CS/B.Tech (CHE) (Supple)/SEM-7/CHE-701/09

MATHEMATICAL METHODS IN CHEMICAL ENGINEERING (SEMESTER - 7)

1. ....
Signature of Invigilator

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

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

Roll No. of the Candidate | | | | | | | | | | | | | | | |

CS/B.Tech (CHE) (Supple)/SEM-7/CHE-701/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JULY – 2009

MATHEMATICAL METHODS IN CHEMICAL ENGINEERING (SEMESTER - 7)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. 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.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) 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.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. 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.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. 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**.
9. 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

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FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

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

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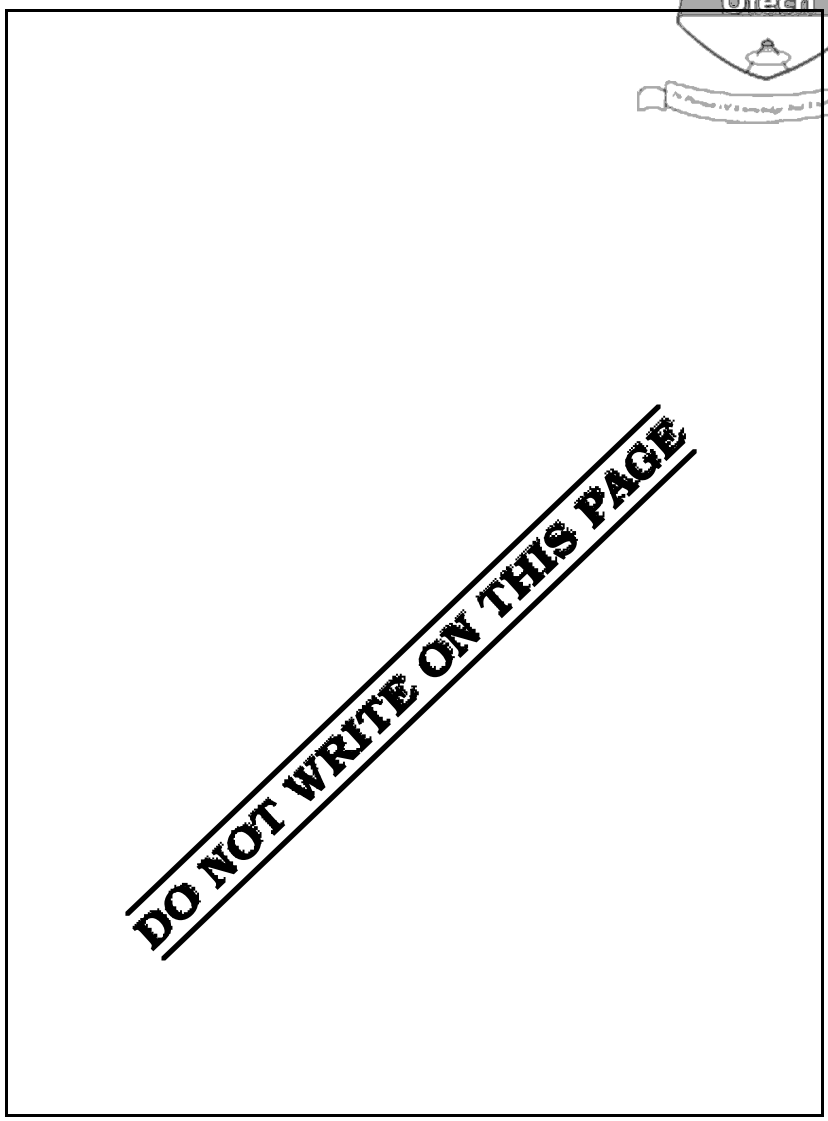
S–53036 (29/07)

Head-Examiner/Co-Ordinator/Scrutineer



CS/B.Tech (CHE) (Supple)/SEM-7/CHE-701/09

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SEMESTER - 7

Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) If A & B are two matrices then $(A + B)^T$ is equal to

a) $A^T + B^T$ + b) $A^T - B^T$

c) $(A^T)^T + (B^T)^T$ d) $A^T \cdot B^T$.

ii) Two matrices A and B are conformable for product AB if the number of

a) columns of A is equal to the no. of rows of B

b) rows of A is equal to the no. of columns of B

c) none of these

d) both (a) and (b).

iii) The general conservation law for non-reacting system becomes

a) Input + Accumulation = Output

b) Input + Output = Accumulation

c) Input – Output = Accumulation

d) none of these.

iv) A series of numbers $U_1 + U_2 + U_3 + \ldots + U_n = S_n$

If $S_n \to S$ some finite number as $n \to \infty$, the series is termed as

a) convergent b) divergent

c) oscillatory d) none of these.

