

**II B.Tech II Semester Supplementary Examinations,  
November/December 2005  
PROBABILITY & RANDOM VARIABLES  
(Bio-Medical Engineering)**

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions  
All Questions carry equal marks**

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1. (a) Distinguish between mutually exclusive events and independent events.
- (b) A letter is known to have come either from LONDON or CLIFTON. On the postmark only the two consecutive letters 'ON' are legible. What is the Chance that it came from London? Give step-by-step answer.
- (c) Show that the chances of throwing six with 4,3 or 2 dice respectively are as 1:6:18.

[4+6+6]

2. (a) If A and B are independent events, prove that the events  $\bar{A}$  and B,  $\bar{A}$  and  $\bar{B}$ ; and A and  $\bar{B}$  are also independent. [6]
- (b) A1, A2 and A3 are three mutually exclusive and exhaustive sets of events associated with a random experiment E1. Events B1,B2 and B3 are mutually exclusive and exhaustive sets of events associated with a random experiment E2. The joint Probabilities of occurrence of these events and some marginal probabilities are listed in the table given below:

	B1	B2	B3
A1	3/36	*	5/36
A2	5/36	4/36	5/36
A3	*	6/36	*
P(Bj)	12/36	14/36	*

- i. Find the missing probabilities (\*) in the table.
- ii. Find  $P(B3|A1)$  and  $P(A1|B3)$
- iii. Are events A1 and B1 statistically independent?

[4+4+2]

3. (a) For a function  $Y=(X - m_x)/\sigma_x$ , prove that mean is zero & variance is 1
- (b) For the joint distribution of (X,Y) given by
 
$$f_{xy}(x, y) = \frac{1}{4a^2} [(1 + xy)(x^2 - y^2)], |x| \leq a, |y| \leq a, a > 0$$

$$= 0, \text{ otherwise}$$

Show that the Characteristic function of X+Y is equal to the product of the characteristic function of X & Y.

[8+8]

4. Consider a Random binary waveform that consists of a sequence of pulses with the following properties
- (a) Each pulse is of duration  $T_0$
  - (b) Pulses are Equally likely to be  $\pm 1$
  - (c) All pulses are statistically independent
  - (d) The pulses are not synchronized, that is, the starting time  $T$  of the first pulse is Equally likely to be anywhere between 0 and  $T_b$

Find the Auto correlation and power spectral density function of  $x(t)$ . [8+8]

5. Find the input auto correlation function, output autocorrelation and o/p spectral density of RC low pass filter, where the filter is subjected to a white noise of spectral density  $N_0/2$ . [16]

6. (a) What are the different man made noises introduced in the communication system?
- (b) Write a short note on noises introduced by extra terrestrial objects.

[8+8]

7. (a) An amplifier has input and output impedances of 75 ohm, 60dB power gain, and a noise equivalent bandwidth of 15KHz. When a  $75\Omega$  resistor at  $290K$  is connected to the input, the output rms noise voltage is 75microvolt. Determine the effective noise temperature of the amplifier assuming that the meter is impedance matched to the amplifier.
- (b) List the devices in which narrowband noise can be present.

[8+8]

8. (a) State the axioms of an entropy function. Show that only function which satisfies the above axiom is,

$$H(P_1, P_2, \dots, P_n) = -\lambda \sum_{i=1}^n p_i \log_2 p_i$$

- (b) A man is informed that when a pair of dice was rolled, the result was a seven. How much information is there in this message?

[8+8]

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