ANALOG COMMUNICATION
(ECEN 2201)

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) Insignificant low frequency band is present in the spectrum of
(a) audio signal (b) video signa
(c) both audio & video signal (d) none of these.

(ii) If the radiated power of AM transmitter is 10 KW, the power in the carrier for modulation index of 0.6 is nearly
(a) 8.24 KW (b) 8.47 KW
(c) 9.26 KW (d) 9.6 KW.

(iii) The Intermediate frequency used for AM in super heterodyne receiver is
(a) 10.07 MHz (b) 455 KHz
(c) 900 KHz (d) 950 KHZ.

(iv) AM signal can be demodulated using Envelope dectector only if
(a) $\mu>1$ (b) $\mu<1$
(c) $\mu=0$ (d) under any circumstances.

(v) For Square-law diode detector the input signal voltage should be
(a) < 1volt (b) >0.6volt
(c) > 0.2 volt (d) > 0.1 volt

(vi) A 10MHz carrier is frequency modulated by a sinusoidal signal of 500Hz, the maximum frequency deviation being 50kHz. The bandwidth required as given by the Carson's rule is
(a) 105 kHz (b) 115 kHz
(c) 101 kHz (d) 99 kHz.

(vii) Choose the correct statement - In AM
(a) sideband power is always constant
(b) total transmitted power is constant
(c) carrier power is constant
(d) bandwidth is infinite.

(viii) Maximum transmission efficiency of AM is
(a) 33.33% (b) 77%
(c) 100% (d) 25%.

(ix) FM is superior to AM in the sense that
(a) FM is more immune to noise (b) FM requires less bandwidth
(c) FM generation is easy (d) all of these

(x) In theoritical case, band width of FM is
(a) infinite (b) $2f_m$
(c) f_m (d) $4f_m$.

Fill in the blanks with the correct word

(xi) Foster Seeley discriminator is used to demodulate _____ Signal.

(xii) De emphasis circuit is used in the _____ section.

(xiii) A 10 KW carrier is sinusoidally modulated by two carriers corresponding to a modulation index of 30% and 40%respectively. The total radiated power is _____.

(xiv) Pre-emphasis circuit is used to boost up _____ _____ signals .

(xv) In commercial FM broadcasting, the maximum frequency deviation is normally _____.

Group - B

2. (a) Differentiate between Single Tone & multiple tone Amplitude Modulation. *[(CO2)(Remember/LOCQ)]*

(b) Show maximum transmission efficiency of AM is 33.33%. *[(CO2)(Remember/LOCQ)]*

(c) VSB modulation is a compromisation between DSB-SC and SSB-SC modulation: Justify the statement with proper spectral diagram. *[(CO2)(Apply/IOCQ)]*

4 + 4 + 4 = 12

3. (a) A transmitter radiates 10KW with carrier unmodulated and 12KW when carrier is sinusoidally modulated. Calculate the modulation index. If another sine wave corresponding to 50% modulation is transmitted simultaneously, determine the total radiated power. *[(CO2)(Evaluate/HOCQ)]*

(b) Tone modulated SSB –SC signal does not provide amplitude modulation - Justify *[(CO2)(Analyze/IOCQ)]*

(c) Determine the percentage of power saving when the carrier wave and one of the sidebands are suppressed in an AM wave modulated to a depth of (i) 100% & (ii) 50%. *[(CO2)(Evaluate/HOCQ)]*

4 + 4 + 4 = 12

Group - C

4. (a) Draw and explain the operation of Ring modulator. *[(CO3)(Understand/LOCQ)]*

(b) Differentiate between double balanced and single balanced Modulator with example. *[(CO3)(Apply/IOCQ)]*

(c) Why synchronous demodulation is called coherent detection? *[(CO3)(Analyze/LOCQ)]*

6 + 4 + 2 = 12

5. (a) Transmission efficiency of SSB+C system using envelope detector is poor: Justify the statement. *[(CO3)(Analyze/IOCQ)]*

(b) Design a envelope detector circuit with $RC \leq 1/w_m$ [$\checkmark(1-m^2)/m$] where m is modulation index, $0<m<1$, and $w_c >> w_m$. *[(CO3)(Evaluate/HOCQ)]*

6 + 6 = 12

Group - D

6. (a) Derive expressions for frequency modulated and phase modulated signals and show one can be obtained from another. *[(CO4)(Analyze/IOCQ)]*

(b) Define modulation index for frequency modulation. *[(CO4)(Remember/LOCQ)]*

(c) In a FM system when the audio frequency is 400Hz and the AF voltage is 2.5V the frequency deviation is 3.6 kHz. If the AF voltage is raised to7.5V what is the new deviation? Find modulation index in each case. *[(CO4)(Evaluate/HOCQ)]*

6 + 2 + 4 = 12

7. (a) Draw and explain the circuit diagram of Foster–Seeley discriminator for FM detectors. *[(CO4)(understand/LOCQ)]*

(b) Define Carson's rule of FM. *[(CO4)(Understand/LOCQ)]*

(c) A single tone modulating signal $\cos(15\pi 10^3 t)$ frequency modulates a carrier of 10MHZ and produces a frequency deviation of 75KHZ. Find (i) the modulation index and (ii) phase deviation produced in the FM wave. *[(CO4)(Apply/IOCQ)]*

6 + 2 + 4 = 12

Group - E

8. (a) Draw the block diagram of Superheterodyne receiver. Which block plays the crucial role of image frequency rejection and why? *[(CO5)(Understand/LOCQ)]*

(b) What is image Frequency? *[(CO5)(Understand/LOCQ)]*

(c) A superheterodyne AM receiver is tuned to a signal frequency of 655 kHz. The local oscillator frequency is 1110 kHz. Find the image frequency. Find the value again if the oscillator frequency is reduced by 200 KHz. *[(CO5)(Evaluate/HOCQ)]*

6 + 2 + 4 = 12

9. (a) How Frequency Division Multiplexing technique is used in radio broadcast system? Explain with proper block diagram. *[(CO5)(Analyse/IOCQ)]*

(b) Define selectivity, sensitivity and Fidelity of a super heterodyne radio receiver. *[(CO6)(Understand/LOCQ)]*

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	41.67	35.41	22.92

Course Outcome (CO):

After the completion of the course students will be able to

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with Amplitude Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
3. Understand principles of various generation and detection techniques of Amplitude Modulation.
4. Identify and apply detailed knowledge of Angle modulation and demodulation techniques.
5. Analyze various multiplexing techniques and radio receivers.
6. Understand system noise and apply this knowledge to compare the noise performance of Analog Communication systems.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*