

9. (a) Why pre-emphasis and de-emphasis are used for commercial FM radio?
- (b) Explain with frequency response and circuit diagram operation of the pre-emphasis and de-emphasis filters. Derive signal to noise ratio at the output of the SSB-SC system.

2 + 6 + 4 = 12

**ANALOG COMMUNICATION
(ECEN 2203)**

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) In undermodulated signal the value of μ ranges between
(a) $0 \geq \mu \geq 1$ (b) $0 \leq \mu \leq 1$ (c) $\mu = \infty$ (d) $\mu = 0$.
 - (ii) A super heterodyne radio receiver with an intermediate frequency of 455kHz is tuned to a station operating at 1200kHz. The associated image frequency is
(a) 1900kHz (b) 2110kHz (c) 1200kHz (d) 1655kHz.
 - (iii) In an Am system the modulating signal is sinusoidal with frequency f_m Hz. If 80% modulation is used then the ratio of the total sideband power in the modulated signal to the total power is
(a) 0.15 (b) 0.24 (c) 0.12 (d) 0.21.
 - (iv) In commercial FM broadcasting, the maximum frequency deviation is normally
(a) 5kHz (b) 15kHz (c) 75kHz (d) 200kHz.
 - (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) 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.

- (vii) Which multiplexing technique transmit analog signals
(a) FDM (b) TDM (c) WDM (d) CDMA.
- (viii) FM is superior to AM in the sense that
(a) FM is more immune to noise (b) FM generation is easy
(c) FM requires less bandwidth (d) all of these.
- (ix) Preemphasis circuit is used in the
(a) modulator section (b) transmitter section
(c) receiver section (d) band pass filters.
- (x) In Bessel function $J_n(m_f)$ for a given m_f $J_n(m_f)$ decreases with increasing n where n is the number of sidebands and m_f is the modulation index.
(a) true (b) false
(c) none of these (d) invalid statement.

Group - B

2. (a) Define and explain single sideband transmission with proper diagram.
(b) Explain with suitable phasor diagram that SSB-SC signal modulated by a single tone modulating signal does not show any amplitude variation in time domain. An SSB transmission contains 10KW. This transmission is to be replaced by a standard amplitude modulated signal with the same power content. Determine the power content of the carrier and each of the sidebands when the percentage modulation is 80%.
3. (a) Explain briefly, why modulation is needed in communication system.
(b) Draw the spectrum of (i) AM (ii) DSB-SC signal (iii) SSB-SC modulated signal and (iv) VSB.
(c) The antenna current of an AM transmitter is 10A when it is modulated to depth of 30% by an audio signal. It increases to 11A when another signal modulates the carrier signal. What will be the modulation index due to the second signal?

4 + 4 + 4 = 12

3 + 4 + 5 = 12

Group - C

4. (a) How AM signal can be generated using Non linear modulator (Balanced modulator)?
(b) How the values of R and C are decided to design an envelope detector without diagonal clipping at the output?
5. (a) Explain the process of SSB generation by phase shift method.
(b) What is the limitation of the frequency discrimination method?
(c) Discuss Costas loop of carrier regeneration at the receiver in DSB SC modulation system.

6 + 6 = 12

4 + 2 + 6 = 12

Group - D

6. (a) Draw the block diagram of Armstrong method of FM generation. Why is it called indirect method?
(b) Bandwidth of FM is theoretically infinite. Justify.
7. (a) Transmission efficiency of FM lies between that of AM and DSB-SC. Justify.
(b) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation $f(t) = 10\cos(\omega_c t + 5\sin(3000t) + 10\sin(2000\pi t))$. Find the (i) Power of the FM signal (ii) frequency deviation and phase deviation (iii) bandwidth of the signal.

5 + 1 + 6 = 12

6 + 6 = 12

Group - E

8. (a) Draw the block diagram of a Superheterodyne Receiver.
(b) Define Selectivity, Sensitivity and Fidelity of a Superheterodyne Receiver.
(c) Define signal to noise ratio and Figure of Merit in a communication system.

3 + 6 + 3 = 12