

CS/B.Tech/(ECE-New)/SEM-5/EC-501/2013-14

2013

ANALOG COMMUNICATION

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following :

10 × 1 = 10

- i) The modulation index of an FM signal is given by
- | | |
|-----------------------|-------------------|
| a) δ / f_m | b) f_m / δ |
| c) $\delta \cdot f_m$ | d) infinity. |
- ii) A carrier is amplitude modulated to a depth of 40%. The increase in power is
- | | |
|--------|--------|
| a) 40% | b) 20% |
| c) 16% | d) 8%. |

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iii) The sound signal in TV broadcast is modulated in

- a) SSB b) VSB
c) FM d) DSB-SC.

iv) Pre-emphasis circuit is used

- a) after modulation b) before modulation
c) before detection d) after detection.

v) Recovering information from a carrier is known as

- a) demultiplexing b) modulation
c) detection d) carrier recovery.

vi) A PLL can be used to demodulate

- a) PAM signals b) PCM signals
c) FM signals d) DSB-SC signals.

vii) IF frequency of FM receiver is

- a) 10.7 MHz b) 12.7 MHz
c) 13.71 MHz d) 10.3 MHz.

viii) If maximum frequency present in one TDM signal is f_m ,then for proper detection the message signal's sampling rate f_s should follow the relation

- a) $f_s = f_m$ b) $f_s > f_m$
c) $f_s \geq 2f_m$ d) $f_s = \frac{f_m}{2}$.

ix) The envelope detection is a/an

- a) synchronous detector
b) asynchronous detector
c) product demodulator
d) coherent detector.

x) In an AM transmitter, the unmodulated output current is I_c . The modulated current I_t equals

- a) $I_c \sqrt{1+m^2}$ b) $I_c \sqrt{1+(m^2)/2}$
c) $I_c \sqrt{1+m}$ d) $(I_c m)/2$.

xi) In commercial TV transmission, picture and speech signals are modulated respectively as

- a) VSB and VSB b) VSB and SSB
c) VSB and FM d) FM and VSB.

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- xii. An FM signal with modulation index of 9 is applied to a frequency tripler. The modulation index in the output signal will be

- a) 0 b) 3
c) 9 d) 27.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A modulating signal given by $V_m = 2 \sin(2\pi \times 500t)$ amplitude modulates a carrier signal given by $V_c = 10 \sin(2\pi \times 10^6 t)$. Determine —
a) modulation index
b) frequency present in the modulated signal
c) total transmission power. 1 + 2 + 2
3. Explain the direct method of generation of FM signal using a varactor diode. What are the problems of this method? 3 + 2
4. a) What do you mean by DSB-SC modulation?
b) With neat diagram explain how DSB-SC can be generated using ring modulator. 1 + 4
5. What is a slope detector? What are the problems of slope detectors and how is it overcome using a balanced detector? 2 + 3
6. Find the expression for figure of merit of a DSB-SC system.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) What is meant by synchronous detection of DSB-SC signal?
b) Discuss the effect of phase and frequency error in synchronous detection.
c) Draw the spectrum of (i) DSB-SC signal, (ii) SSB-SC signal, (iii) VSB signal.
d) The total power content of an AM signal is 1000 W. Determine the power being transmitted at the carrier frequency and at each of the sidebands when the per cent modulation is 100%. 2 + 5 + 3 + 5
8. a) Define modulation index for AM. Derive an expression of the power content in AM wave and determine the maximum efficiency of AM system.
b) Show that if the envelope detector output is to follow the envelope at all times, it is required that
$$RC \leq \sqrt{(1 - \mu^2)} / \omega_m$$

c) Derive the expression of single tone amplitude modulation. 5 + 6 + 4

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9. a) Explain the phase shift method for SSB-SC generation.
 b) What is VSB-SC modulation ? Explain how VSB-SC is advantageous over the other modulation techniques.
 c) Explain the working principle of a super-heterodyne receiver in AM systems. 6 + 3 + 6
10. a) Derive the relationship between FM and PM modulated waveforms.
 b) What is Carson's rule ? Derive the bandwidth approximation for NBFM and WBFM.
 c) Explain the working principle of the Foster-Seeley discriminator in the demodulation of FM with proper circuit diagram. 4 + 4 + 7
11. a) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation $\Phi_{EM}(t) = 10 \cos(\omega_c t + 5 \sin 3000t + 10 \sin 2000\pi t)$. Find the
 i) power of the FM signal
 ii) frequency deviation and phase deviation
 iii) bandwidth of the signal.
 b) Derive the PSD of thermal noise and state why it is considered as white noise.

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- c) Define noise figure and figure of merit. Calculate the figure of merit for SSB-SC modulation. 6 + 4 + 5

Write short notes on any *three* of the following 3 × 5

- a) PLL method for FM demodulation
 b) Direct method for FM generation using VCO
 c) Wide Band Frequency Modulation (WBFM)
 d) Ring Modulator
 e) Balance Modulator

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