



## **BRAINWARE UNIVERSITY**

Term End Examination 2023
Programme – M.Sc.(MATH)-2021
Course Name – Stochastic Processes
Course Code - MSCME407
( Semester IV )

Full Marks: 60

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

## Group-A

(Multiple Choice Type Question)

1 x 15=15

1.	Choose the correct alternative from the follo	owing:	
(i)	Compute the variance of a negative binomial distribution with parameter r and p.		
	a) rp(1-p)	b) $r(1-p)/p^2$	
	c) $rp^2(1-p)$	d) $r^2p(1-p)$	
(ii)	Which of the following is known as 'mem	s known as 'memory less' property? Select the correct option.	
a) I	$P(X > s + t   X > t) = P(X > s), \forall s, t \ge$	0 b) $P(X < s + t   X > t) = P(X > s), \forall s, t \ge 0$	
c) i	$P(X > s + t) = P(X > s), \forall s, t \ge 0$	d) none of these	
(iii)	The probability of any event A satisfies	Select the correct option.	
	a) $P(A) \ge 1$	b) $P(A) < 0$	
	c) $0 \le P(A) \le 1$	d) None of these	
(iv)	The distribution function $F(x)$ of a random	variable V is given by [ ]	

- a)  $P(-\infty < X < \infty)$ b)  $P(-\infty < X \le x)$ c)  $P(-\infty \le X < \infty)$ d) none of these.
- (v) Let X(t) and Y(t) be two random processes with respective auto correlation functions  $R_{\chi\chi}(\tau)$  and  $R_{\chi\chi}(\tau)$ . Then compute  $\left|R_{\chi\chi}(\tau)\right|$

a) = 
$$\sqrt{R_{xx}(0)R_{yy}(0)}$$
 b)  $\geq \sqrt{R_{xx}(0)R_{yy}(0)}$ 

the correct option.

(vi)	Identify one of the conditions for a counting process $\{N(t), t \ge 0\}$ , is said to be Poisson process if-		
	a) N(0)=0	b) N(0)=1	
	a) N(1)-0	d) $N(1)=1$	
(vii)	The cost of providing service in a queueing sycorrect option.	stem decreases with Select the	
	a) decreased average waiting time	b) decreased arrival rate	
	c) increased arrival rate	d) none of these	
(viii)	A continuous time Markov chain is said to be a option.		
	a) it's with probability 1, the number of transitions in any finite length of time is finite.	b) it's with probability 0, the number of transitions in any finite length of time is finite.	
	c) it's with probability 1, the number of	d)	
	transitions in any finite length of time is infinite.	none of these	
(ix)	(ix) Identify one of the conditions for a counting process $\{N(t), t \ge 0\}$ , is said to be Poiss process if-		
	a) The process has non-stationary	b) The process has stationary and	
		independent increments	
(x)	c) The process has dependent increments Service mechanism in a queuing system is cha option.	d) The process is involuntary aracterized by Select the correct	
	a) Server's behaviour	b) Customer behaviour	
	c) Customers in the system	d) All of these	
(xi)	The condition for independence of two events option.	A and B is Select the correct	
	a) $P(A \cap B) = P(A)P(B)$	b) $P(A+B)=P(A)P(B)$	
	c) $P(A-B) = P(A)P(B)$	d) $P(A \cap B) = P(A)P(B/A)$	
(xii)	ii) Classify the process if the future value of a sample function cannot be predicted based on its past values.		
	a) Deterministic process	b) non-deterministic process	
	c) Independent process	d) Statistical process	
(xiii	A coin is tossed. The events {H}, {T} are	Select the correct option.	
	a) mutually exclusive	b) independent events	
/viv	c) dependent events ) In the long run, the state probabilities become	d) None of these e 0 & 1 Select the correct option.	
lvia	a) In no case	b) In same cases	
	a) In all cases	d) Cannot say	
(xv) Compute the mean of a negative binomial distribution with parameter r and p.			
(///		b) r/p	
	a) rp c) rp <sup>2</sup>	d) $r^2p$	
	-/ IP		

## Group-B

(Short Answer Type Questions)

3 x 5=15

2. Describe discrete time stochastic processes.

(3)

Consider the Markov chain with three states, S= {1,2,3}, that has the following transition matrix

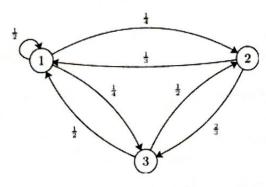
(3)

$$\begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$

Sketch the state transition diagram.

4. Consider the Markov chain shown in Figure

(3)



Determine if this chain is reducible.

5. Consider the following transition matrix

(3)

$$\begin{bmatrix} 0 & 1 \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

Justify if the matrix is valid TPM.

Consider the Markov chain with three states, S= {1,2,3}, that has the following transition matrix

$$\begin{bmatrix} 0 & 0 & 1 \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & 0 & \frac{1}{2} \end{bmatrix}$$

Determine if this chain is communicative.

OR

$$P = \begin{bmatrix} \frac{3}{4} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$
 (3)

Consider the Markov chain with two states and transition probability matrix Compute the stationary probabilities of the chain.

**Group-C** 

(Long Answer Type Questions)

5 x 6=30

(5)

- Summarize the concept of branching processes with an example.
- 8. Summarize the concept of birth and death processes with examples. (5)
- 9. Explain the concept of transition probability matrix with an example. (5)
- 10. Summarize the transition probability diagram in DTMC. (5)
- 11. Establish the concepts of merging independent Bernoulli processes with examples (5)
- 12. Summarize the concept of Periodic and aperiodic states in DTMC. (5)

OR

Summarize the concept of Recurrent and transient states in DTMC.

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