M.Sc. PHYSICS
THIRD SEMESTER
ELECTRONICS & COMMUNICATION TECHNOLOGY-I
MSP - 304B
[USE OMR FOR OBJECTIVE PART]

SET A

Duration: 1:30 hrs.

Full Marks: 35

(**Objective**)

Time: 15 mins.

Marks: 10

Choose the correct answer from the following: $1 \times 10 = 10$

1. The modulation index in AM is defined as the ratio of:
   a. Maximum amplitude of the modulating signal to the minimum amplitude of the carrier
   b. Maximum amplitude of the modulating signal to the amplitude of the carrier
   c. Frequency of the modulating signal to the frequency of the carrier
   d. None of the above

2. The bandwidth of an amplitude-modulated signal is given by
   a. Twice the modulating frequency
   b. Equal to the modulating frequency
   c. Half the modulating frequency
   d. Three times the modulating frequency

3. FM signals are generally less affected by noise than AM signals. This is mainly due to:
   a. Their higher power levels
   b. The larger bandwidth
   c. The constant amplitude of the carrier
   d. The use of analog techniques

4. In FM, the bandwidth can be approximated using:
   a. Carson's rule
   b. Shannon's theorem
   c. Nyquist's criterion
   d. Hartley's law

5. The primary function of a demodulator is to:
   a. Modulate the carrier signal
   b. Extract the original information from the modulated signal
   c. Amplify the modulated signal
   d. Filter out noise

6. In single tone amplitude modulation, the modulating signal is:
   a. A complex waveform
   b. A single frequency signal
   c. A random signal
   d. None

7. The sidebands in a single-tone AM signal are located at:
   a. Carrier frequency ± double the modulating frequency
   b. Carrier frequency ± half the modulating frequency
   c. Carrier frequency ± modulating frequency
   d. None

8. In digital communication, if the sampling rate is below the Nyquist rate, the result is:
   a. Accurate signal reconstruction
   b. Distorted signal reconstruction
   c. Increased bandwidth
   d. Improved signal-to-noise ratio

9. TheSampling Theorem states that a signal can be completely reconstructed if it is sampled at a rate of:
   a. Twice the maximum frequency
   b. Four times the maximum frequency
   c. Half the maximum frequency
   d. The same as the maximum frequency

10. What is the Nyquist rate for a signal with a maximum frequency of 5 kHz?
   a. 20 kHz
   b. 15 kHz
   c. 5 kHz
   d. 10 kHz

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Time : 1 hr. 15 mins.   Marks: 25

[Answer question no.1 & any two (2) from the rest]

1. a. Define modulation index of AM wave.   1+4=5

    b. A sinusoidal carrier has amplitude of 10 V and frequency 30 kHz.
       It is amplitude modulated by a sinusoidal voltage of amplitude 3
       V and frequency 1 kHz.
       (i) Write the equation for modulated wave
       (ii) Modulation index
       (iii) Plot the modulated wave showing maxima and minima of
       waveform.
       (iv) Draw the spectrum of modulated wave.

2. a. Derive the expression for power in multitone AM wave and write   7+3=10
       the net modulation index.

    b. The antenna current of an AM transmitter is 10 A when it is
       modulated to a 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 second signal?

3. Draw the circuit diagram and explain the analysis of the following: 5+5=10
        a. Diode balanced modulator
        b. Square law detector

4. a. Explain the analysis of a Wide Band Frequency Modulation   8+2=10
       (WBFM) technique. Draw the frequency spectrum.
    b. Write two differences between NBFM and WBFM.

5. State and prove the Sampling Theorem, addressing the following aspects: 10
   a. Representation of a signal x(t) in terms of its samples.
   b. Reconstruction of the signal x(t) from its samples.

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