2025

M.Sc. 3rd Semester Examination

APPLIED MATHEMATICS

Paper : MTM - 303 A & B

Full Marks : 50 Time : Two Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Paper : MTM - 303A

(Stochastic Process and Regression)

[Marks - 20]

1. Answer any *two* questions : 2×2=4

(a) Define the terms :

(i) accessible state

(ii) closed state

(iii) periodic state

(iv) aperiodic state

(b) What do you mean by a step of a Markov chain, and explain with an example.

P.T.O.

(c) Draw the diagram for a Markov chain with three states, whose transition probability matrix is

$$\begin{bmatrix} 0.8 & 0.2 & 0 \\ 0.2 & 0.5 & 0.3 \\ 0 & 0.6 & 0.4 \end{bmatrix}$$

(d) Write down the expression for the multiple correlation coefficient and the partial correlation coefficient. Also, write the ranges of these two correlation coefficients.

2. Answer any ***two*** questions : 4×2=8

(a) Prove that $1-r_{1.23}^2=\left(1-r_{12}^2\right)\left(1-r_{13.2}^2\right)$. The symbols have their usual meanings.

(b) Deduce the differential equation for the forward Wiener process.

(c) Deduce the differential-difference equation for the birth and death process.

(d) State the Gambler's ruin problem and write the transition probability matrix for it.

3. Answer any ***one*** question : 8×1=8

(a) Deduce the multiple regression equation of x_1 on $x_2, x_3, \ldots, x_p$ in terms of the means, the standard deviations and the inter-correlations of the variables.

(b) Show that the generating function $P_n(s)$ for the branching process satisfies the following relations :

(i) $P_n(s) = P_{n-1}(P(s))$ and

(ii) $P_n(s) = P(P_{n-1}(s))$, where $P_1(s) = P(s)$.

P.T.O.

Paper : MTM - 303B

(Cryptography)

[Marks - 20]

1. Answer any *two* questions : 2×2=4

   (a) What is cryptography and cryptanalysis?

   (b) Define symmetric-key encryption and draw its graphical model.

   (c) Write down a short note on "Block Ciphers".

   (d) What is the meaning of 'digital signature' to use in public-key cryptosystem?

2. Answer any *two* questions : 4×2=8

   (a) Explain the concepts "Brute-force Attacks" and "Hypertext Transfer Protocol".

   (b) Write down the algorithm of Data Encryption Standard (DES) and illustrate it graphically.

   (c) Explain "Play fair cipher" for substitution technique and write down its working rules.

   (d) Define Public-key certificate. Describe the six ingredients for Public-key encryption.

3. Answer any *one* question : 8×1=8

   (a) (i) What do you mean by "One-Time Pad"? 2

(ii) Define Hill cipher. Write down the algorithm of Hill cipher and verify it using an example. 1+2+3

(b) Write down the statement of "Feistel Cipher". Describe Feistel cipher structure and draw its graphical representation to encrypt the data. Hence, write down its all parameters and design features. 2+3+3

[Internal Assessment - 10 marks]
