Ex/ET/PC/B/T/223//2022

B. E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING EXAMINATION, 2022

(2nd Year, 2nd Semester)

ANALOG COMMUNICATION SYSTEMS

Time : Three hours Full Marks : 100

Answer all parts & sub-parts of a question in the same place
Avoid unnecessary elaboration of answers

UNIT 1 (Marks: 10)

Q1. Draw the channel model due to multi-path transmission. Hence derive the expressions of magnitude and phase responses of the channel. What type of distortion does it produce and why? [2+6+2]

UNIT 2 (Marks: 15x2=30)

(Answer any two questions)

Q2. a) Draw the neat sketch of Vestigial Side Band (VSB) spectrum of TV signal. Label and explain all necessary parts. Hence calculate the bandwidth corresponding to this spectrum. [10]

b) Draw the phasor diagrams of Narrow Band Frequency Modulated (NBFM) signal as well as Amplitude Modulated (AM) signal and label them properly. [5]

Q3. a) Derive the time domain expression of Frequency Modulated (FM) wave. [7]

b) What is the significance of Bessel coefficient in case of Wide Band FM signal? [3]

c) How can you define bandwidth of an FM signal? [5]

Q4. a) Consider an arbitrary signal g(t) and a sinusoidal carrier c(t). Demonstrate the Double Side Band Suppressed Carrier (DSB-SC) modulation as well as demodulation techniques using relevant block diagrams, mathematical expressions and corresponding spectra. [10]

b) Point out the difficulties faced while removing one of the side bands of Double Side Band Suppressed Carrier (DSB-SC) Amplitude Modulated (AM) signal using Filtering Technique. [5]

[Turn over

UNIT 3 (Marks: 15x2=30)

(Answer any two questions)

Q5. Draw the circuit of a Ring Modulator. Explain the principle of operation of this circuit. State the necessary assumptions made in this regard. Is it a single or double balanced modulator? Justify your answer. [3+7+3+2]

Q6. Draw the block diagram of a Phase Locked Loop (PLL) and label it properly. Identify its basic components. Explain the principle of operation of PLL. Hence draw its equivalent model. [4+2+7+2]

Q7.a) Draw the block diagram of a Superheterodyne Receiver and identify its each section. [3]

b) How is heterodyning achieved in this type of receiver? [7]

c) Why is Superheterodyning preferred to Subheterodyning? [5]

UNIT 4 (Marks: 20x1=20)

(Answer any one question)

Q8. a) Given, message signal $m(t) = \sin 2000\pi t$; Frequency sensitivity $K_f = 200{,}000\pi$; Phase sensitivity $K_p = 10$. [6+4]

i) Calculate the bandwidths of the FM and PM signals.

ii) If the frequency of m(t) is doubled, what is the effect of this on the bandwidth of FM and PM signals?

b) A DSB-SC modulated signal $u(t) = Am(t) \cos(2\pi f_c t)$ is mixed with a local carrier $x_L(t) = \cos(2\pi f_c t + \theta)$ and the output is passed through a low-pass filter. [3+4+3]

i) Find the output of the low-pass filter (LPF). State the required specification of the filter, so that the message signal m(t) can be recovered.

ii) If the power of the signal at the output of the LPF is denoted by P_{out} and the power of the modulated signal is indicated by P_U, Find the ratio of P_{out} / P_U.

iii) What is the maximum allowable value of θ if the required signal is to be 90% of the maximum possible value?

Q9. a) It is required to design an FM transmitter to generate an FM carrier having a carrier frequency of 96 MHz and frequency deviation of 20 KHz. For this purpose, a Narrow Band FM generator with a carrier frequency of 200 KHz and adjustable frequency deviation in the range of 9-10 Hz are available. Moreover, following equipments/components are also available for design purpose:

i) An oscillator with adjustable frequency in the range of 9-10 MHz

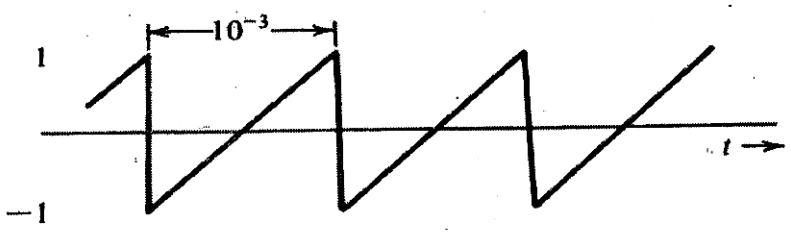
ii) A bandpass filter with any required center frequency

iii) Frequency doublers as required

Design the above FM transmitter using Armstrong indirect method. Represent the design using block diagram by mentioning the value of the carrier frequency as well as the frequency deviation at each stage of the design. [14]

b) Sketch FM wave corresponding to the modulating signal m(t) as shown below. [6]

Given, $\omega_c = 2\pi \times 10^6$, $k_f = 2000\pi$ and $K_p = \pi/2$.



UNIT 5 (Marks: 10x1=10)

(Answer any one question)

Q10. Establish that for small amplitude interference signal, the interference signal at the output of the detector is inversely proportional to the carrier amplitude, in case of Angle Modulated signal; whereas, for Amplitude Modulated signal, it is independent of the carrier amplitude. [10]

Q11. Represent the effect of interference in Frequency Modulated (FM) and Phase Modulated (PM) system graphically. Hence explain, how the Pre-emphasis De-emphasis (PDE) technique offers an opportunity to reduce noise to the great extent in an FM system. [10]