**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(MID SEMESTER EXAMINATION SP/2025)**

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

**SUBJECT: ED217 STOCHASTIC PROCESSES**

**TIME: 02 Hours** **FULL MARKS: 25**

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 5 marks and total 25 marks.**
**2. All questions are compulsory.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

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| Q.1 | The t.p.m of a Markov chain $\{X_n$, n=1,2,3,…} having three states 1, 2 and 3 is P= $\begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ and the initial distribution is $\Pi_0 = (0.7, 0.2, 0.1)$. Find the following:<br>i) P[$X_2$=3, $X_1$=3, $X_0$=2]<br>ii) P[$X_2$=1| $X_0$=1] | [5] | C01 | III |
| Q.2 | Give a brief idea of Branching process. Show that the mean generation size of the $n^{th}$ generation of a branching process is $\mu^n$ , where μ is the mean of the offspring distribution, i.e E($X_n$) = $\mu^n$, for all $n \geq 0$. | [5] | C01 | II |
| Q.3 | State and deduce the relationship between the generating functions $P_{jj}$(s) and $F_{jj}$(s). | [5] | C02 | II |
| Q.4 | State Abel's Lemma and prove that state j is recurrent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} = \infty$. All notations have their usual meaning. | [5] | C02 | II |
| Q.5 | Define time reversibility in Markov chain. Consider the t.p.m of a Markov chain $\{X_n$, n=1,2,3,…} having three states 1, 2 and 3 as P= $\begin{bmatrix} 0 & 2/5 & 3/5 \\ 1/2 & 1/4 & 1/4 \\ 1/2 & 1/6 & 1/3 \end{bmatrix}$. Determine if the chain is time reversible or not. | [5] | C02 | III |

**::::::27/02/2025::::::E**