B. E. Electronics Tele-Communication Engineering Examination, 2019

(2nd Year 2nd Semester)

Analog Communication Systems

Time: Three hours | Full Marks: 100

Answer the following questions as directed

Unit-1

(Marks: 10)

1. Linear distortion causes pulse dispersion; whereas, channel nonlinearities leads to spectral dispersion - explain. (10)

OR

1. a) Explain the need for modulation in a communication system. (6)
   b) Linear modulation offers higher bandwidth efficiency than non-linear modulation - explain. (2)
   c) Non-linear modulation offers greater noise immunity than linear modulation – justify this statement. (2)

Unit-2

(Marks: 30)

2. a) Derive the expression of Power Efficiency for Amplitude Modulated (AM) signal. (3)
   b) Draw and explain the phasor diagram of AM signal. (1.5+1.5)
   c) Discuss the need for using Vestigial Side Band (VSB) modulation in commercial TV broadcasting instead of Double Side Band (DSB) or Single Side Band (SSB) AM. (3)
   d) Explain the principle of operation of VSB transceiver. (6)
   e) Draw the VSB spectrum of TV signal and calculate the required bandwidth. (5)

OR

2. a) Derive the expressions of Frequency Modulated (FM) and Phase Modulated (PM) signals. Hence establish the relationship between them. (7+3)
   b) Establish that wide band FM signal contains the frequency components as described by the relation $f_c \pm nf_m$, where the symbols have their usual meanings. (10)

3. a) A sinusoidal carrier is modulated in amplitude by another sinusoidal baseband signal to a depth of 50%. Draw the corresponding waveform. (2)
   b) Draw and explain the phasor diagram of Narrow Band FM signal. (1.5+1.5)
   c) Unlike AM, the total transmitted power in FM is constant – explain. (3)
   d) How does the modulation index affect the bandwidth in FM signal? (2)

Unit – 3

(Marks: 30)

4. a) How does a single balanced modulator circuit successfully suppress the carrier component of an AM signal? Explain with necessary circuit diagram and mathematical derivations. Also mention the assumptions you have made while describing its operation. (8+2)

b) How can the Phase Shifting method be successfully used in suppressing the upper side band of AM signal? (5)

OR

4. a) Draw the schematic diagram of a Phase Locked Loop (PLL) and identify its basic components. (2+2)

b) State the principle of operation of PLL. (2)

c) Following the above principle, develop the equivalent model of PLL. (6)

d) How can the PLL be used as FM demodulator? (3)

5. a) Draw the block diagram of a Superheterodyne receiver and label its different sections. (2+2)

b) How is heterodyning function achieved in this receiver? (4)

c) What do you mean by superheterodyne tracking? (1)

d) How does this receiver handle the problems of sensitivity and selectivity related to the Tuned Radio Frequency (TRF) receiver? (4)

e) Why is super heterodyning preferred to sub heterodyning in modern receivers? (2)

Unit – 4

(Marks: 20)

6. a) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^6$ is described by the equation $s(t) = 5 \cos (\omega_c t + 20 \sin 1000 \pi t + 10 \sin 2000 \pi t)$.

i) Find the frequency deviation

ii) Find the phase deviation

iii) Find the bandwidth of s(t) (2+2+2)

b) Show that it is possible to design a DSB-SC modulator to generate a modulated signal $k\, m(t) \cos \omega_c t$ with the carrier frequency $f_c = 300$ KHz. A signal generator of frequency 100 KHz, a ring modulator and a band pass filter tuned to 300 KHz are available for the design. Also find the value of k. (4)

7. It is required to design an Armstrong indirect FM modulator to generate an FM signal with carrier frequency of 91.2 MHz and frequency deviation of 76.8 KHz. A Narrow Band FM generator with carrier frequency of 200 KHz and frequency deviation of 25 Hz is

available. You are provided with an oscillator with adjustable frequency in the narrow range of 10.75 - 10.95 MHz. Represent the final design of the FM modulator by mentioning the carrier frequency as well as frequency deviation at every stage of the design. (10)

Unit – 5

(Marks: 10)

8. a) Consider that both FM and PM signals are subjected to weak or small signal interference. Mathematically establish the effect of interference on both the signals. How does this analysis help an FM system to handle channel noise in a better way through the introduction of the concept of Preemphasis-Deemphasis? (4+6)