U/E/TX

Reg. No:

Final Assessment Test – May 2024

Course: BECE304L - Analog Communication Systems

Class NBR(s): 1302 / 1305 / 1307 / 1310 / 1313 / 1316 / 1319 / 1322

Slot: G1+TG1

Time: Three Hours

Max. Marks: 100

- KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instructions : Scientific calculators and Bessel's table are permitted

Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) (i) Differentiate simplex, half duplex and full duplex. (ii)Specify the frequency ranges allotted for AM and FM broadcast. [3]

   b) List the need for modulation in a communication system and find the practicality of length of the antenna for the transmission of voice signal at a carrier frequency of 1kHz and 200MHz? [4]

   c) Calculate the theoretical channel capacity if the SNR is 40dB and the channel bandwidth is 6MHz? [3]

2. a) A modulating signal $10\sin(2\pi \times 10^3 t)$ is used to modulate a carrier signal $20\sin(2\pi \times 10^4 t)$. Determine the modulation index, percentage of modulation, frequencies of the sideband components and their amplitudes. What will be the bandwidth of the modulated signal? [5]

   b) An AM transmitter has an unmodulated carrier power of 10 kW. It can be modulated by a sinusoidal modulating voltage to a maximum depth of 40%, without overloading. If the maximum modulation index is reduced to 30%, what is the extent up to which the unmodulated carrier power can be increased without overloading? [5]

3. The signal $x(t)=\frac{1}{2}\cos(2\pi 70t)+\frac{1}{3}\cos(2\pi 120t)$ is input to the square law modulator with a carrier frequency of 10 kHz as shown in Figure. 1. Assume $V_{out}=a_1 v_{in}+a_2 v_{in}^2$ and use $v_{in}=x(t)+\cos\omega_c t$.

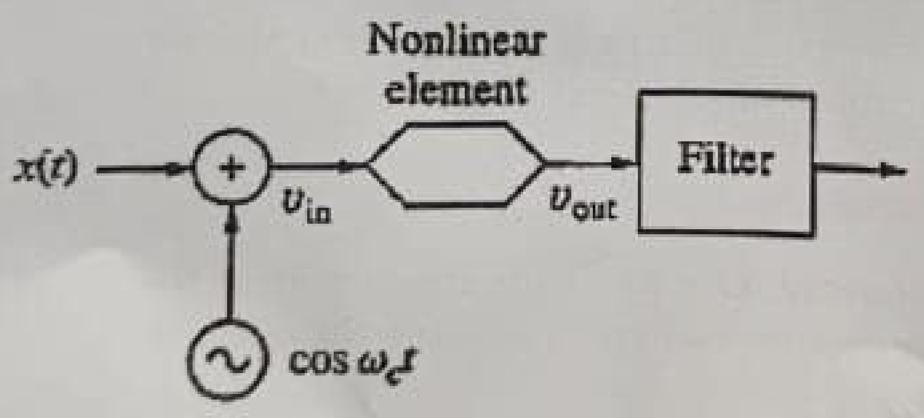

Figure 1 Square law modulator

   a) Calculate the centre frequency and bandwidth of the filter such that this system will produce a standard AM signal.

   b) Determine the values of a_1 and a_2 such that carrier amplitude A_c =10 V and modulation index is 0.5.

4. a) A 400 W carrier is Amplitude modulated to a depth of 100%. Calculate the total power in case of SSB technique. How much power saving (in W) is achieved for SSB compared to AM and Double-Sideband Suppressed Carrier (DSB-SC)? If the depth of modulation is changed to 75%, then how much power (in W) is required for transmitting the SSB wave? Compare the powers required for SSB in both the cases and comment on the reason for change in the power levels. [5]

b) Compute the demodulated signal y(t) from Figure 2. The DSB-SC modulated s(t) = 4cos2π400t(2cos4000πt) where the Balanced modulated carrier signal c(t) = 2cos4000πt. [5]

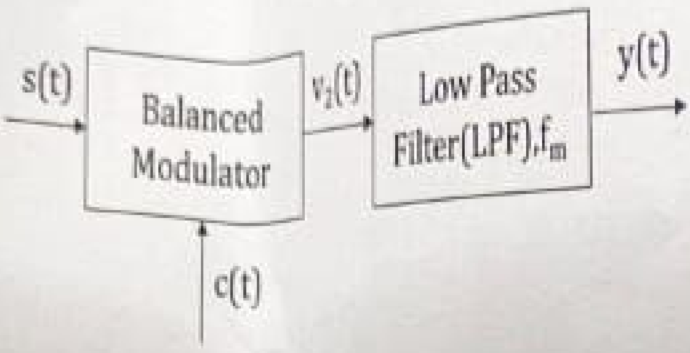

Figure 2

5. Consider a message signal *m(t)* with a spectrum shown in Figure 3. The message bandwidth is 1 kHz. This signal is applied to a product modulator together with a carrier wave $A_c \cos(2\pi f_c t)$, producing the DSB-SC modulated signal *s(t)*. The modulated signal is next applied to a coherent detector.

