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MMT-009

**M. SC. (MATHEMATICS WITH
APPLICATIONS IN
COMPUTER SCIENCE**

[M. SC. (MACS)]

Term-End Examination

June, 2026

MMT-009 : MATHEMATICAL MODELLING

Time : $1\frac{1}{2}$ Hours

Maximum Marks : 25

Weightage : 70%

Note : (i) Attempt any **five** questions.

(ii) Use of scientific non-programmable
calculator is allowed.

1. (a) Define the following terms : 2

(i) Non-linear models

(ii) Dynamic models

- (b) For the differential equation of tumour

growth $\frac{dc}{dt} = \lambda c, \lambda = \text{constant}$. If the

tumour cells in a particular organ of a

human body are 5×10^3 , their growth

increases upto 7.2×10^5 within five

days. Find the value of λ . 3

2. Maximize $Z = 11x_1 + 4x_2$, subject to the

constraints 5

$$-x_1 + 2x_2 \leq 4$$

$$5x_1 + 2x_2 \leq 16$$

$$2x_1 - x_2 \leq 4$$

$$(x_1, x_2) \geq 0.$$

3. Do the stability analysis of the following model which is formulated to study the effect of toxicant on a population : 5

$$\frac{dN}{dt} = N(r_0 - r_1 C_0 - sN)$$

$$\frac{dC_0}{dt} = kP - gC_0 - mC_0$$

$$\frac{dP}{dt} = -k_1PN + g_1C_0N - hP + Q$$

together with the initial conditions

$$N(0) = N_0 > 0, C_0(0) = 0, P(0) = P_0 > 0.$$

4. (a) A telephone exchange has two long distance operators. The telephone company observes that during the peak load, long distance calls arrive in a Poisson fashion at an average rate of 15 per hour. The length of service on these calls is approximately

exponentially distributed with mean length 5 minutes : 3

(i) What is the probability that a subscriber will have to wait for his long distance call during the peak hours of the day ?

(ii) If the subscriber will wait and serviced in turn, what is the expected waiting time ?

(b) Define the following with suitable examples : 2

(i) Markowitz model

(ii) Stochastic model

5. (a) A company manufacturing soft drink is thinking of expanding its plant capacity. The monthly sales for the past

5 years are available. The problem is to develop a model to obtain good estimates for future demand so as to help the company to make the right decisions. List the two essentials and two non-essentials in the problem. 2

- (b) Let the return distribution on a security A be given in the following table : 3

Possible rate of return (in %) (R_j)	Associated probabilities (p_j)
- 8	0.04
- 6	0.06
9	0.2
10	0.3
12	0.25
8	0.15

Find the expected return of the security.

6. Consider the following data : 5

x	y
2	1
9	17
3	3
5	9
1	0

Use a best fit line to estimate the value of y for $x = 6$ and 8.

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