $u = x^2 - y^2, v = 2xy$, and $x = r \cos \theta, y = r \sin \theta$, find $\frac{\partial(u,v)}{\partial(r,\theta)}$. [5] 1,3 L1
- Q.4(b) Expand $e^x \log(1 + y)$ in power of x and y up to 3rd degree term using Taylor's theorem. [5] 2,3,4 L2
- Q.5(a) Find the mean and standard deviation of the following frequency distribution around the point 10: [5] 1,3 L1
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|---|---|---|---|----|----|----|----|
| X | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| y | 3 | 6 | 9 | 13 | 8 | 5 | 4 |
- Q.5(b) Find the regression line to the following data: [5] 1,2,3 L3
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|---|----|----|----|----|-----|----|-----|----|-----|-----|
| X | 21 | 23 | 30 | 54 | 57 | 58 | 72 | 78 | 87 | 90 |
| Y | 60 | 71 | 72 | 83 | 110 | 84 | 100 | 92 | 113 | 135 |