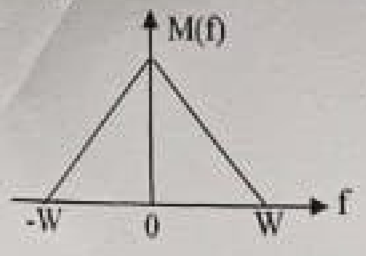

Figure 3 Spectrum of message signal

(i) Assuming perfect synchronism between the carrier waves in the modulator and detector, determine the spectrum of the detector output when

(a) f_c = 1.25 kHz

(b) f_c = 0.75 kHz

(ii) What is the lowest carrier frequency for which each component of the modulated signal *s(t)* is uniquely determined by *m(t)* and draw the resultant spectrum?

6. A block diagram of an indirect (Armstrong) FM transmitter is shown in Figure 4. Compute the maximum frequency deviation Δf of the output of the FM transmitter and the carrier frequency f_c if f_1 = 200 kHz, f_{LO} = 10.8 MHz, Δf_1 = 25 Hz, n_1 = 64, and n_2 = 48.

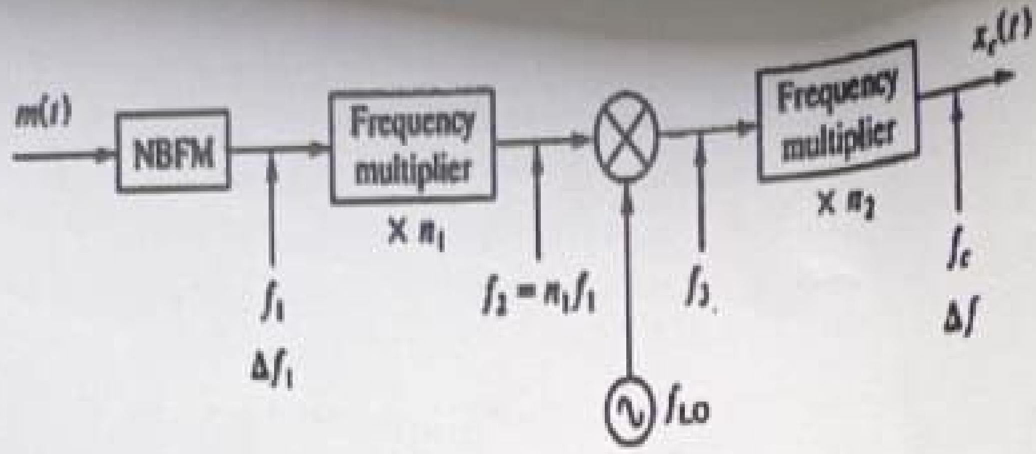

Figure 4

7. Draw and explain Foster-Seeley Discriminator circuit to demodulate FM signal.

8. a) Explain the operation of superhetrodyne receiver with neat diagram and it is advantage and disadvantage compare with TRF receiver. [7]

b) Compare high-level modulation and low-level modulation of AM broadcast transmitters. [3]

9.(a) i) A PCS cellular receiver front-end is shown below Figure 5. The operating frequency is 1805-1880 MHz, and the physical temperature of the system is 300 K. A noise source with noise power Ni = -95 dBm is applied to the receiver input. [6]

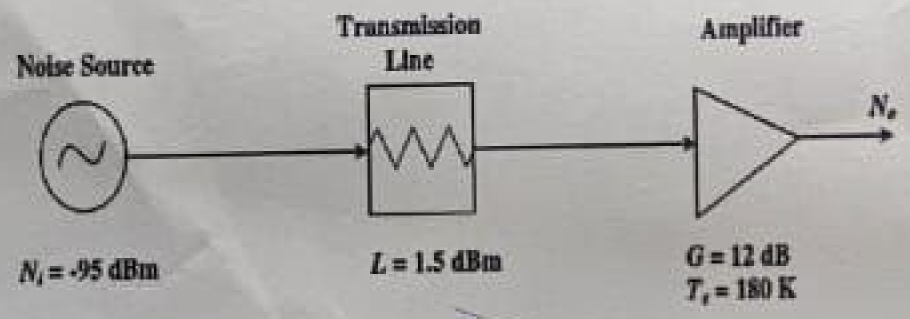

Figure 5

a) What is the equivalent noise temperature of the source over the operating bandwidth?

b) What is the noise figure (in dB) of the amplifier?

c) What is the noise figure (in dB) of the cascaded transmission line and amplifier?

ii) Derive the expressions for output signal to noise ratio for Tandem connection of repeaters [4]

a) Assuming all links are identical

b) Assuming if any one link is much worse than others

OR

9.(b) i) The signal power and noise power measured at the end of an amplitude are 150μW and 1.5μW If the signal power at the output is 1.5W and noise power is 45mW. Calculate the amplifier noise factor and noise figure. [5]

ii) The equivalent noise resistance for an amplifier is 300Ω and equivalent shot noise current 5μA. The amplifier is fed from 150Ω 10μV rms sinusoidal signal source. Calculate the individual noise voltage at the input signal to noise ratio in decibels. The noise bandwidth is 10MHz. [5]

10.(a) Explain the generation and detection of pulse amplitude modulation signal with neat diagram.

OR

10.(b) i) State Nyquist theorem and explain the three following three cases with the frequency spectrum : [5]

a) When sampling frequency is twice the message signal frequency.

b) When sampling frequency is greater than twice the message signal frequency.

c) When sampling frequency is lesser than twice the message signal frequency.

ii) With a neat sketch explain the transmitter and receiver of TDM. [5]

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