BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSc | **SEMESTER : IV**
BRANCH: QEDS | **SESSION : SP/2025**

SUBJECT: ED217 STOCHASTIC PROCESSES

TIME: 3 Hours | **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1	Let us suppose a gambler is playing a game and at each play, the probability of winning(losing) 1unit is p(q). Deduce the expression of the probability that starting with "i" units, the gambler wins the game for (i) p≠q and (ii) p=q	[10]	C01	II
Q.2(a)	University administrators have developed a Markov model to simulate graduation rates at their college. Students can be in 6 states i.e. first year, second year, third year, fourth year, drop out or graduate. Students might repeat a year or move on to the next year. Students have a 3% chance of repeating the year. First and second years have 6% chance of dropping out. For third and fourth year, the drop out rate is 4%. Find the probability that a student who starts as a first year eventually graduates.	[5]	C02	III
Q.2(b)	Let $P = \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix}\begin{bmatrix} 0 & 0.6 & 0.4 & 0 \\ 0.8 & 0 & 0 & 0.2 \\ 0.5 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ be a probability transition matrix. Find the expected number of transitions you need to reach state 4 starting from state 2.	[5]	C02	III
Q.3	Suppose a counting function X(t) represents the number of events occurring in time interval (0,t). Derive the expression for the probability that there are 'k' events occurring in (0,t).	[10]	C03	II
Q.4(a)	Define a martingale. Show that X_n is a martingale if $Z_i,\ i = 1,2,\ldots$ be a sequence of iid random variable with $\mathrm{E}(\mathrm{Z_i}) = 0$ & $\mathrm{Var}(\mathrm{Z_i}) = \sigma^2$ and $X_n = \sum_{i=1}^{n} Z_i^2 - n\sigma^2$.	[5]	C04	V
Q.4(b)	Let $Z_i,\ i = 1,2,\ldots$ be a sequence of iid random variable with exponential distribution defined as, $f(z) = \begin{cases} e^{-z}, & z \geq 0 \\ 0, & z < 0 \end{cases}$ and $S_n = Z_1 + Z_2 + \ldots + Z_n,\ n \geq 1$. If $X_n = 2^n exp(-S_n),\ \ n \geq 1$ then prove that X_n is a martingale.	[5]	C04	V
Q.5	Describe birth and death process briefly. Deduce the differential equations in birth and death process and the subsequent steady state solution in case of constant birth and death rate.	[10]	C05	III

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