

INTRODUCTION TO ANALOG & DIGITAL COMMUNICATION (ECE2201)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Theoretical bandwidth of wideband FM wave is
 - (a) $2f_m$
 - (b) $(2f_m + \Delta f)$
 - (c) Infinity
 - (d) $(2f_m - \Delta f)$
- (ii) In phasor representation of an AM signal the resultant and the carrier phasor for $\omega_m t > \pi/2$ are
 - (a) always in phase quadrature
 - (b) always out of phase
 - (c) in any phase relationship
 - (d) none of the above
- (iii) Which encoding method uses alternating positive and negative values for 1s?
 - (a) NRZ
 - (b) RZ
 - (c) Manchester
 - (d) AMI
- (iv) Granular noise in DM occurs when
 - (a) signal changes rapidly with time
 - (b) signal remains constant with time
 - (c) there is interference from the adjacent channel
 - (d) bandwidth is too large
- (v) In a non-orthogonal BFSK system with 10 kbps data rate, '1' & '0' are represented by 25 KHz & 15 KHz sinusoid the bandwidth of BFSK is
 - (a) 20 KHz
 - (b) 30 KHz
 - (c) 40 KHz
 - (d) 50 KHz
- (vi) The output SNR of a matched filter, fed at its input by a rectangular pulse of amplitude A and duration T is given as (noise power spectral density)
 - (a) $2A^2 T / \sigma$
 - (b) AT
 - (c) A/T
 - (d) A/ σ
- (vii) An 16-PSK modulated signal has the bit rate 4000bps; baud rate is (symbols / sec)
 - (a) 2000
 - (b) 4000
 - (c) 8000
 - (d) 1000

- (viii) The information I contained in a message with probability of occurrence P is given by
 (a) $I = \log_2 P$ (b) $I = \log_2 1/P$
 (c) $I = \log_2 2P$ (d) $I = \log_2 P^2$
- (ix) Bluetooth uses a 2.4GHz ISM band divided into
 (a) 79 channels (b) 69 channels
 (c) 70 channels (d) 80 channels
- (x) In spread spectrum technique, the multiple users are assigned
 (a) Same spectrum and same PN code
 (b) Same spectrum and different PN code
 (c) Different spectrum and different PN code
 (d) Different spectrum and same PN code

Fill in the blanks with the correct word

- (xi) In phase modulation the phase angle varies ____ with the message signal.
- (xii) For a given data rate, the bandwidth of a BPSK signal is _____ than the bandwidth of the QPSK signal.
- (xiii) Analog to digital signal converter includes _____, _____ & _____.
- (xiv) The source coding theorem says that to encode a source with entropy $H(m)$, on an average a minimum of _____ number of bits per message is required.
- (xv) In Delta modulation slope overload distortion can be minimized by _____ the step size.

Group - B

2. (a) Draw the block diagram of a superheterodyne receiver. [[CO1](Remember/LOCQ)]
 (b) A superheterodyne AM receiver is tuned to a signal frequency of 655kHz. The local oscillator frequency is 1110kHz. Find the image frequency. [[CO1](Evaluate/HOCQ)]
 (c) Discuss the concept of image frequency? Which block of the superheterodyne receiver is responsible for rejection of image frequency and why? [[CO1](Apply/IOCQ)]
3 + 4 + (3 + 2) = 12
3. (a) A FM wave is represented by the following expression:
 $V = 12 \cos [6 \times 10^8 t + 5 \sin 1250 t]$ Determine
 (i) Carrier and modulating frequencies
 (ii) Modulation index and maximum deviation. [[CO2] (Evaluate/HOCQ)]
 (b) FM and PM are related to each other - justify the statement. [[CO2](Analyse/IOCQ)]
 (c) Discuss the Carson's rule for FM transmission. [[CO1](Apply/IOCQ)]
4 + 6 + 2 = 12

Group - C

4. (a) Mention the desirable properties of a line code. [[CO3](Understand/LOCQ)]