v) For a function $y = f(x)$ if the independent variable is discretely increased by an amount h and D is given as $\frac{d}{dx}$, then the E-operator E raised to m *i.e.* E is given by

a) $\exp(-mhD)$ b) $\exp(mhD)$

c) $D\exp(mh)$ d) none of these. ☐

vi) $\Phi_n(x)$ and $\Phi_m(x)$ are said to be orthogonal w.r.t. a weighting function $r(x)$ over the interval a to b if

a) $m \neq n$ b) $m = n$

c) $m - n = 0$ d) both (b) and (c). ☐

vii) Functions arising from eigenvalue are termed as

a) eigenfunction b) eigenvector

c) both (a) and (b) d) none of these. ☐

viii) Δ^{p+q} can be written as

a) $\Delta^p \cdot \Delta^q$ b) $\Delta^q \cdot \Delta^p$

c) $\Delta^p + \Delta^q$ d) either (a) or (b). ☐

ix) If $y = 5x^3 + 7z^3$ then the value of $\frac{\partial^3 y}{\partial x^3}$ and $\frac{\partial^3 y}{\partial z^3}$ are respectively

a) 30, 42 b) 42, 30

c) 15, 21 d) 10, 14. ☐

x) $F = \square^2 f(x, y, z, t) + \frac{\partial f}{\partial t} + \frac{\partial^2 f}{\partial t^2}$ can be called

a) Parabolic equation b) Elliptical equation

c) Hyperbolic equation d) Both (a) and (c). ☐

xi) $y_{n+1} - y_n^2 + 3y_n + 2 = 0$ is

a) 1st order linear difference equation

b) 1st order non-linear difference equation

c) 2nd order non-linear difference equation

d) none of these.

xii) If $Rx_{n-1} - Rx_n = \frac{dx_n}{dt}$, where R is some scalar parameter then in Laplace Domain one can say

a) $R\overline{x_{n-1}} = S\overline{x_n} + R\overline{x_n}$

b) $R\overline{x_n} = S\overline{x_n} + R\overline{x_{n-1}}$

c) $\overline{x_{n-1}} = \left(\frac{S}{R} + 1\right)\overline{x_n}$

d) both (a) and (c).

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \infty 5 = 15$

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

find A^T .

3. Solve $\left(D^2 - 6D + 9\right) y = e^{2x}$.

4. Solve the equation $y_{n+2}\, y_n = y_{n+1}^2$

5. Explain Sylvester's theorem.

6. The decrease of volume y [%] of leather for certain fixed values of high pressure x [atmospheres] was measured. The results are shown in the Table. Find the regression line of y on x. What is the value of correlation co-efficient ?

x, atm	4000	6000	8000	10000

y, %	2.3	4.1	5.7	6.9

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Obtain a numerical solution of the equation

$$\frac{dy}{dx} = 1 + x - y$$

with the initial condition that $y = 2$ at $x = 1$, for the range $x = 1{\cdot}0\ (0{\cdot}2)\ 3{\cdot}0$, that is from $x = 1{\cdot}0$ to $x = 3{\cdot}0$ with step length $x = 0{\cdot}2$.

8. If $Z = f(x, y)$ and $x = \frac{1}{2}\left(u^2 - y^2\right)$ and $y = uv$, show that

$$u\frac{\partial z}{\partial v} - v\frac{\partial z}{\partial u} = 2\left(x\frac{\partial z}{\partial y} - y\frac{\partial z}{\partial x}\right)$$

9. A hot water storage tank is a vertical cylinder surmounted by a hemispherical top of the same diameter. The tank is designed to hold 400 m^3 of liquid. Determine the total height and the diameter of the tank if the surface heat loss is be a minimum.

Dia.

10. a) Solve the set of equations using matrix method : 6

$$3x_1 + 2x_2 - x_3 = 4$$

$$2x_1 - x_2 + 2x_3 = 10$$

$$x_1 - 3x_2 - 4x_3 = 5.$$

b) Determine matrices A and B where

$$A + 2B = \begin{bmatrix} 1 & 2 & 0 \\ 6 & -3 & 3 \\ -5 & 3 & 1 \end{bmatrix} \text{ and}$$

$$2A - B = \begin{bmatrix} 2 & -1 & 5 \\ 2 & -1 & 6 \\ 0 & 1 & 2 \end{bmatrix}$$ 9

11. Use Lagrange's interpolation to fit a polynomial $y(x)$ to the data :

x	– 1	0	2	3
y	8	3	1	12

Hence find $y(1)$.

END