

**ANALOG AND DIGITAL COMMUNICATION
(ECEN 3223)**

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) The transmitted power in an FM system is
 - (a) Dependant on the number of sidebands
 - (b) Always constant
 - (c) Dependant on the carrier power and sidebands
 - (d) None
- (ii) For modulation index $m = 1$, if the carrier and one sideband are completely suppressed, then the amount of power transmitted is given by,
 - (a) 16.66%
 - (b) 83.33%
 - (c) 50%
 - (d) None
- (iii) A carrier is amplitude modulated simultaneously by two sine waves with modulation indices of 0.3 and 0.6. The effective modulation index is,
 - (a) 0.9
 - (b) 0.3
 - (c) 0.67
 - (d) 0.45
- (iv) An analog signal has significant spectral components from 1 kHz to 5 kHz. What is the Nyquist sampling rate for this signal?
 - (a) 5 k samples/s
 - (b) 8 k samples/s
 - (c) 10 k samples/s
 - (d) 4 k samples/s
- (v) In a PCM system an increase in the number of quantization levels, the encoded bit size changes from 6 bits to 8 bits. The signal-to-quantization noise ratio changes by
 - (a) 36 dB
 - (b) 48 dB
 - (c) 12 dB
 - (d) 2 dB
- (vi) If the baud rate for a QAM signal is 3000 and a signal element is represented by a tribit, what is the bit rate?
 - (a) 300
 - (b) 400
 - (c) 1000
 - (d) 9000

- (vii) In QPSK the transmission bandwidth required is
 (a) f_b (b) $2 f_b$
 (c) $f_b/2$ (d) $4 f_b$
 where f_b = Bit frequency
- (viii) In GSM system, the same pair of frequencies can be shared by
 (a) An adjoining cell of same cluster
 (b) Same cell number of an adjoining cluster
 (c) Any cell of an adjoining cluster
 (d) None of these
- (ix) Which of the following multiple access techniques are used by second generation cellular systems?
 (a) FDMA/FDD and TDMA/FDD (b) TDMA/FDD and CDMA/FDD
 (c) FDMA/FDD and CDMA/FDD (d) FDMA/FDD only
- (x) In a GSM network, the unit that facilitates roaming is called
 (a) HLR (b) EIR
 (c) AuC (d) VLR

Fill in the blanks with the correct word

- (xi) The type of modulation used generally in TV transmission for video signal is _____.
- (xii) A super-heterodyne receiver is tuned at 1000 kHz. If the Intermediate Frequency is 450 kHz, the image frequency is _____.
- (xiii) In Delta modulation slope overload distortion can be minimized by _____ the step size.
- (xiv) For a given data rate, the bandwidth of a BPSK signal is _____ the bandwidth of the QPSK signal.
- (xv) If baud rate is 400 for a QPSK signal. The bit rate is _____.

Group - B

2. (a) Draw the spectrum of (i) AM (ii) DSB-SC signal (iii) SSB-SC modulated signal.
 [(CO2, CO3)(Analyse/IOCQ)]
 (b) A 400 watts carrier is modulated to a depth of 75%. Find the total power in the amplitude modulated wave assuming sinusoidal modulating signal.
 [(CO1, CO2, CO3)(Evaluate/HOCQ)]
 (c) Why SSB is called the most efficient approach? What is the advantage for VSB over SSB.
 [(CO1, CO2)(Remember/LOCQ)]
4 + 4 + 4 = 12
3. (a) Define frequency deviation and modulation index of a FM wave.
 [(CO1, CO3)(Remember/LOCQ)]
 (b) How phase modulated signal can be generated using frequency modulator circuit and vice versa?
 [(CO3)(Understand/LOCQ)]

- (c) A 100 MHz carrier wave has a peak voltage of 5volts. The carrier is frequency modulated by asinusoidal modulating signal or waveform of frequency 2KHZ such that the frequency deviation is 75KHZ. The modulated waveform passes through zero and is increasing at $t=0$. Determine the expression for the modulated carrier waveform.

[[C03](Create/HOCQ)]

3 + 3 + 6 = 12

Group - C

4. (a) Draw the block diagram of the PCM Transmitter & Receiver section considering the basic elements of digital communication system. [[C01, C02, C04](Remember/LOCQ)]
 (b) Companding technique improves noise performance of a PCM system: Justify the statement. [[C01, C04](Analyse/IOCQ)]
 (c) A DM system is designed to operate at 3 times the Nyquist rate for a signal with a 4 KHz Bandwidth. Determine the maximum amplitude of a 1 KHz input sinusoid for which the DM does not show slope-overload. Quantization step size is 200 mV.

[[C02, C04](Evaluate /HOCQ)]

4 + 4 + 4 = 12

5. (a) Consider a binary sequence with four 1s followed by two 0s and then five 1s. Draw the waveform for this sequence using (i) Unipolar RZ, (ii) Polar RZ, (iii) Bipolar NRZ and (iv) split phase signalling or Manchester coding.

[[C04](Analyse/IOCQ)]

- (b) Draw a flat top sampler circuit and identify its necessity? [[C02, C04](Understand/LOCQ)]
 (c) In a Digital Communication System the number of quantization levels is 16 and the maximum frequency of the message signal is 4 KHz. Calculate the bit transmission rate.

[[C04](Evaluate /HOCQ)]

4 + 4 + 4 = 12

Group - D

6. (a) With suitable diagrams, explain the working principle of the QPSK transmitter. [[C05](Analyse/IOCQ)]
 (b) Draw the signal space diagram of QPSK and explain it. [[C05](Understand/LOCQ)]
 (c) A binary data stream 0010010011 is to be transmitted using DPSK. Show the encoding sequences.

[[C05](Evaluate /HOCQ)]

4 + 4 + 4 = 12

7. (a) M-ary modulation saves bandwidth but makes the system less immune to noise over binary modulation: Establish the statement with proper example.

[[C05](Analyse/IOCQ)]

- (b) Draw the signal space diagram of BASK. [[C05](Remember/LOCQ)]
 (c) For a bit sequence of 10001101 draw the resulting waveform both in time and frequency domain for (i) ASK (ii) FSK (iii) PSK modulation scheme.

[[C05](Evaluate /HOCQ)]

4 + 2 + 6 = 12

Group - E

8. (a) Explain with suitable diagram the handoff phenomena in cellular communication system. [[CO6](Create/HOCQ)]
- (b) Draw and explain GSM architecture. What is the role for MSC in GSM? [[CO2, CO6](Analyse/LOCQ)]
- (c) What is the duration of a bit in a GSM system? If 8 voice channels are supported in each radio channel and there are no guard bands, then how many simultaneous users can be accommodated in a GSM system? [[CO2, CO6](Create/HOCQ)]
- 4 + 4 + 4 = 12**
9. (a) Describe briefly the advantage and disadvantages of dynamic channel allocation strategy. [[CO6](Understand/LOCQ)]
- (b) How are locations of co-channel cells determined in a cellular system, explain with pictorial representation. [[CO6](Analyse/IOCQ)]
- (c) If a normal GSM time slot consists of six training bits, 8.25 guard bits 26 training bits, and two traffic bursts of 58 bits of data, find the frame efficiency. [[CO2, CO6](Evaluate/HOCQ)]
- (2 + 2) + 4 + 4 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33	25	41.66