Master of Computer Science & Engg. 1st Semester Examination, 2017

Information and Coding Theory

Full marks: 100

Time: 3 hours

Attempt any five questions

1. a) Find out the expression for entropy of a source. Prove that entropy is maximum when all the source symbols are equi-probable.   3+4
   b) Probability that a person is male, p(M)=.5 and same is p(F), a person is female. 20% of males are tall (T) and 6% of females are tall. Calculate the information (in bits) associated with the event -- if a person is tall then the person is male.   6
   c) Show that $H(X, Y) <= H(X)+H(Y)$ 7

2. a) State and proof Kraft's inequality.   10
   b) A zero memory source X generates 4 symbols with probabilities 1/2, 1/4, 1/8 and 1/8. Encode the symbols of X^3 using Huffman coding. Also find the efficiency of the code.   10

3. a) Define a symmetric channel. Obtain the expression for the channel capacity of a symmetric channel.   3+5
   b) Define transmission efficiency of a channel. I(X,Y) is the mutual information of a BSC. Show that $I(X^2, Y^2) = 2I(X,Y)$.   3+4
   c) What is a Markov source? How its behavior may be represented?   5

4. a) Differentiate between i) random error and burst error, ii) FEC and ARQ strategies.   5
   b) Describe product code and its capability of handling single and double error.   7
   c) Define minimum distance of a block code. What is the joint error correction and detection capability of a block code with d_{min} =7? What is a perfect code?   2+ 3+3

5. a) Explain, (n, k) block code is linear if the code words form k-dimensional subspace of vector space of all n-tuples over GF(2). Based on the same idea formulate the generator matrix.   10

b) Consider a t error correcting (n, k) block code is being used strictly for error correcting on a BSC with bit error probability p. Find the limit on erroneous decoding. 5

c) Consider (n, k) linear code with minimum distance d_{min}. Show that it can correct t or fewer errors where $2t+1 <= d_{min} <= 2t+2$. 5

6. a) What is standard array? How does it help in error correction? 7

b) Show that a polynomial of degree (n –k) which is also a factor of $x^n + 1$ generates cyclic code. 7

c) For a (7,4) cyclic code, assume $1+x+x^3$ is the generator polynomial. If 1+x be the message polynomial then find out the code polynomial in systematic form. If error polynomial is $x+ x^3$, find out the syndrome. 6

7. a) Draw the schematic diagram of Meggitt decoder for (n, k) cyclic code. Explain the steps with justification and also establish how the effect of error pattern is removed from the syndrome. 4+7+3

b) State and proof, when the error is trapped in an error trapping decoder. 6

8. write short notes on the following:
   a) Adjoint source
   b) Cascading BSCs
   c) Maximum likelihood decoding
   d) Hamming code
   e) Incorrect decoding and decoding failure   3+5+4+4+4