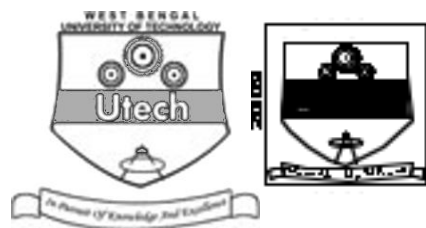


# MATHEMATICS ( SEMESTER - 2 )

CS/B.Tech/SEM-2/M-201/09



1. ....  
Signature of Invigilator

2. ....  
Signature of the Officer-in-Charge

Reg. No.

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Roll No. of the Candidate

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CS/B.Tech/SEM-2/M-201/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

MATHEMATICS ( SEMESTER - 2 )

Time : 3 Hours ]

[ Full Marks : 70

## INSTRUCTIONS TO THE CANDIDATES :

- This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
- In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
  - For **Groups – B & C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
- Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
- Read the instructions given inside carefully before answering.
- You should not forget to write the corresponding question numbers while answering.
- Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
- Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
- You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
- Rough work, if necessary is to be done in this booklet only and cross it through.

**No additional sheets are to be used and no loose paper will be provided**

## FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

Group – A								Group – B				Group – C				Total Marks	Examiner's Signature
Question Number																	
Marks Obtained																	

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Head-Examiner / Co-Ordinator / Scrutineer

2241 ( 05/06 )



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# MATHEMATICS

## SEMESTER - 2



Time : 3 Hours ]

[ Full Marks : 70

**GROUP – A****( Multiple Choice Type Questions )**1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) If  $A = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}$ , then  $A^{100}$  is

a)  $\begin{bmatrix} 1 & 0 \\ -150 & 1 \end{bmatrix}$

b)  $\begin{bmatrix} 1 & 0 \\ -50 & 1 \end{bmatrix}$

c)  $\begin{bmatrix} 1 & 0 \\ -100 & 1 \end{bmatrix}$

d) None of these.

ii) The set of vectors  $\{ (2, 1, 1), (1, 2, 2), (1, 1, 1) \}$  in  $R^3$  is

a) linearly dependent

b) linearly independent

c) basis of  $R^3$

d) none of these.

iii) The matrix  $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix}$  is

a) an orthogonal matrix

b) a symmetric matrix

c) an idempotent matrix

d) a null matrix.



iv) The value of the determinant  $\begin{vmatrix} 4 & 1 & 4 & 16 \\ 1^2 & 2^2 & 4^2 & 1^2 \\ 0 & 1 & 6 & 1 \end{vmatrix}$  is



a) 0

b) 1

c) 4

d) 22.

v) The solution of a system of  $n$  linear equations with  $n$  unknowns is unique if and only if

a)  $\det A = 0$ b)  $\det A > 0$ c)  $\det A < 0$ d)  $\det A \neq 0$ ,

where  $A$  is the matrix of the coefficients of the unknowns in the linear equations.

vi) The eigenvalues of the matrix  $\begin{bmatrix} 1 & 4 \\ 4 & 1 \end{bmatrix}$  are

a)  $-5, -3$ b)  $-5, 3$ c)  $3, -5$ d)  $5, 3$ .

vii) The general solution of  $p = \log(px - y)$  where  $p = \frac{dy}{dx}$  is

a)  $y = cx - c$ b)  $y = cx - e^c$ c)  $y = c^2 x - e^{-c}$ 

d) none of these.

viii) Which of the following is not true ( the notations have their usual meanings ) ?

a)  $\Delta = E - 1$ b)  $\Delta \cdot \square = \Delta - \square$ c)  $\frac{\Delta}{\square} = \Delta + \square$ d)  $\square = 1 - E^{-1}$ .



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ix)  $\Delta^2 e^x$  is equal to (  $h = 1$  )

a)  $(e - 1)^2 e^x$

b)  $(e - 1) e^x$

c)  $e^{2x} (e - 1)$

d)  $e^{2x}$




x) The value of  $\int_0^{\cdot} \frac{\sin t}{t} dt$  is equal to

a)  $\frac{\pi}{3}$

b)  $\frac{\pi}{6}$

c)  $\frac{\pi}{4}$

d)  $\frac{\pi}{2}$

xi) If  $S$  and  $T$  are two subspaces of a vector space  $V$ , then which one of the following is a subspace of  $V$  also ?

