

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

CLASS: BARCH  
BRANCH: BARCH

SEMESTER : I  
SESSION : MO/2022

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  
where A=

$$A = \begin{bmatrix} 1 & 2 & 1 & 2 & 1 \\ 2 & 1 & 2 & 1 & 2 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

- Q.1(b) Show that the given matrix A satisfies its characteristic equation. [5] CO 1,3 BL L1  
A =  $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

- Q.2(a) Find the  $n^{\text{th}}$  derivative of  $x \log x$ . [5] CO 1,3 BL L1

- Q.2(b) Find the maximum and minimum values of [5] CO 2,3,4 BL L2  
 $f(x) = 3x^4 - 2x^3 - 6x^2 + 6x + 1$  in the interval (0,2).

- Q.3(a) Find  $\frac{\partial f}{\partial x}$  and  $\frac{\partial f}{\partial y}$  for the following functions: [5] CO 1,3 BL L1

(i)  $f(x, y) = (x^2 - 1)(y + 2)$       (ii)  $f(x, y) = e^{x+y+1}$

- Q.3(b) If  $\sin u = \frac{x^2 y^2}{x+y}$ , and  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 3 \tan u$  [5] CO 1,3 BL L1

- Q.4(a) If  $x = r \cos \theta, y = r \sin \theta$ ; evaluate  $\frac{\partial(x,y)}{\partial(r,\theta)}$  and  $\frac{\partial(r,\theta)}{\partial(x,y)}$ . [5] CO 1,3 BL L1

- Q.4(b) A rectangular box open at the top is to have volume of 32 cubic ft. [5] CO 2,3,4 BL L2  
Find the dimensions of the box requiring least material for its construction.

- Q.5(a) Find the mean and standard deviation of the following frequency [5] CO 1,3 BL L1  
distribution:

X	10	20	30	40	50	60
y	9	18	25	27	14	7

- Q.5(b) Find the least-squares regression line to the following data: [5] CO 1,2,3 BL L2

X	1	3	4	6	7	9
Y	1	8	17	34	52	78