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14ECS41

Fourth Semester M.Tech. Degree Examination, June/July 2016

Error Control Coding

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***

2. GF(2^4). Use minimal polynomial table for $1+\alpha+\alpha^4=0$.

1 a. For a set of integers G = {0, 1, 2, ..., m – 1} where 'm' is any +ve integer, show that $(i \boxplus J) \boxplus k = i \boxplus (J \boxplus k)$ where $\boxplus$ denotes modulo 'm' addition. **(08 Marks)**

b. Solve for x and y, from the following linear equations over GF(2^4):

$$x+\alpha^7 y=\alpha^2, \qquad \alpha^{12}x+\alpha^8 y=\alpha^4$$ **(06 Marks)**

c. Find minimal polynomial for x^2+x+1 for GF(2^4). **(06 Marks)**

2 a. Design (n, k) hamming code with a minimum distance of $d_{min} = 3$ and message length of 4 bits.

i) Construct G and H matrix.
ii) List all the code vectors.
iii) What is the error correcting capability? **(06 Marks)**

b. In a (7, 4) linear block code the parity check matrix H is given by,

$$H=\begin{bmatrix}1&1&1&0&1&0&0\\0&1&1&1&0&1&0\\1&0&1&1&0&0&1\end{bmatrix}$$

i) Find the generator matrix G.
ii) Find the codeword for all the messages.
iii) Find the minimum distance between the codes.
iv) Write the encoder and decoder circuit.
v) If the received data is 1011011, is it a valid code? If code is not valid, assuming single error, write the valid code. **(10 Marks)**

c. Write a short note on interleaved codes. **(04 Marks)**

3 a. The Golay code of (24, 12) is used for error correction, decode the following R_x^d sequence:
r = [101101110010000011000011] **(12 Marks)**

b. For a (7, 4) linear block code, the received vector r = 1110101, g(x) is $1+x+x^3$, draw (n – k) stage syndrome circuit. Correct the error in the received vector. **(08 Marks)**

4 a. 'α' is a primitive element of the Galois field of GF(2^4) such that $1+\alpha+\alpha^4=0$. Given double and triple error-correcting BCH code, find its generator polynomial. **(10 Marks)**

b. Consider the double error correcting (15, 7) BCH code and find the syndrome if the received vector is r = (100000001000000) in GF(2^4). **(10 Marks)**

5 a. Determine the parameters of Q-ary RS code over GF(16) for $d_{min} = 9$. Also find the total number of code words in the code and also the nearest neighbors for any code word at a distance $d_{min} = 9$. **(12 Marks)**

b. Explain the procedure of error correction using type-II one step majority logic decoder. **(08 Marks)**

6 a. A rate of R = 2/3 non systematic feed forward convolutional encoder (3, 2, 1) shown in Fig.Q6(a). Find the code-word C for i/p sequence using convolution and matrix approach.

$u^1 = 101, \quad u^2 = 110$

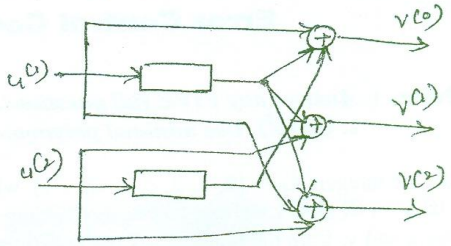

Fig.Q6(a) **(12 Marks)**

b. Consider (3, 1, 5) systematic feed forward encoder with $g^{(0)} = (101101)$, $g^{(1)} = (110011)$.
   i) Find time domain of G
   ii) Find the sequence $v^{(1)}$ and $v^{(2)}$ for the i/p sequence u = 1101. **(08 Marks)**

7 a. Explain with a flowchart of the Stack and Fano sequential decoding algorithm. **(12 Marks)**

b. Give the steps involved in viterbi algorithm. **(08 Marks)**

8 a. Explain with neat diagram of communication system using a concatenated codes. **(08 Marks)**

b. Explain the basic encoding structure of turbo codes. **(06 Marks)**

c. With neat diagram, explain the error trapping decoder for burst error correcting codes. **(06 Marks)**

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14ECS425

Fourth Semester M.Tech. Degree Examination, June /July 2016
Advanced Radar Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Starting from the basic principles, derive radar range equation in terms of transmitted power, antenna again and minimum detectable signal power of the receiver. Deduce the equation to other forms also. **(10 Marks)**

b. A 10 GHz radar has the following characteristics "Peak transmitted power = 250 KW, power gain of antenna = 2500, minimum detectable peak signal power by the receiver = 10^{-14} watt, cross –sectional area of the radar antenna = 10 sq.m. If this radar were to be used to detect a target of 2 sq. m. equivalent cross-section, find the maximum range possible. **(02 Marks)**

c. Mention the different types of radars with brief explanations. **(08 Marks)**

2 a. Give a brief account of frequencies used by radar with neat table illustrating band designation, nominal frequency range and specific frequency ranges. What are the effects of operating frequencies on rader? **(08 Marks)**

b. With necessary equations and waveforms, explain the waveform, spectrum, energy and autocorrelation functions of real radar signals and complex radar signals. **(10 Marks)**

c. An automobile vehicle moving at a speed of 54 KMPH produces a Doppler shift of 400 Hz in the radial direction. Determine the frequency of the transmitted wave. **(02 Marks)**

3 a. Explain parabolic reflector antenna and cassegrain reflector antenna with neat diagrams. **(06 Marks)**

b. Derive the equation for array factor and radiation intensity pattern for a circular planar array and explain clearly how beam steering can be achieved in array antenna used in radars. **(08 Marks)**

c. Explain briefly low–side lobe phased arrays with illumination functions. **(06 Marks)**

4 a. Explain the three classes of propagation paths and derive the nomistatic radar range equation including the two way propagation factor. **(10 Marks)**

b. Explain the different layers of ionosphere in radio wave propagation. Also derive the expression for conospheric refractive index in terms of transmit frequency and plasma frequency. **(10 Marks)**

5 a. Explain a matched filter and its frequency response function, impulse response and receiver bandwidth used in radar networks. Derive the equation for matched filter frequency response. **(08 Marks)**

b. Explain the following :
i) Neyman–Pearson detection criterion
ii) Likelihood–ratio detection criterion **(06 Marks)**

c. What do you mean by CFAR receiver? Explain cell averaging CFAR with neat block diagram. **(06 Marks)**

6 a. With the help of a neat block diagram, explain the working of a digital MTI. Explain with neat sketches how blind phases are eliminated by the DMTI. **(10 Marks)**

b. Explain receive channel processing with all relevant steps involved in the processing with neat block diagram and waveforms. **(10 Marks)**

7 a. What is meteorological radar? Derive the radar equation for meteorological targets starting from basic principles. **(10 Marks)**

b. Explain an ocean viewing radar altimeter with a neat generic signal flow diagram. **(10 Marks)**

8 Write short notes on :

a. Radar clutter

b. Synthetic aperture radar

c. Multipath propagation

d. Secondary surveillance radar. **(20 Marks)**

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