

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

CLASS: BE  
BRANCH: ECE

SEMESTER: VII  
SESSION : MO/2018

SUBJECT : MEC1011 PROBABILITY MODELS AND STOCHASTIC PROCESSES

TIME: 1.5 HOURS

FULL MARKS: 25

**INSTRUCTIONS:**

1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

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- Q1 (a) Describe the probability distribution function and probability density function with their properties? [2]  
(b) A particular random variable has probability distribution function given by [3]  
Find the probability that  $0.3 < X \leq 0.7$ ? 
$$F_X(x) = \begin{cases} 0, & -\infty < x < 0 \\ 1 - e^{-2x} & 0 \leq x \leq \infty \end{cases}$$
- Q2 (a) Define conditional probability and conditional expectation? [2]  
(b) A mouse is trapped in a room with three exits at the centre of a maze. Exit 1 leads outside the maze after 3 minutes, exit 2 leads back to the room after 5 minutes and exit 3 leads back to the room after 7 minutes. Every time the mouse makes a choice, it is equally likely to choose any of the three exits. What is the expected time taken for the mouse to leave the maze? [3]
- Q3 (a) Define Jointly Gaussian random variables with properties. [2]  
(b) Find a constant 'b' so that the function  $f_X(x) = \begin{cases} \frac{1}{10} e^{3x} & 0 \leq x \leq b \\ 0 & \text{elsewhere} \end{cases}$  is a valid PDF. [3]
- Q4 (a) Explain central Limit theorem with suitable example. [2]  
(b) A joint probability density function is given as: [3]  
$$f(x, y) = \begin{cases} \frac{1}{ab} & \text{for } 0 < x < a, 0 < y < b \\ 0 & \text{elsewhere} \end{cases}$$
  
Find the joint probability distribution function?
- Q5 (a) Discuss stationary vs non stationary random processes. [2]  
(b) A stationary random process has a band limited spectral density of the form [3]  
$$S_X(f) = \begin{cases} 0.1, & |f| < 1000 \\ 0, & \text{elsewhere} \end{cases}$$
  
Find the smallest value of  $\tau$  for which  $R_X(\tau) = 0$ ?
- Q6 (a) Define auto correlation and cross correlation function. [2]  
(b) The joint pdf of a bivariate random variable (X, Y) is given as [3]  
$$f_{X,Y}(x, y) = \begin{cases} ke^{-(ax+by)} & x > 0, y > 0 \\ 0 & \text{elsewhere} \end{cases}$$
  
Find k and discuss whether X and Y are independent?

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