a)  $S \cup T$

b)  $S \cap T$

c)  $S - T$

d)  $T - S$

xii) If  $\lambda^3 - 6\lambda^2 + 9\lambda - 4$  is the characteristic equation of a square matrix  $A$ , then  $A^{-1}$  is equal to

a)  $A^2 - 6A + 9I$

b)  $\frac{1}{4} A^2 - \frac{3}{2} A + \frac{9}{4} I$

c)  $\frac{1}{4} A^2 - \frac{3}{2} A + \frac{9}{4}$

d)  $A^2 - 6A + 9$

xiii) Co-factor of  $-3$  in the determinant  $\begin{vmatrix} -2 & -3 & 4 \\ 1 & 0 & 1 \\ 0 & -1 & 4 \end{vmatrix}$  is

a) 4

b) -4

c) 0

d) none of these.



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**GROUP – B****( Short Answer Type Questions )**Answer any *three* of the following. $3 \times 5 = 15$ 

2. If  $A$  be a skew symmetric and  $(I + A)$  be a non-singular matrix, then show that  $B = (I - A)(I + A)^{-1}$  is orthogonal.

3. Evaluate  $L^{-1} \left\{ \frac{1}{(s-1)^2(s-2)^3} \right\}$ .

4. Solve the differential equation

$$\frac{dy}{dx} + y = y^3 (\cos x - \sin x).$$

5. Evaluate the definite integral  $\int_1^4 (x + x^3) dx$  by using Trapezoidal rule, taking five

ordinates and calculate the error.

6. If  $A(\theta) = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$ , then show that

$$A(\theta)A(\phi) = A(\phi) \cdot A(\theta) = A(\theta + \phi).$$

**GROUP – C****( Long Answer Type Questions )**Answer any *three* of the following. $3 \times 15 = 45$ 

7. a) If  $A = \begin{bmatrix} 1 & 2 & 1 \\ 1 & -4 & 1 \\ 3 & 0 & -3 \end{bmatrix}$ ,  $B = \begin{bmatrix} 2 & 1 & 1 \\ 1 & -1 & 0 \\ 2 & 1 & -1 \end{bmatrix}$ , show that  $AB = 6I_3$ . Utilise

this result to solve the following system of equations :

$$2x + y + z = 5$$

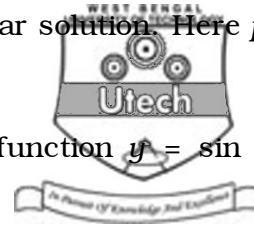
$$x - y = 0$$

$$2x + y - z = 1$$



b) Solve :  $(y - px)(p - 1) = p$  and obtain the singular solution. Here  $p = \frac{dy}{dx}$ .

c) Construct the interpolation polynomial for the function  $y = \sin \pi x$ , taking the points  $x_0 = 0$ ,  $x_1 = \frac{1}{6}$ ,  $x_2 = \frac{1}{2}$ .



Hence find  $f\left(\frac{1}{3}\right)$  where  $y = f(x)$ .

8. a) Solve the differential equation

$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = x^2 e^{3x}.$$

b) Apply suitable interpolation formula to calculate  $f(9)$  correct up to two significant figures from the following data :

$x :$	2	4	6	8	10
$f(x) :$	5	10	17	29	49

c) Determine the conditions under which the system of equations

$$x + y + z = 1$$

$$x + 2y - z = b$$

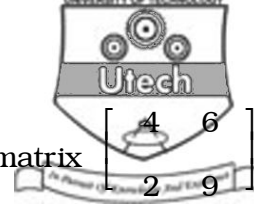
$$5x + 7y + az = b^2$$

admits of

- i) only one solution
- ii) no solution
- iii) many solutions.



9. a) Prove that  $P^T A P$  is a symmetric or a skew-symmetric matrix according as  $A$  is symmetric or skew-symmetric.



- b) Find the eigenvalues and the eigenvectors of the matrix  $\begin{bmatrix} 4 & 6 \\ 2 & 9 \end{bmatrix}$ .

- c) Solve by Cramer's rule the following system of equations :

$$3x + y + z = 4$$

$$x - y + 2z = 6$$

$$x + 2y - z = -3.$$

10. a) What is meant by linear independence of a set of  $n$ -vectors ?

- b) Solve by the method of variation of parameters the equation

$$\frac{d^2 y}{dx^2} + 9y = \sec 3x.$$

- c) Prove that  $\Delta = \begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3.$

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END