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Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2017

Seventh Semester

Branch : Electronics and Communication Engineering

EC 010 702—INFORMATION THEORY AND CODING (EC)

(New Scheme—2010 Admission onwards)

[Regular/Supplementary]

Time : Three Hours

Maximum : 100 Marks

Part A

*Answer all questions.
Each question carries 3 marks.*

1. Define mutual information and state the two properties of mutual information.
2. What is meant by prefix coding ? Give examples.
3. Define channel capacity theorem for a discrete memory less channel.
4. State linear block codes. Give examples.
5. Present the properties of hamming codes.

(5 × 3 = 15 marks)

Part B

*Answer all questions.
Each question carries 5 marks.*

6. A four symbol alphabet has the probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}$ and $\frac{1}{8}$ with an entropy of 1.75 bits. Find a codebook for this four symbol alphabet that satisfies source coding theorem.
7. Consider the random variable $X = \{x_1, x_2, x_3, x_4, x_5, x_6, x_7\}$ with probabilities $\{0.4, 0.32, 0.12, 0.05, 0.05, 0.04, 0.02\}$ respectively. Determine a binary huffman code for X and compute the expected codelength for this encoding.
8. State the properties of channel capacity.
9. Present the syndrome decoding algorithm.
10. Explain the principles of turbo codes using examples.

(5 × 5 = 25 marks)

Turn over

Part C

Answer all questions.
Each question carries 12 marks.

11. Prove the chain rules for entropy, relative entropy and mutual information.

Or

12. (a) Let (X, Y) have the following joint distribution :

| | | | |
|---|---|-----|-----|
| | X | 1 | 2 |
| Y | | | |
| 1 | | 0 | 3/4 |
| 2 | | 1/8 | 1/8 |

Find $H(X)$, $H(Y)$, $H(X|Y)$, $H(Y|X)$, $H(X, Y)$.

(6 marks)

(b) Explain rate of information transmission with an example.

(6 marks)

13. (a) Prove that any codeword that satisfies the prefix condition satisfies the Kraft's inequality.

(6 marks)

(b) Find the bounds on the length of the optimal codes.

(6 marks)

Or

14. With the given symbols and probabilities of occurrence, encode the message "went#" using arithmetic coding :

| | | | | | | |
|-------------|---|-----|-----|-----|-----|-----|
| Symbols | : | e | n | t | w | # |
| Probability | : | 0.3 | 0.3 | 0.2 | 0.1 | 0.1 |

15. State and prove Channel coding theorem.

Or

16. An analog signal having 4 Hz bandwidth is sampled at 2.5 times the Nyquist rate and each sample is quantized into one of the 256 equally likely levels. The successive samples are statistically independent :

- Can the output of this source be transmitted without errors over a Gaussian channel with a bandwidth of 50 Hz and S/N ratio of 23 dB.
- What will be the bandwidth requirement to transmit the output of this source without errors if S/N ratio is 12 dB ?
- Calculate the information rate of this source.

17. The parity check matrix of a (7, 4) hamming code is given as $H = \begin{bmatrix} 1110:100 \\ 0111:010 \\ 1101:001 \end{bmatrix}$.

(a) Calculate the syndrome vector for single bit errors.

(7 marks)

(b) Explain the procedure to detect the errors.

(5 marks)

Or

18. Discuss the capabilities of a linear block code.

19. Verify if $g(x) = 1 + x + x^2 + x^3 + x^4$ is a valid generator polynomial for generating a cyclic code for message [1 1 1].

Or

20. Construct a convolution encoder for the specifications : rate efficiency = $\frac{1}{2}$; constraint length = 4.

The connections from the shift to modulo 2 adders are described as $g_1(x) = 1 + x$; $g_2(x) = x$.

Determine the output codeword for the input message [1 1 1 0].

[5 × 12 = 60 marks]

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B.TECH. DEGREE EXAMINATION, NOVEMBER 2017

Seventh Semester

Branch : Electronics and Communication Engineering

EC 010 703—MICROWAVE ENGINEERING (EC)

(New Scheme—2010 Admission onwards)

[Regular/Supplementary]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer all questions.

Each question carries 3 marks.

1. What is S matrix ? State its properties.
2. What is the function of Helix in TWT ?
3. Explain the potential applications of Tunnel Diodes ?
4. Define VSWR and reflection coefficient.
5. What are the advantages of microstrip lines over strip lines ?

(5 × 3 = 15 marks)

Part B

Answer all questions.

Each question carries 5 marks.

6. With neat diagram, explain the operation of a 3 port circulator.
7. Describe the action of the slow-wave structure in a TWT.
8. Explain two-valley model of a Gunn diode ?
9. Describe a method of measuring low VSWR.
10. A microstrip line has a substrate 1 mm thick with a Dielectric constant $\epsilon_r = 8$. The strip width $W = 2.5$ mm. Find the low frequency equivalent dielectric constant and the characteristic impedance.

(5 × 5 = 25 marks)

Turn over

Part C

Answer all questions.

Each full question carries 12 marks.

11. Explain the terms : Coupling factor and directivity of directional coupler. Obtain the reduced S matrix of the directional coupler.

Or

12. Describe the construction and properties of an E plane Tee. Obtain the simplified S matrix of the E-plane Tee.

13. Derive expressions for exit velocity for both Klystron amplifier and Reflex Klystron oscillator. Explain the principle of any one of these.

Or

14. Explain how oscillations are sustained in the cavity magnetron, with suitable sketches, assuming that the TT mode oscillations already exist.

15. Draw the schematic diagram of an IMPATT diode and explain the two effects that combine to produce a 180° phase difference between the applied voltage and the resulting current pulse.

Or

16. Derive the Manely-Rowe power relations and obtain the expression for the power gain of an upconverter non-inverting parametric amplifier using these relations. What are the merits of the parametric amplifiers?

17. Describe the methods employed for the measurements of reflection coefficient, return loss and Q of a cavity.

Or

18. (a) Describe the experimental set up and practical procedure of measuring the impedance of a load at microwave frequencies.

(9 marks)

- (b) A transmission line of characteristic impedance 50Ω is terminated by an unknown load. VSWR is measured as 2. What is the load impedance?

(3 marks)

19. (a) Compare different properties of the materials used for MICs.

(6 marks)

- (b) Mention the factors on which the selection of materials for MICs are based on.

(6 marks)

Or

20. (a) A transmission line with $Z_0 = 600 \Omega$ and length 150 m is operated at 400 KHz with $\alpha = 2.4 \times 10^{-3} \text{ Np/m}$ and $\beta = 0.0212 \text{ rad/m}$. The load impedance is $Z_L = 424.3 \angle 45^\circ$. Find the following.

(i) The length of the line in wavelength.

(ii) Reflection coefficient at the load.

(iii) Reflection coefficient at the source.

(iv) Sending-end impedance and

(v) If the load voltage is $V_L = 50 \text{ V}$, find the sending-end voltage.

[5 × 12 = 60 marks]