QP Code:MA2T04A-1 **(Pages: 3)**

Reg No : .... Name : ....

MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

(Govt. Aided Autonomous Institution)

Fourth Semester B.Tech. Degree Examination, May 2026

Course Code: B24MA2T04A

Course Name: STOCHASTIC PROCESSES AND NUMERICAL METHODS

Max. Marks: 100 Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)

Answer all questions

1. The mean and variance of a binomial distribution are 7.5 and 3.75 respectively. Find $P(X=2)$.

2. X follows Poisson distribution with mean 6. Find $P(X=1)$ and $V(X)$.

3. A continuous random variable X is uniformly distributed in $(-k,k)$. Find k if $P[X \geq 2]=0.25$.

4. For an exponential random variable X, given that $P(X>2)=e^{-10}$. Find $P(X>7|X>5)$.

5. Find the mean function of the sine wave random process with random amplitude defined by $X(t)=A\sin\omega_0 t$ where ω_0 is a constant and A is a random variable uniformly distributed in $(0,1)$.

6. Find the variance at time $t=3$ of a WSS random process $X(t)$ with autocorrelation function $R_X(\tau)=e^{-|\tau|}$.

7. Find the first iterate x_1 for the root of the function $f(x)=x^3-5x-9$ using Newton Raphson method with initial guess $x_0=2$

8. Construct Newton's backward difference table for the below data.

1931	1941	1951
40.62	60.80	79.95

9. Perform one Gauss–Seidel iteration for $4x+y=9$, with $x^{(0)}=0,\ y^{(0)}=0$.
$x+3y=7,$

10. Write normal equations for fitting a parabola of the form $y=ax^2+bx+c$ to a given data by the method of least squares.

PART - B: 70 Marks (5 Qns x 14 Marks)

Answer any One full question from each module.

Module 1

11. a. If a random variable X has the probability mass function (7 Marks)

x	1	2	3	4
$f(x)$	$2k$	$3k$	k	$4k$

then find (i) k, (ii)$P(0 < X < 3)$, (iii) $P(4)$, (iv) Distribution function.

b. A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 2. Calculate the proportion of days on which (i) neither car is used (ii) some demand is refused. (7 Marks)

OR

12. a. A gambler plays a game of rolling a die with the following rules. He will win $Rs. 200$ if he throws a 6, but will lose $Rs. 40$ if he throws 4 or 5 and lose $Rs. 20$ if he throws $1, 2$ or 3. Find the expected value that the gambler may gain. (7 Marks)

b. The number of gamma rays emitted per second by a certain radioactive substance follows a Poisson distribution with mean 8. Determine the probability that (i) three particles are emitted in one second (ii) at most one particle is emitted in one second (iii) more than one particle is emitted in one second. (7 Marks)

Module 2

13. a. Passengers come to a bus station at random times. The waiting time of a random passenger, until his bus arrives, follows a uniform distribution between 5 and 15 minutes. (7 Marks)

1) Calculate the probability that a person waiting at this bus stop will wait for more than 10 minutes.

2) If 120 people arrive at this bus stop independently, what is the expected number of people who will wait between 7 and 12 minutes?

b. The heights of a population of adult males in a certain country follow a normal distribution with a mean of $175cm$ and a standard deviation of $7cm$. (7 Marks)

1) What percentage of adult males in this country have a height greater than 185 cm?

2) If 200 adult males are randomly selected from this population, what is the expected number of individuals with a height between 170 cm and 180 cm?

OR

14. a. The distribution of resistance for resistors of a certain type is known to be normal, with 10% of all resistors having a resistance exceeding $10.256\ ohms$ and 5% having a resistance smaller than $9.671\ ohms$. What are the mean value and standard deviation of the resistance distribution?. (7 Marks)

b. A random variable X has the following probability density function $f(x) = kx(2-x), 0 < x < 2$. Find (i) the value of k (ii) the mean (iii) variance. (7 Marks)

Module 3

15. a. Find the power spectral density function of the WSS process whose autocorrelation function is $A^2 e^{-2\alpha|\tau|}$ where A and α are constants. (7 Marks)

b. The joint distribution is $f(x,y) = \frac{x+3y}{54}$, $x = 1,2,3,\ y = 1,2$. Find marginal distributions of X and Y and also find $E(X), E(Y)$. (7 Marks)

OR

16. a. Assume that $X(t)$ is a random process defined as follows: $X(t) = A\cos(2\pi t + \Phi)$ where A is a zero-mean normal random variable with variance $\sigma_A^2 = 2$ and Φ is uniformly distributed random variable over the interval $-\pi \leq \Phi \leq \pi$. A and Φ are statistically independent. Let the random variable Y be defined as $Y = \int_0^1 X(t)dt$. Determine (i) the mean of Y (ii) the variance of Y. (7 Marks)

b. The joint density function of 2 continuous random variable X and Y is $f(x,y) = \begin{cases} c(x+y), & 0<x<1,\ 0<y<2 \\ 0, & \text{otherwise} \end{cases}$ (7 Marks)

i) Find the value of the constant c.

ii) Find $P(X \geq 0.5, Y \leq 1)$.

iii) Find the marginal density of X.

Module 4

17. a. Use Newton's forward difference formula to find y at $x = 1.5$. (7 Marks)

X	0	1	2	3	4
Y	7	10	13	22	43

b. Given $f(0) = 1, f(1) = 3, f(3) = 55$. Use Lagrange's Interpolation method to find $f(2)$. (7 Marks)

OR

18. a. Using Lagrange's interpolation, find the value of $y(8)$, given $y(0) = 18, y(1) = 42, y(7) = 57, y(9) = 90$. (7 Marks)

b. Evaluate $\int_0^{0.6} \frac{dx}{\sqrt{1+x}}$ using Simpson's rule with $n = 6$. (7 Marks)

Module 5

19. a. Using Gauss-Seidal iteration method, find an approximate solution to the following system of equations correct to 4 decimal places. (7 Marks)

$8x - 3y + 2z = 20, \quad 4x + 11y - z = 33, \quad 6x + 3y + 12z = 36.$

b. Use Runge-Kutta method of fourth order to find $y(0.7)$ if $\frac{dy}{dx} = y - x^2$ given $y(0.6) = 1.737$. (Choose $h = 0.1$) (7 Marks)

OR

20. a. Use Euler's method to solve $\frac{dy}{dx} = x + xy + y, y(0) = 1$. Compute y at $x = 0.15$ by taking $h = 0.05$. (7 Marks)

b. Use Runge-Kutta method of fourth order to find $y(0.1)$ from $\frac{dy}{dx} = \sqrt{x+y}, y(0) = 1$ taking $h = 0.1$. (7 Marks)

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