

**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) The process of transmitting two or more information signals simultaneously over the same channel is called  
(a) telemetry (b) multiplexing (c) modulation (d) detection.
  - (ii) The minimum channel bandwidth is used by which modulation technique?  
(a) VSB (b) SSB-SC (c) DSB-SC (d) AM.
  - (iii) 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  
(a) 11.25 kW (b) 12.5 kW (c) 15 kW (d) 17 kW.
  - (iv) To get amplitude variation in the modulated signal using SSB modulation technique, the modulating signal must be at least  
(a) single tone (b) double tone (c) triple tone (d) none of this.
  - (v) In synchronous detection Quadrature Null Effect takes place if the phase of the carrier used for detection is  
(a) zero and no error in angular frequency  
(b) 90° and no error in angular frequency  
(c) 90° and error in angular frequency is nonzero  
(d) none of these.
  - (vi) For removing unwanted signal components from a composite signal we should use  
(a) mixing method (b) filter method  
(c) modulation method (d) detecting method.
  - (vii) Plan the bandwidth needed to transmit the amplitude modulated voice signal which occupies a bandwidth of 4 KHz?  
(a) 4 kHz (b) 6 kHz (c) 8 kHz (d) 5 kHz.

- (viii) In superheterodyne receiver, the image frequency at 1000 kHz is  
(a) 1910 kHz      (b) 455 kHz      (c) 900 kHz      (d) 950 kHz.
- (ix) Deemphasis circuit is used in the  
(a) modulator section      (b) transmitter section  
(c) receiver section      (d) band pass filters.
- (x) If frequency deviation is 75 kHz and modulating frequency is 15 kHz, the bandwidth of a commercial FM transmission is.  
(a) 150 kHz      (b) 30 kHz      (c) 180 kHz      (d) 120 kHz.

**Group - B**

2. (a) Draw modulating signal, carrier signal & DSB+C modulated signal in time domain for under modulated, critically modulated and over modulated output signal.      [(CO1&CO2)(Understand/LOCQ)]
- (b) In an AM modulator, 500 kHz carrier of amplitude 20 V is modulated by 10 kHz modulating signal of amplitude 7.5 V. Evaluate the signal parameters (Upper and lower side band frequencies, Modulation Index, Peak amplitude of upper and lower side band frequency, Maximum and minimum amplitudes of envelope) of the modulated signal.      [(CO2)(Evaluate/HOCQ)]
- (c) The output voltage of a AM transmitter is given by  $500 \cdot (1 + 0.4 \times \sin(3140)t) \cdot \sin(6.28 \times 10^7)t$ . Find the carrier frequency & modulating signal frequency.      [(CO2) (Apply/IOCQ)]
- 5 + (1 + 1 + 1 + 2) + 2 = 12**
3. (a) Distinguish between over modulated and under modulated AM signal with proper diagram.      [(CO2)(Understand/LOCQ)]
- (b) Draw the diagram of a tone modulated DSB-SC signal in time domain and frequency domain with proper labelling.      [(CO2)(Analyse/IOCQ)]
- (c) The antenna current of an AM broadcast transmitter modulated to a depth of 40% by an audio sine wave is 11 A. It increases to 12 A as a result of simultaneous modulation by another audio sine wave. What is the modulation index due to the second wave?      [(CO2)(Apply/IOCQ)]
- 4 + 4 + 4 = 12**

**Group - C**

4. (a) How a DSB SC signal can be a generated using single balanced modulator? Why the circuit is called single balanced?      [(CO3) (Remember/LOCQ)]
- (b) Design a amplitude modulator circuit for low level ( $< 1V$ ) modulating signal.      [(CO3) (Evaluate/HOCQ)]
- (c) The input to an envelope detector is a single tone AM signal  $X_{AM}(t) = A(1+m\cos w_m t)$ , where  $m$  is constant,  $0 < m < 1$ , and  $w_c \gg w_m$ . Show that if the detector output is to follow the envelope at all times, it is required that  $RC \leq 1/w_m [\sqrt{(1-m^2)}/m]$ .      [(CO3)(Evaluate/HOCQ)]
- (3 + 1) + 4 + 4 = 12**

5. (a) What are the two methods used to generate SSB SC modulated signal ? Which modulator we should prefer to transmit video signal using SSB modulation and why? [(CO3)(Remember/LOCQ)], [(CO3)(Analyze/IOCQ)]
- (b) Design a carrier acquisition technique where the modulating signal can be retrieved back along with carrier signal. [(CO3)(Apply/IOCQ)]
- (c) Optimum value of time constant in envelope detector compromises between diagonal clipping and minimum fluctuation in the detected envelope: Justify the statement with time domain waveforms only. [(CO3)(Evaluate/HOCQ)]
- (2 + 2) + 4 + (2 + 2) = 12**

### **Group - D**

6. (a) Generate a frequency modulated signal using a phase modulator circuit. [(CO4)(Understand/LOCQ)]
- (b) A NBFM radio link has a frequency deviation of 30 kHz. The modulating frequency is 3 kHz. Find the bandwidth needed for this link. [(CO4)(Apply/LOCQ)]
- (c) Generate a WBFM signal (carrier frequency 91.2 MHz and frequency deviation 75 kHz) as per given specification: Input carrier frequency and frequency deviation are 200 kHz and 25 Hz, respectively. A 10.9 MHz carrier signal generator may be used at intermediate stage. [(CO4)(Evaluate/HOCQ)]
- 4 + 2 + 6 = 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 10 MHz and produces a frequency deviation of 75 kHz. 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) How Frequency Division Multiplexing technique is used in radio broadcast system ? Explain with proper block diagram. [(CO5)(Understand/LOCQ)]
- (b) Mention the disadvantages of a FDM system? [(CO5)(Remember/LOCQ)]
- (c) What are the basic features of a radio receiver those need to be considered before designing the receiver system? [(CO5)(Analyze/IOCQ)]
- 4 + 2 + 6 = 12**
9. (a) Derive signal to noise ratio of DSB-SC system. [(CO5)(Analyze/IOCQ)]
- (b) In a Superheterodyne receiver having no RF amplifier, the loaded Q of the antenna Coupling circuits is 90. If the IF is 455 kHz. Calculate the following:
- (i) the image frequency and
- (ii) Image frequency rejection ratio at 950 kHz. [(CO5)(Evaluate/HOCQ)]
- 6 + 6 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42.71	33.33	23.96

**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