Reg No.:_______________ Name:_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (FT/WP) (S) and S2 Challenge Course Examinations April/May 2026 (2024 Scheme)

Course Code: GAMAT301

Course Name: MATHEMATICS FOR INFORMATION SCIENCE-3

Max. Marks: 60 Duration: 2 hours 30 minutes

PART A

	(Answer all questions. Each question carries 3 marks)	CO	Marks
1	In a certain city, during the month of July there will be 0, 1, 2 and 3 power failures with probabilities 0.4, 0.3, 0.2 and 0.1 . Find the mean and variance of the probability distribution.	CO1	(3)
2	10 fair coins are thrown simultaneously. Find the probability of getting at least 7 heads.	CO1	(3)
3	Find the value of 'b' so that the following function is a valid PDF $f(x) = \begin{cases} 2x, 0 \leq x \leq b \\ 0, otherwise \end{cases}$.	CO2	(3)
4	If X is normally distributed with mean1 and variance 4, find $P(-3 < X < 3)$.	CO2	(3)
5	Classify random processes with suitable examples.	CO3	(3)
6	The abridged version of the *Encyclopaedia Britannica* contains, on average, 1000 words per page. Using an appropriate inequality, determine an upper bound for the probability that a page contains more than 1200 words.	CO3	(3)
7	Define a Markov chain. Illustrate your answer with a suitable example.	CO4	(3)
8	Three boys A, B, and C play a game of passing a ball among themselves. A always throws the ball to B, B always throws it to C, while C is equally likely	CO4	(3)

to throw the ball to A or to B. Construct the transition probability matrix corresponding to this Markov process.

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

9	a)	Suppose the number of drivers who travel between a particular origin and destination during a designated time period has a Poisson distribution with parameter $\lambda = 20$. What is the probability that the number of drivers will: a). Be at most 10? b). Exceed 20? c). Be within 2 standard deviations of the mean value?	CO1	5
	b)	The joint probability mass function (PMF) of two random variables, X and Y, is given by: $f(x,y) = k(x+2y), \quad x = 1,2,3;\ y = 1,2,3.$ $= 0, \quad otherwise$ Find (i) k (ii) the marginal PMF of X and the marginal PMF of Y (iii) $P(X < 3,\ Y \geq 2)$	CO1	4
10	a)	The probability that an electric component manufactured by a firm is defective is 0.01. The produced items are sent to the market in packets of 10. In a consignment of 1000 such packets how many can be expected to contain (i) exactly 2 defectives (ii) at most 2 defectives?	CO1	5
	b)	The probability distribution of a discrete random variable X is given by $f(x) = \frac{k}{2^x}$ for $x = 0,1,2,3,4$. Find (i) the value of k (ii) the CDF of X	CO1	4

Module -2

11	a)	Each front tyre on a particular type of vehicle is supposed to be filled to a pressure of 26 psi. Suppose the actual air pressure in each tyre is a random variable X for the right tyre and Y for the left tyre, with joint pdf $$f(x,y) = \begin{cases} k(x^2+y^2), & 20 \le x \le 30, \quad 20 \le y \le 30 \\ 0, & otherwise \end{cases}$$ a). What is the value of k? b). What is the probability that both tyres are underfilled?	CO2	5
	b)	A random variable X follows an exponential distribution with mean 3. Find $P(X > 3)$ and the variance of X.	CO2	4
12	a)	In a normal distribution 7% of the items are below 35 and 89% are below 63. Find the mean and standard deviation of the distribution.	CO2	5
	b)	Buses arrived at a certain stop at 15-minute intervals starting at 7 am. A passenger arrives at the stop at a random time between 7 am and 7.30 am, find the probability that he waits (i) less than 5 minutes (ii) at least 12 minutes	CO2	4

Module -3

13	a)	Customers arrive at a service counter in accordance with a Poisson process with a mean 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. (iii) less than or equal to 4 minutes.	CO3	5
	b)	An internet service provider claims that the average download speed in a certain city is 50 Mbps with a standard deviation of 12 Mbps. The company wants to estimate the probability that a randomly selected household experiences a speed below 20 Mbps or above 80 Mbps. Find an upper bound of the probability.	CO3	4

14 In a game involving repeated throws of a balanced dice, a person receives Rs.3 if the resulting number is greater than or equal to 3 and loses 3 otherwise. Use the Central Limit Theorem to find the probability that in 25 trials his total earnings exceed Rs.25. CO3 9

Module -4

15 A Markov Chain $\{X_n,\ n = 0, 1, 2, \ldots\}$ on the state space $\{1, 2, 3\}$ has the transition probability matrix $P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.3 & 0.4 & 0.3 \\ 0.6 & 0.2 & 0.2 \end{bmatrix}$ and the initial probability distribution $p(0)= [0.7\ \ 0.2\ \ 0.1]$. Find CO4 9

(i) $P^{(2)}$

(ii) $P(X_2 = 3)$

(iii) $P(X_3 = 2,\ X_2 = 3,\ X_1 = 2,\ X_0 = 1)$

16 Assume that a computer system can be in one of three states: busy, idle, or under repair, denoted by 0, 1, and 2 respectively. The state of the system is observed daily at 2 p.m., and the transition probability matrix is CO4 9

$P=\begin{bmatrix} 0.6 & 0.2 & 0.2 \\ 0.1 & 0.8 & 0.1 \\ 0.6 & 0 & 0.4 \end{bmatrix}$. Compute the 3^{rd} -step transition probability matrix and find the limiting distribution of the Markov chain.

***