

**ANALOG COMMUNICATION
(ECEN 2201)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) 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.
- (ii) The non-linear region of I-V characteristics of a diode is used in
(a) ring modulator (b) varacter diode modulator
(c) square - law modulator (d) none of these.
- (iii) The process of transmitting two or more information signals simultaneously over the same channel is called
(a) telemetry (b) multiplexing
(c) modulation (d) detection.
- (iv) In phasor representation of an AM signal the resultant and the carrier phasor for $\omega_{mt} > \pi/2$ are
(a) always in phase quadrature (b) always out of phase
(c) in any phase relationship (d) none of the above.
- (v) In commercial FM broadcasting the maximum frequency deviation is normally
(a) 5 kHz (b) 75 kHz (c) 10 kHz (d) 99 kHz.
- (vi) Amplitude Modulated wave is
(a) sum of carrier and modulating wave
(b) product of carrier and modulating wave
(c) difference of carrier and modulating wave
(d) sum of carrier and its product with modulating wave.
- (vii) What is the maximum power efficiency of an AM modulator?
(a) 25% (b) 33% (c) 66% (d) 100%.

- (viii) Special type of spectrum having a energy gap centered at the origin is required for generation of SSB using
(a) selective filtering method (b) phase shift method
(c) third method (d) none of these.
- (ix) For getting 100% modulation, carrier amplitude should
(a) exceed signal amplitude (b) be equal to signal amplitude
(c) be lesser than signal amplitude (d) be equal to 0.
- (x) DSB+C modulated wave is represented by which equation?
(a) $[1 + m(t)].c(t)$ (b) $[1 - m(t)].c(t)$
(c) $[1 + m(t)].2c(t)$ (d) $[1 + 2m(t)].c(t)$.

Group- B

2. (a) Estimate the transmission bandwidth requirement of the following Amplitude Modulated system from the frequency domain representation of the modulating, carrier and modulated signal : Carrier signal amplitude is 5 V and frequency 100 KHz. The carrier signal is simultaneously modulated by three message signals 2 V & 5 kHz, 1.5 V & 2 kHz. 1 V & 1 kHz. [(CO2)(Evaluate/HOCQ)]
(b) Maximum transmission efficiency of AM signal is 33.33% - Justify. [(CO2)(Analyse/IOCQ)]
6 + 6 = 12
3. (a) A transmitter radiates 10 kW with carrier unmodulated and 12 kW 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) The antenna current of an AM transmitter is 10 A when it is modulated to depth of 30% by an audio signal. It increases to 11 A when another signal modulates the carrier signal. What will be the modulation index due to the second signal? [(CO2)(Evaluate/HOCQ)]
(c) Derive the expression for total modulation index if the carrier is modulated by several sine waves. [(CO2)(understand/LOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Implement an Amplitude Modulation and Demodulation system with 100% transmission efficiency. [(CO3)(Evaluate/HOCQ)]
(b) Draw and explain principle of operation of envelope detector. Justify the selection of resistor and capacitor values of that detector. [(CO3)(Understand/LOCQ)][(CO3)(Analyse/IOCQ)]
(3 + 3) + (4 + 2) = 12

5. (a) When does quadrature null effect appear at the output of synchronous demodulator of AM system? How this effect can be avoided?
[[CO2](Analyze/IOCQ)]
- (b) Discuss Costas loop of carrier regeneration in DSB SC modulation system.
[[CO3](Understand/LOCQ)]
- (c) Distinguish between single balanced and double balanced modulator.
[[CO3](Analyze/IOCQ)]
- 5 + 5 + 2 = 12**

Group - D

6. (a) FM and PM are related to each other - justify the statement.
[[CO4](Analyze/IOCQ)]
- (b) Define frequency deviation and modulation index of a frequency modulated signal.
[[CO4](Remember/LOCQ)]
- (c) Compare the transmission bandwidth of the FM system under two different input specifications:
System 1: the audio frequency is 1 kHz and audio voltage is 2 volts. The frequency deviation is 4 kHz.
System 1 with modified input signal: the AF voltage is increased to 8 volts and its frequency dropped to 500 Hz.
[[CO4](Evaluate/HOCQ)]
- 4 + 4 + 4 = 12**
7. (a) Explain the principle of detection of FM signal using balanced slope detector with proper sketch.
[[CO4](Understand/LOCQ)]
- (b) Design an Armstrong Transmitter circuit for a WBFM system with the given specifications: narrow band carrier $f_{c1} = 200$ kHz, narrowband deviation is 25 Hz, second carrier $f_{c2} = 10.9$ MHz, output carrier frequency $f_{c, out} = 91.2$ MHz and $\Delta f_{out} = 75$ kHz.
[[CO4](Evaluate/HOCQ)]
- 5 + 7 = 12**

Group - E

8. (a) Explain the process of TDM with proper block diagram.
[[CO5](Remember/LOCQ)]
- (b) In superheterodyne receiver the local oscillator frequency is always kept higher than the signal frequency - Justify.
[[CO5](Analyze/IOCQ)]
- (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.
[[CO5](Evaluate/HOCQ)]
- 6 + 3 + 3 = 12**
9. (a) Explain the importance of Pre-emphasis and De-emphasis in FM system.
[[CO6](Analyze/IOCQ)]

(b) Draw the block diagram and explain the operating principle of a FDM system.

[(CO5)(Understand/LOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.42	29.16	35.42

Course Outcome (CO):

After completing this course, the 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