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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP/PT) (S2 PT) Examination December 2025/January 2026 (2019 Scheme)

Course Code: MAT204

Course Name: PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1 Find the probability distribution function, if the Random variable X takes the values 1,2,3,4 such that $2P(X=1)=3P(X=2)=P(X=3)=5P(X=4)$. 3

2 8 coins are tossed 256 times. In how many tosses do you except no heads? 3

3 Find the mean and variance for the PDF, $f(x)=\begin{cases} Kx^2, & 0<x<1 \\ 0 & , elsewhere \end{cases}$ 3

4 A random variable X follows exponential distribution with mean 3. Find $P(X>3)$ and $Var(X)$. 3

5 State any three properties of autocorrelation function. 3

6 Write down the properties of Power Spectral Density. 3

7 Using Newton Raphson method find the positive root of the equation $x^3-24=0$ that lies between 2 and 3 correct to three decimal places. 3

8 Use Lagrange's interpolation method to find the unique polynomial $p(x)$ which agree with the data $y(0)=1, y(1)=0$ and $y(3)=10$. 3

9 Using Runge-Kutta Method of order 2 to find $y(0.2)$ for $\frac{dy}{dx}=x+y^2$, $y(0)=1$ with $h=0.2$. 3

10 Using Euler's method to find y at $x=0.25$ given $\frac{dy}{dx}=2xy, y(0)=1, h=0.25$ 3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) A Random variable X has the following probability distribution function 7

x	0	1	2	3	4	5	6	7	8
$f(x)$	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

Determine (i) the value of a (ii) $P(X < 3)$ $(iii) P(X \geq 3) (iv) P(0 < X < 5)$

b) Show that Poisson distribution is the limiting case of Binomial distribution as $n \to \infty,\ p \to 0.$ 7

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

b) The joint distribution of a two-dimensional random variable (X, Y) is given by $f(x, y) = k(2x + 3y), x = 0,1,2; y = 1,2,3.$ Find (i) the value of k (ii) the marginal distributions (iii) Are X and Y independent? 7

Module -2

13 a) If $f(x) = kx^2e^{-x}, x > 0$, find k, mean and variance of the random variable. 7

b) In an examination, 30% of the students got marks below 40 and 10% got marks above 75. Assuming the marks are normally distributed find, the mean and standard deviation of the distribution. 7

14 a) Buses arrive at a specified stop at 15 minutes interval starting at 8 am. If a passenger arrives at the stop at a random time that is uniformly distributed between 8.00 and 8.30 hours, find the probability that the passenger waits (i) less than 6 minutes for the bus (ii) at least 12 minutes for the bus. 7

b) Let $X_1, X_2, \dots \dots .. X_n$ be independent and identically distributed random variables with mean 3 and variance 0.5. Use Central limit theorem to estimate $P(340 \leq S_n \leq 370)$ where $S_n = X_1 + X_2 + \cdots + X_n$ and $n = 120$. 7

Module -3

15 a) If $X(t)$ is a WSS process with autocorrelation $R_X(\tau) = \frac{\tau^2+44}{\tau^2+4}$. Find the mean and variance. 7

b) If the customers arrive at a counter in accordance with Poisson distribution with rate of 2 per minute, Find the probability that the interval between two consecutive arrivals is (i) more than 1 minute (ii) between 1 minute and 2 minutes. 7

16 a) If $X(t) = A\cos(\omega t + \theta)$ where A *and* ω are constants and θ is uniformly distributed over $[0,2\pi]$, find the auto correlation function and Power Spectral Density of the process. 7

b) Determine the autocorrelation function of the random process with power spectral density given by $S_{XX}(w) = \begin{cases} S_0 & |w| < w_0 \\ 0 & Otherwise \end{cases}$. 7

Module -4

17 a) Find a real root of the following equation using Regula Falsi method $x\log_{10}x - 1.2 = 0$ correct to 3 decimals. 7

b) Use Newton's backward interpolation method to estimate $y(2005)$ 7

x	1961	1971	1981	1991	2001	2011
No. of people	16	19	23	28	34	41

18 a) Evaluate $\int_0^1 e^{-x^2}dx$ using Trapezoidal rule with $h = 0.25$. 7

b) Using Lagrange's interpolation method to find the polynomial $f(x)$ which agree with the following data: $f(1) = 1, f(3) = 27, f(4) = 64$. Hence find $f(2)$. 7

Module -5

19 a) Use the method of least squares to fit a straight line $y = ax + b$ for the following data 7

x	1	2	3	4	5
y	6	7	9	10	12

b) Obtain the value of $y(0.1)$ using Runge-Kutta method of fourth order of the differential equation $\frac{dy}{dx} = -y$ and $y(0) = 1$. Take $h = 0.1$. 7

20 (a) Solve by Gauss-Seidal method correct to 3 decimal places 7

$10x - 5y - 2z = 3, \quad 4x - 10y + 3z = 3, \quad x + 6y + 10z = 3.$

Perform four iterations.

(b) Using Adams-Moulton Method, solve $\frac{dy}{dx} = x^2(1 + y)$ for $x = 1.4$, Given that 7

$y(1) = 1, \quad y(1.1) = 1.233, \quad y(1.2) = 1.548, \quad y(1.3) = 1.979$

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