


VIT

Vellore Institute of Technology

Final Assessment Test – November 2024

Course: BITE203L - Principles of Communication Systems

Class NBR(s): 3291 / 3295 / 3301

Time: Three Hours

Slot: B1+TB1

Max. Marks: 100

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

 Answer ALL Questions

(10 X 10 = 100 Marks)

1. Illustrate the generation and detection of modulation scheme which is suitable for television video signal transmission. Present appropriate diagrams and equations along with the advantages of the modulation scheme used in television broadcasting.

2.a) The message signal, $m(t) = 0.5\cos(2\pi 2000t)$ has to be transmitted from one place to another place. The carrier signal used is $c(t) = \cos(2\pi 500 \times 10^5 t)$. Compute the bandwidth, modulated signal power, and sideband amplitude for the following modulation schemes. Consider the antenna resistance as 10Ω .

- i) DSB-FC [3]
- ii) DSB-SC [3]
- iii) SSB-SC [3]
- iv) In addition, find the highest frequency component in DSB-SC signal. [1]

OR

2.b) A frequency modulated waveform is mathematically represented as $s(t) = 10 \cos(4 \times 10^6 t + 6 \sin 1500 t)$. Compute the following:

- i) Carrier frequency [2]
- ii) Modulating frequency [2]
- iii) Modulation index [2]
- iv) Maximum frequency deviation [2]
- v) Power dissipated by the FM wave in a 200Ω resistor. [2]

3.

a) Consider the broadcasting of speech signal through the modulation scheme for which the instantaneous frequency is given by $f_i = f_c + k_f m(t)$. Narrate the process of detecting the message signal from the modulated signal through balanced slope discriminator method with circuit diagram. [6]

b) If $x(t) = E_m \cos \omega_m t$ in the following figure 1, then identify the output expressions of each block, viz. integrator, balanced modulator, phase shifter, and summer. [4]

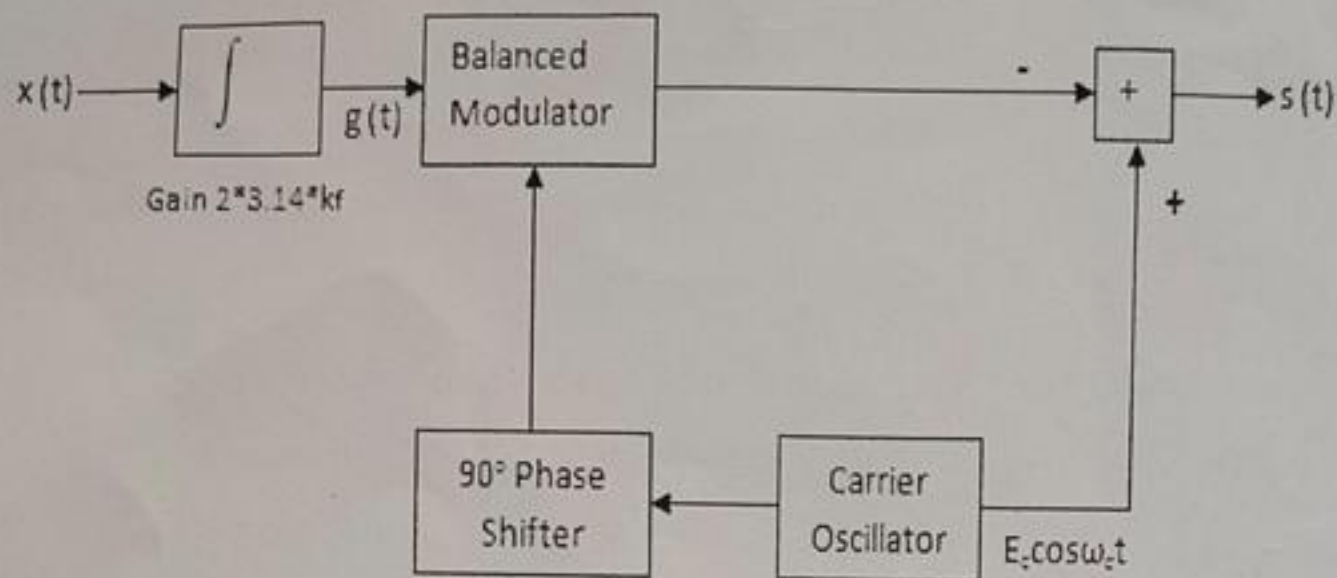


Figure 1

4.

To enhance the amplitude of the received signal, three-stage cascaded amplifiers are used as shown in Figure 2. Represent the derivation of mathematical expression for the overall noise factor. In addition, represent the derivation of mathematical expression for effective noise temperature.

