B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Fifth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE126**:** Information Theory and Coding

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   Which of the following statements is always true?
   a) If $H(X \mid Y) = H(X) − H(Y)$ then X and Y are independent.
   b) If $H(X \mid Y) = 0$ then X and Y are independent.
   c) If the mutual information $I(X,Y) = 0$, then X and Y are independent.
   d) If $H(X, Y) = 0$ then X and Y are independent

2.   Which of the following sets of codewords could be the Huffman code for some 4 symbol source alphabet?
   a) 01, 10, 00, 111
   b) 0, 10, 110, 111
   c) 1, 01, 10, 001
   d) 0, 110, 111, 101

3.   The code rate of encoder is the ratio of _____ and number of encoded output bits.
   a) Constraint length
   b) Code length
   c) Number of storage elements
   d) Number of parity bits

4.   Which one of the following is true about Turbo codes?
   a) Turbo codes are non- linear block codes
   b) Turbo decoding uses soft input hard output decoding algorithm.
   c) Turbo codes are compound codes
   d) Turbo code is a class of source code

5.   A Lempel-Ziv dictionary starts with two entries – "0" and "1". The dictionary size after parsing the symbol stream 00101100 is
   a) 4
   b) 5
   c) 6
   d) 7

6.   The coding efficiency of arithmetic coding is expected to improve if
   a) The interval of real numbers is increased to [0, 10)
   b) Shorter sequence of source symbols is encoded.
   c) Longer sequence of source symbols is encoded.
   d) The knowledge of the previous encoding is used.

7.   Adaptive quantizers used in DPCM adjust their decision and reconstruction levels in accordance with
   a) local statistics of the prediction error
   b) local statistics of the intensity values of the predicted image
   c) local statistics of the intensity values of the original image
   d) variation in channel characteristics

8.   Pick the odd one out from the list.
   a) Delta modulation
   b) Differential pulse code modulation
   c) Linear Predictive coding
   d) Sub band coding

9.   The number of frames between successive I-frames is known as------------
   a) GOP
   b) prediction span
   c) motion estimation
   d) motion prediction

10.   "Temporal redundancy" refers to the fact that
   a) Neighboring pixels in a frame have varying intensities.
   b) Neighboring pixels in a frame have similar intensities.
   c) Pixels in the same location across successive frames have varying intensities.
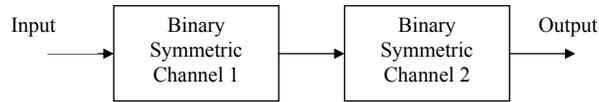   d) Pixels in the same location across successive frames have similar intensities

PART B (10 x 2 = 20 Marks)

11.   State the importance of Kraft Mc Milan inequality.

12.   A voice-grade channel of the telephone network has a bandwidth of 3.4 kHz. Calculate the channel capacity of the telephone channel for a signal to noise ratio of 30 dB.

13.   Write the two most advantages of LDPC codes over turbo codes.

14.   Write the Generator matrix and Parity check matrix using the generator polynomial $g(D) = 1+D^2+ D^3$ of a (7,3) code.

15.   State the basic principles of Lempel-Ziv coding.

16.   What should be the design consideration for quantization level in Delta modulation?

17.   How ADPCM codes speech at low bit rates?

18.   Bring out the importance of bit allocation in sub band coding.

19.   Write the principles involved in MM-READ coding applied to compressing digitized documents.

20.   Differentiate between CIF and QCIF resolution used in H.261 video standard.

PART C (5 x 14 = 70 Marks)

21.   a)   Two binary symmetric channels are connected in cascade, as shown in figure

below. Find the mutual information of the cascaded connection, assuming that both channels have same transition probability. Assume the probability of error p=0.2.

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Input    ┌──────────┐      ┌──────────┐    Output
─────────▶│  Binary  │─────▶│  Binary  │──────▶
          │Symmetric │      │Symmetric │
          │Channel 1 │      │Channel 2 │
          └──────────┘      └──────────┘
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(OR)

b) Apply Huffman's encoding procedure to the following message ensemble and determine the coding efficiency.

[x] = [x1, x2, x3, x4, x5, x6, x7, x8, x9, x10]

P [x] = [0.17, 0.18, 0.15, 0.02, 0.05, 0.12, 0.08, 0.05, 0.10, 0.08]

The encoding alphabet is [A] = [0, 1].

22. a) (i) Draw the convolutional encoder for the following specifications. (4)

Code rate =1/2

No. of stages of the shift register M= 3

Constraint Length K = 4

Generator Sequences g1= (1,1,1,1) & g2 = (1,1,0,1)

(ii) Let the input to the convolutional encoder developed in 22 a (i) be 1011011011. (10) Decode the given sequence using Viterbi algorithm.

(OR)

b) Draw the encoder and decoder for the generator $g(x) = 1+x+x^3$ and demonstrate the operation with an example.

23. a) Consider A = { a_1 a_2 a_3 } with P{A} = {0.8, 0.02, 0.18}. With the definition of random variable $X(a_i) =i$, consider a sequence 1232. Obtain the tag for the given sequence. Explain how the deciphering of the tag can be done.

(OR)

b) Illustrate adaptive Huffman coding with the given text: "mississippi". Clearly explain each step.

24. a) (i) What is slope overload distortion and granular noise and how it is overcome in (7) adaptive delta Modulation?

(ii) For a sinusoidal modulating signal m(t) = A cos ω_mt, where $\omega_m= 2\pi f_m$, show that (7)

the maximum output signal to quantization noise ratio in a DM system under the assumption of no slope overload is given by,

$$SNR_o = \left[\frac{S}{N_q}\right] = \frac{3 f_s^3}{8 \pi^2 f_m^3 f_M}$$

where $f_s = 1/T_s$ is the sampling rate and f_M is the cut off frequency of a low pass filter at the output end of the filter.

(OR)

b) (i) Explain how frequency masking and temporal masking are helpful in designing (10) MPEG audio coders?

(ii) In what ways do Dolby audio coders differ from MPEG audio coders? (4)

25. a) Explain the implementation schematic of H.261.Also, explain macro- block and frame /picture encoding formats of H.261.

(OR)

b) Discuss the encoding procedure used for compressing motion vectors, P-Frames and B-Frames in an MPEG compression scheme with appropriate diagrams.

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