Total No. of printed pages = 6

ECE 181403

Roll No. of candidate | | | | | | | | | | |

2022

B.Tech. 4th Semester End-Term Examination

ANALOG COMMUNICATION
ELECTRONICS AND TELECOMMUNICATION

(New Regulation & New Syllabus)

Full Marks – 70 | Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No.1 and any *four* from the rest

1. Answer the following:(MCQ/Fill in the blanks) $(10 \times 1 = 10)$

   (i) What frequencies are present in a DSBFC AM wave?

   (a) Carrier frequency (ω_c) with amplitude A

   (b) Lower side band $(\omega_c + \omega_m)$ having amplitude $m_{A/2}$

   (c) Upper side band $(\omega_c - \omega_m)$ having amplitude $m_{A/2}$

   (d) Carrier frequency $(\omega_c/2)$ with amplitude A

   (ii) SSB-SC modulation is not used for audio broadcasting because

   (a) it is difficult to generate SSB-SC signals

   (b) it makes the receiver circuit quite complex and expensive

   (c) SSB-SC modulation cannot be used for speech signals

   (d) None of the above

[Turn over

(iii) Another name for high frequency noise is:

(a) High transit time noise.

(b) Low transit time noise

(c) Ultra transit time noise

(d) Transit time noise

(iv) To produce frequency modulation using a phase modulator

(a) the message signal must be integrated and then used for modulation

(b) the message signal must be differentiated and then used for modulation

(c) the phase-modulated signal must be integrated

(d) the phase-modulated signal must be differentiated

(v) For a WBFM signal, when the frequency of the single-tone modulating signal is doubled, the transmission bandwidth

(a) doubles

(b) does not change

(c) increases slightly but does not become double

(d) reduces considerably since the deviation ratio is halved

(vi) The standard intermediate frequency used in the superheterodyne FM receiver is

(a) 88 MHz

(b) 455 MHz

(c) 15MHz

(d) 10.7 MHz

(vii) Given a resistance of R ohms at T K, the available noise power from it over a bandwidth of $(\Delta f) Hz$ is

(a) kT (Δf)

(b) ½ kT (Δf)

(c) 4 kTR (Δf)

(d) 2 kTR (Δf)

(viii) An amplifier

(a) improves the signal-to-noise ratio

(b) does not alter the signal-to-noise ratio

(c) degrades the signal-to-noise ratio

(d) none of the above

(ix) In an AM broadcast superheterodyne receiver, the local oscillator frequency is arranged to be higher than the incoming signal frequency in order to

(a) provide better image rejection

(b) make tracking easier

(c) produce the correct intermediate frequency, since a lower LO frequency will not permit generation of correct IF

(d) enable us to cover the required tuning range with the practically possible ratio of maximum to minimum values of the variable capacitors

(x) 'Pre-emphasis' is

(a) boosting up of the high-frequency components of the message signal after detection in the receiver

(b) boosting up of the high-frequency components of the message signal at the transmitter before modulation

(c) boosting up of the low-frequency components of the message signal after detection in the receiver

(d) boosting up of the low-frequency components of the message signal at the transmitter before modulation

2. (a) In an amplitude modulation process, the carrier and modulating signals, respectively, are given as

$$v_c(t) = V_c \sin(\omega_c t)$$

$$v_m(t) = V_m \sin(\omega_m t) + \sin(2\omega_m t) + \frac{V_m}{3}\sin(3\omega_m t) + \frac{V_m}{4}\sin(4\omega_m t)$$

Derive an expression to show that for every modulating frequency component, the AM signal contains two sideband frequencies in addition to the carrier frequency. Also draw the frequency spectrum of this AM signal. (10)

(b) An amplitude modulator has output

$$s(t) = A\cos(\pi 400t) + B\cos(\pi 360t) + B(\pi 440t)$$

The carrier power is 100 W and the power efficiency (ratio of sideband power to total power) is 40%. Compute A, B and the modulation factor μ. (5)

3. (a) A square-law device has an input—output relation given by $e_0 = a_1 e_{in} + a_2 e^2 in$ To this device, we give an input signal which is the sum of the message signal, $x(t) = 0.3\cos 2\pi 50t + 0.4\cos 2\pi 150t$ and a carrier signal of frequency 5 kHz. The output signal $e_0(t)$ is then subjected to bandpass filtering. What should be the centre frequency and the bandwidth of this BPF if the output of the filter is to be an AM signal? (10)

