BETCE EXAMINATION, 2017

(2^{nd} Year 2^{nd} Semester)

Analog Communication Systems

Time: Three hours | Full Marks: 100

Answer any five questions
All the answers carry equal marks
Answer all the parts of a question in the same place

1. a) Determine the characteristics of a system that allows a signal to pass without distortion over a communication channel. (5)

b) Explain that a memory-less nonlinear channel causes spectral dispersion in contrast to a linear time invariant channel which leads to pulse dispersion. (7)

c) Why does multipath transmission occur in a channel? Consider a transmission channel is represented as two channels in parallel each with a different relative attenuation and a different time delay. Establish that such channel causes pulse dispersion. How do such channels cause frequency selective fading of transmitted signals? (2+4+2)

2. a) Discuss the relative merits and demerits of a linearly modulated system over a non-linearly modulated system. (6)

b) Draw and explain the phasor diagrams of Amplitude Modulated (AM) signal and Narrow Band Frequency Modulated (NBFM) signal. (5)

c) Show that under the best condition only one-third of the transmitted power is used for carrying messages in an AM system. (3)

d) The baseband signal m(t) in the frequency-translated signal $v(t) = m(t)\cos 2\pi f_c t$ is recovered by multiplying v(t) by the waveform $\cos(2\pi f_c t + \theta)$. If the product waveform is transmitted through a low-pass filter which rejects the double frequency signal, what is the output of this filter? What is the maximum allowable value for the phase θ if the recovered signal is to be 90% of the maximum possible value? If the baseband signal m(t) is bandlimited to 10KHz, what is the maximum value of f_c for which it is possible to recover m(t) by filtering the product waveform? (6)

3. a) Draw the neat sketch of an Amplitude Modulated (AM) wave. How will you find out the modulation index from this diagram? (2+3)

b) Discuss the need for using Vestigial Side Band (VSB) modulation in commercial TV broadcasting instead of Double Side band or Single Side Band AM. (3)

c) Explain the principle of operation of VSB transceiver. (6)

d) For the baseband signal $m(t) = e^{-|t|}$ and the carrier signal cos (10,000t - $\pi/4$), sketch the spectra of m(t) and DSB-SC signal. Also identify the Upper Side Band (USB) and Lower Side Band (LSB) spectra of the DSB-SC signal. (6)

4. a) Explain with proper block diagram how can Double Side Band Suppressed Carrier (DSB-SC) modulation be achieved by non-linear modulator. Hence draw the circuit diagram of a single balanced modulator and explain its operation. (5+7)

b) Discuss the difficulties associated with the filtering method while removing one of the side bands from the DSB signal. How can the Phase Shifting method be successfully used in this context? (3+5)

5. a) Derive the expressions of Frequency Modulated (FM) and Phase Modulated (PM) waves. Hence establish the relationship between them. (7+3)

b) Discuss the effect of the variation of the amplitude and frequency of the modulating signal on the FM spectra. (6)

c) A carrier of frequency 10^6 Hz and amplitude 3 volts is frequency modulated by a sinusoidal modulating waveform of frequency 500 Hz and of peak amplitude 1 volt. As a consequence, the frequency deviation is 1 KHz. The level of the modulating waveform is changed to 5 volts peak, and the modulating frequency is changed to 2 KHz. Write the expression for the new modulated waveform. (4)

6. a) Establish that Wide Band FM signal is effectively composed of a carrier and an infinite set of side frequencies located symmetrically on either side of the carrier at frequency separations of nf_m, where symbols have their usual meanings. (10)

b) How will you define the bandwidth of FM signal? (4)

c) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^6$ is described by the equation $s(t) = 10 \cos (\omega_c t + 0.1 \sin 2000 \pi t)$. Find the frequency deviation, phase deviation and bandwidth of the given signal. (6)

7. a) Discuss the disadvantages associated with Tuned Radio Frequency (TRF) receiver. (5)

b) How can you overcome the above disadvantages using Superheterodyne receiver? (10)

c) Explain the terms Sensitivity, Selectivity and Image Interference in relation to radio receiver. (1+1+3)

8. Write short notes on any two of the following: (10+10)

a) Envelope detector

b) Phase Locked Loop

c) Pre-emphasis-De-emphasis technique