Name:

Enrolment No:

UPES

End Semester Examination, May 2024

Course: Time Series and Forecasting Methods **Semester: VI**

Program: B. Sc. (Hons.) Mathematics **Time: 03 hrs.**

Course Code: MATH 3037P **Max. Marks: 100**

Instructions: Attempt all questions.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Examine whether the Poisson process $\{X(t)\}$ is covariance stationary.	**4**	**CO3**
Q 2	Find the semi average for the following data: Year: 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008 Production: 20, 22, 23, 21, 25, 23, 27, 24	**4**	**CO1**
Q 3	Discuss the difference between AR (1) process and ARIMA process.	**4**	**CO2**
Q 4	Differentiate between seasonal variation and cyclical variation.	**4**	**CO4**
Q 5	Define auto covariance for time series.	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

		Marks	CO
Q 6	Calculate the five yearly moving average of the following data: Year: 1950, 1951, 1952, 1953, 1954, 1955, 1956 Values: 105, 115, 100, 90, 80, 95, 85	**10**	**CO1**
Q 7	Given a random variable Y with characteristic function $\varphi(\omega) = E(e^{i\omega Y})$ and a random process defined by $X(t) = \cos(\alpha t + Y)$, show that $\{X(t)\}$ is stationary in the wide sense if $\varphi(1) = \varphi(2) = 0$.	**10**	**CO2**
Q 8	Find the mean and variance of simple random walk.	**10**	**CO2**

<table>
<tr>
<td>Q 9</td>
<td>Compute the trend by the method of moving averages assuming a 4-yearly cycle is present in the following series.

<table>
<tr><td>Year</td><td>1958</td><td>1959</td><td>1960</td><td>1961</td><td>1962</td><td>1963</td></tr>
<tr><td>Annual Value</td><td>54.0</td><td>40.5</td><td>47.0</td><td>48.5</td><td>42.9</td><td>42.1</td></tr>
<tr><td>Year</td><td>1964</td><td>1965</td><td>1966</td><td>1967</td><td>1968</td><td></td></tr>
<tr><td>Annual Value</td><td>36.6</td><td>42.7</td><td>45.7</td><td>45.1</td><td>37.8</td><td></td></tr>
</table>

OR

Consider the following auto regressive model of order 2, $X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + Z_t$. For the following data set X_t: 3.91, 3.86, 3.81, 3.02, 2.62, 1.89, -1.13, -3.82, -5.08, -4.42. Use Yule-Walker equations to estimate the model.</td>
<td>10</td>
<td>CO3</td>
</tr>
<tr>
<td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td>
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<tr>
<td>Q 10</td>
<td>Consider a two-state Markov chain with the transition probability matrix

$$P = \begin{bmatrix} 1-a & a \\ b & 1-b \end{bmatrix} \qquad 0 < a < 1, 0 < b < 1$$

Assume that $a = 0.1$ and $b = 0.2$, and the initial distribution is $P(X_0 = 0) = P(X_0 = 1) = 0.5$.

i) Find the distribution of X_n . ii) Find the distribution of X_n when $n \to \infty$.</td>
<td>20</td>
<td>CO1</td>
</tr>
<tr>
<td>Q 11</td>
<td>The following table gives the sales figures for a hundred units of a product.

Quarters

<table>
<tr><th>Year</th><th>I</th><th>II</th><th>III</th><th>IV</th></tr>
<tr><td>1982</td><td>36</td><td>34</td><td>38</td><td>32</td></tr>
<tr><td>1983</td><td>38</td><td>48</td><td>52</td><td>42</td></tr>
<tr><td>1984</td><td>42</td><td>56</td><td>50</td><td>52</td></tr>
<tr><td>1985</td><td>56</td><td>74</td><td>68</td><td>62</td></tr>
<tr><td>1986</td><td>82</td><td>90</td><td>88</td><td>80</td></tr>
</table>

Use least square method to form equation and compute the demand for the product for the quarter wise using ratio to trend method.

OR</td>
<td>20</td>
<td>CO4</td>
</tr>
</table>

Compute seasonal indices from the following time series data using method of link relative:

Year/Quaters	Quaterly output of coal for 4 years			
	I	II	III	IV
2001	65	58	56	61
2002	68	63	63	67
2003	70	59	56	52
2004	60	55	51	58