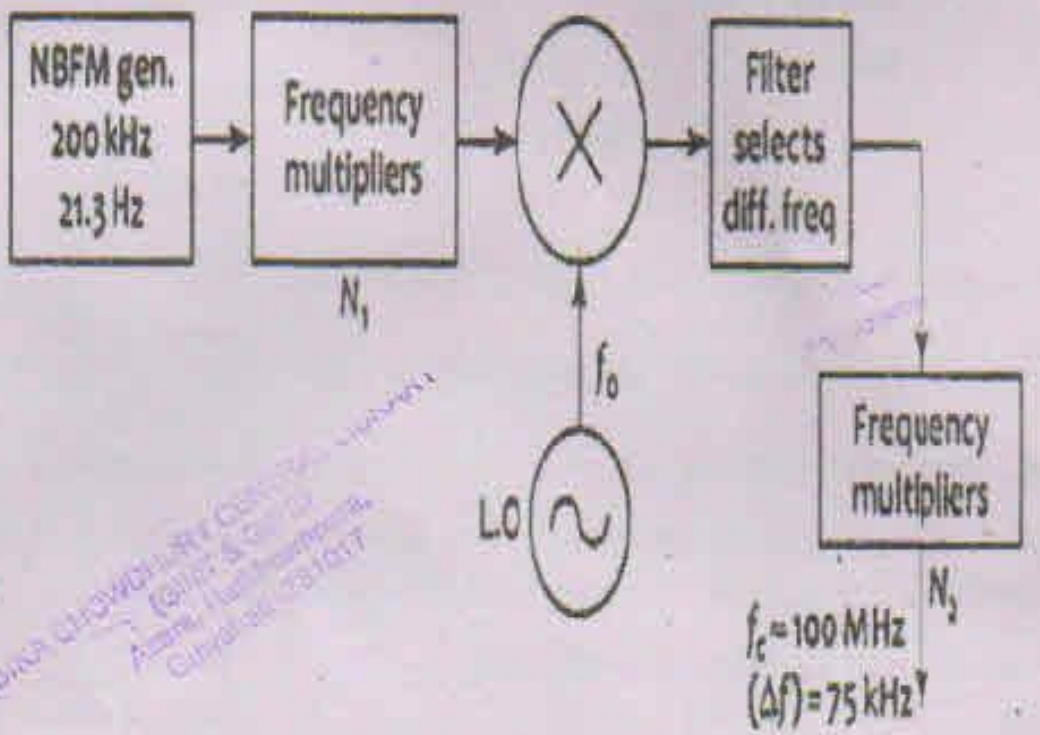
(b) A message signal $x(t)$ is positive for all t. This message DSB-SC modulates a carrier signal. Show that an envelope detector can be used to demodulate this DSB-SC signal. (5)

4. (a) A sinusoidal signal of 4 kHz modulates an analog carrier signal using FM process, producing maximum frequency deviation of 10 kHz.

(i) Determine the approximate bandwidth of the FM signal using Carson's rule.

(ii) The frequency of the modulating signal is decreased to 2 kHz (halves) and its amplitude is increased by a factor 3. Determine the frequency-modulation index, maximum frequency deviation and the approximate bandwidth of the resultant FM signal. (7)

(b) A NBFM signal with a carrier frequency of 200 kHz and peak frequency deviation of 21.3 Hz is to be used to produce a WBFM signal of carrier frequency about 100 MHz and peak frequency deviation of 75 kHz, using frequency multipliers, a mixer, etc., as shown in the Figure. Determine N1, N2 and fc to achieve the desired result. Note that the multipliers should comprise either doublers or triplers, or a combination of these two. (8)

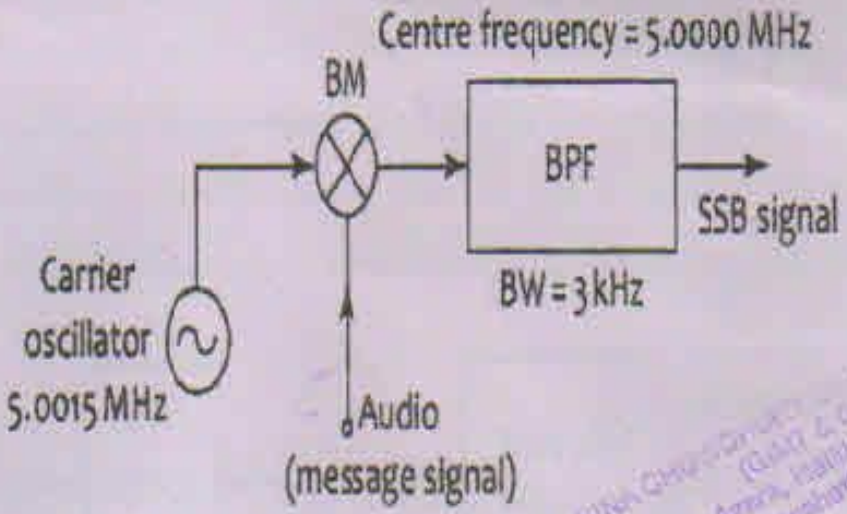


5. (a) A SSB transmitter radiates 0.5 kw when the modulation percentage is 60%. How much of carrier power (in kw) is required if we want to transmit the same message by an AM transmitter? (5)

(b) A DSBSC transmitter radiates 1kw when the modulation percentage is 60%. How much of carrier power (in kw) is required if we want to transmit the same message by an AM transmitter? (5)

(c) Calculate the percentage power saving when the carrier and one of the sidebands are suppressed in an AM wave modulated to a depth of 50 percent. (5)

6. (a) A SSB transmitter uses a set-up of the form shown in the figure to generate the SSB signal using filter method.



For the values given in the figure, determine

(i) whether the lower sideband or the upper sideband will be produced

(ii) the carrier frequency value if the other sideband is to be produced (6)

(b) In a super heterodyne receiver, it is preferable to have an RF amplifier with high gain to be the first stage instead of a mixer. Explain. (5)

(c) Discuss time division multiplexing. (4)

7. Write short notes (any *three*) (5+5+5=15)

(a) Thermal Noise

(b) Sources of noises in a communication system

(c) FM detection using PPL

(d) PAM and PWM