Roll No. | | | | | | | | | | |

B.E / B.Tech (FULL-Time) DEGREE ARREAR EXAMINATIONS, APRIL / MAY 2014

ELECTRONICS AND COMMUNICATION BRANCH

7th Semester

EC 9027 - INFORMATION THEORY

(Regulation – 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Define entropy and relative entropy.
2. State chain rule for entropy and mutual information.
3. What is meant by prefix code and instantaneous code?
4. List out the properties of Asymptotic Equipartition.
5. Enumerate the properties of channel capacity.
6. An analog source has a 4 kHz BW. The signal is sampled at 2.5 times the Nyquist rate. Each sample is quantized into 250 equally likely levels. The successive samples are statistically independent. What is the information rate of the source?
7. A Gaussian channel has 1 MHz bandwidth. Calculate the channel capacity if the signal power to noise spectral density ratio (S/η) is 10^5 Hz. Also find the maximum information rate.
8. What is the significance of Shannon limit? How can it be increased?
9. State Slepian-Wolf theorem for many sources.
10. What is correlated source encoding?

PART-B (5x16 = 80 Marks)

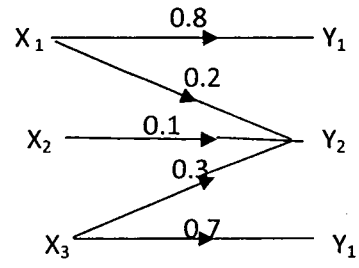
11. State and prove the FISHER information and the Cramer-Rao inequalities. Explain their significances and give their applications.

12.(a) Prove and justify the following:
(i) Any codeword set that satisfies the prefix condition has satisfies the Kraft inequality.
(ii) The length of code words for a uniquely decodable code will also satisfy the Kraft inequality.

OR

12.(b) Consider the random variable X = $\{x_1, x_2, x_3, x_4, x_5, x_6, x_7\}$ with probabilities (0.49, 0.26, 0.12, 0.04, 0.04, 0.03, 0.02) respectively. Determine a binary Huffman code for X, expected code length for this encoding, ternary Huffman code for X and determine a Shannon Fano code for X.

13.(a) A discrete source transmits message x_1, x_2 and x_3 with the probabilities 0.3, 0.4 and 0.3. The source is connected to the channel given in Figure. Calculate all the entropies.



OR

13.(b)(i) Explain Binary Symmetric channel and Binary Erasure channel. **(8)**

(ii) State and prove the joint source channel coding theorem. **(8)**

14.(a) Define Shannon Hartley theorem and derive the channel capacity of a white band limited Gaussian channel.

OR

14.(b)(i) State and prove the upper bound for the capacity of the Gaussian channel with feedback. **(8)**

(ii) State and prove the properties of differential entropy, relative entropy and mutual information. **(8)**

15.(a) Derive and explain the achievability of the capacity region for a multiple access channel.

OR

15.(b) Explain the source coding with side information and rate distortion with side information.