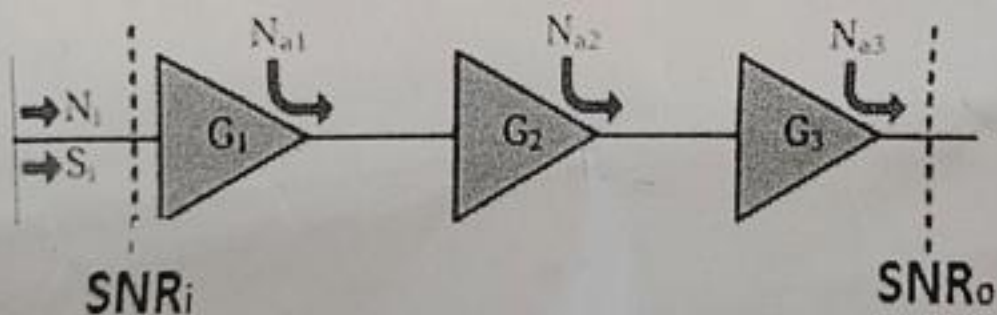


Figure 2

5.a)

Analyse the significance of heterodyning process in receivers and functionalities of each block present in the super heterodyne receiver along with a block diagram.

OR

5.b) Consider the scenario in which amplitude modulated signal is affected by the additive white Gaussian noise. Analyse the performance of AM receiver by deriving the Figure of Merit with appropriate equations. In addition, compare its Figure of Merit with FM receivers and identify the modulation index of FM to perform better than AM.

6. Consider the transmission of a message signal with the peak-to-peak amplitude of 2V and highest frequency component of 3KHz. This message signal needs to be transmitted using DSB-FC system that employs critical modulation. Additive white Gaussian noise with power spectral density of 10×10^{-14} W/Hz is present in the channel. Compute the following:

- i) Average noise power in the message bandwidth. [2]
- ii) Average power of AM waveform [2]
- iii) SNR at the receiver's input [2]
- iv) SNR at the receiver's output [2]
- v) Figure of Merit [2]

7. Breakdown the drawbacks of Delta Modulation (DM) and analyse how the drawbacks are solved in Adaptive Delta Modulation (ADM) by explaining the transmitter and receiver sections with neat diagrams and necessary equations.

8. A Delta Modulator system is designed to operate at five times the Nyquist rate for an analog information signal band limited to 10 KHz. The quantizing step size is 40mV. The frequency spectrum of message signal to be transmitted is shown in figure 3.

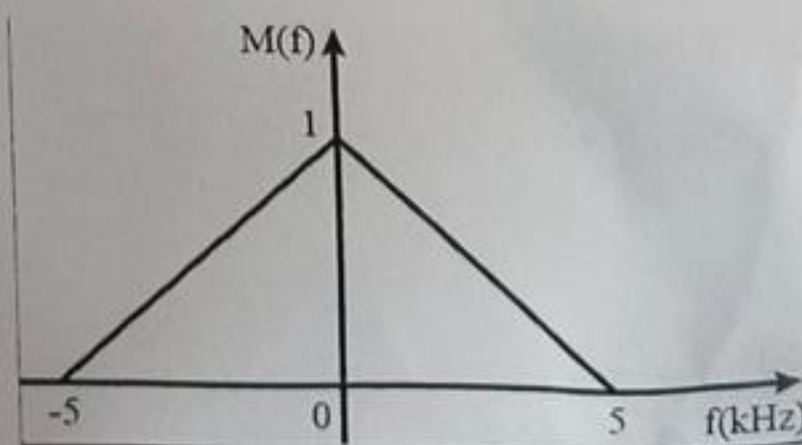


Figure 3

Determine the following:

- i) Maximum allowable amplitude of input signal for which the delta modulator does not experience Slope overload distortion. [2]
 - ii) Power of granular noise [2]
 - iii) Determine the pre-filtered SNR [2]
 - iv) Determine the post-filtered SNR [2]
 - v) Number of bits transmitted in 10 seconds. [2]
9. Illustrate binary frequency shift keying waveform along with necessary equations. In addition, explain the operation of transmitter and receiver used in this modulation scheme with neat sketches.
10. a) In a DS-SS modulation, it is required to have a jamming margin greater than 30dB. The ratio E_b/N_0 is set at 20. Compute the minimum processing gain and the minimum number of stages required to generate the maximum length sequence. [7]
- b) In a Direct sequence CDMA system, the chip rate is 1.2288×10^6 chips per second. If the minimum processing gain is 100, then compute the data rate. [3]

⇔⇔⇔ BG/K/TX ⇔⇔⇔