- (b) Draw and explain the operation of a regenerative repeater. [[CO3](Understand/LOCQ)]
 (c) To transmit a bit sequence of 011001011010110, draw the resulting waveform using (i) Unipolar NRZ and RZ (ii) Polar-NRZ and RZ (iii) Bipolar NRZ or AMI (iv) Manchester Coding. [[CO3](Apply/IOCQ)]

3 + 3 + 6 = 12

5. (a) Eye diagram helps us to measure the amount of ISI present in a channel : Justify. [[CO3](Analyse/HOCQ)]
 (b) Explain Nyquist 1st criterion for zero ISI to control inter symbol interference at decision making instants of the sampled signal. [[CO3](Analyse/IOCQ)]
 (c) Data rate of 12 kbps is to be transmitted over a channel of bandwidth 8 kHz by using a raised cosine pulse. Determine the roll off factor. [[CO3](Apply/IOCQ)]

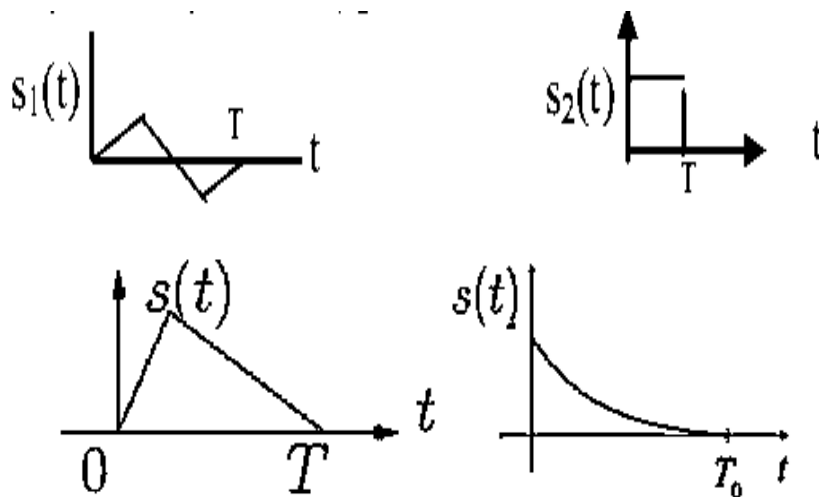
4 + 4 + 4 = 12

Group - D

6. (a) Mention the advantage of M ary modulation technique? [[CO4](Understand/IOCQ)]
 (b) Define bit rate and baud rate. [[CO4](Remember/LOCQ)]
 (c) The bit rate for the digital system is 34 Mbps. For the QPSK modulation scheme, calculate the baud rate. [[CO4](Apply/IOCQ)]

4 + 4 + 4 = 12

7. (a) What is the significance of the term 'Matched' in matched-filter? [[CO4](Understand/LOCQ)]
 (b) Draw the impulse responses of the matched filter where the input bit 1 is represented by the given waveforms.



[[CO4](Apply/IOCQ)]
2 + (5 + 5) = 12

Group - E

8. (a) Apply the Shannon-Fano coding procedure for the 8 message ensemble $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8$ with probabilities $1/4, 1/8, 1/16, 1/16, 1/16, 1/4, 1/16, 1/8$ respectively. Show that the code efficiency is 100%. [[CO6](Evaluate/HOCQ)]

- (b) Explain the concept of conditional entropy of a discrete memoryless channel.
[[CO6](Understand/LOCQ)]
8 + 4 = 12
9. (a) State the source coding theorem. Design an analytical proof for the same.
[[CO6](Analyse/IOCQ)]
- (b) Define information rate for a message source. A source is described both by its entropy and rate of information- Justify.
[[CO6](Analyse/IOCQ)]
- (c) A source produces 3 symbols A, B, C with probabilities $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{4}$. Find the entropy.
[[CO6](Apply/IOCQ)]
(2 + 4) + (2 + 2) + 2 = 12
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	19.79	59.38	20.83