IEBT Examination, 2018
(2nd Year 2nd Semester)
Signal Processing and Transmission

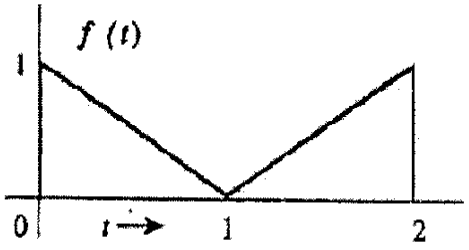
Time: Three hours | Full Marks: 100

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

1. a) Find the odd and even components of the signal $g(t) = 2e^{-t/2} u(t)$ and sketch them. (3)

b) Differentiate between energy signal and power signal. (4)

c) For the given signal f(t), sketch f(2t + 2) and f(2 – 2t). (5)

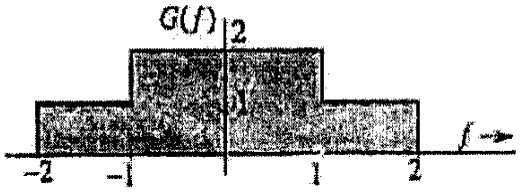


d) Express the signal f(t) in part c) by a single expression valid for all t. (4)

e) State and explain the sampling property of unit impulse function. (4)

2. a) From definition, show that the Fourier transform of rect (t-5) is sinc (ω/2) $e^{-j5\omega}$. Sketch the resulting amplitude and phase spectra. (8)

b) Find the inverse Fourier transform of the signal as shown below: (6)



c) Explain the significance of Frequency Shifting property of Fourier transform in communication system. (4)

d) How will you define time autocorrelation function of a signal g(t)? (2)

3. a) State the difference between linear and non-linear modulation. (5)

b) Draw the neat sketch of Amplitude Modulated (AM) wave in time domain and find its modulation index. (2+2)

c) Show that the maximum power requirement for amplitude modulation is 1.5 times the unmodulated carrier power. (5)

d) Draw and explain the operation of Envelope Detector circuit. (6)

4. a) Why is it necessary to suppress the carrier of AM signal? How will you suppress the carrier of AM signal using Single Balanced Modulator circuit? (3+7)

b) Establish that TV signal requires a bandwidth of 6 MHz using Vestigial Side Band (VSB) modulation technique. (5)

c) The output signal from an AM modulator is $u(t) = 5 \cos (1800 \pi t) + 20 \cos (2000 \pi t) + 5 \cos (2200 \pi t)$. Determine the message signal, carrier and modulation index. (5)

5. a) Derive the expression of Frequency Modulated (FM) wave. Hence show that a Narrow Band FM wave essentially requires the same transmission bandwidth as AM wave. (5+5)

b) Draw and explain the phasor diagrams of Narrow Band FM and AM signals. (5)

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. (5)

6. a) Explain that unlike AM, the total power in FM is constant. (4)

b) Briefly explain the impact of amplitude as well as frequency of modulating signal on FM spectra. (6)

c) How can you define bandwidth of FM signal using Carson's rule? (2)

d) It is desired to generate wideband FM signal using Armstrong indirect method. This system is to accommodate audio signal containing frequency down to 40 Hz. The narrow band phase modulator is supplied with a carrier signal of frequency 100 KHz by a crystal controlled oscillator. To avoid distortion in narrow band phase modulator, modulation index is limited to 0.2. At the output of the transmitter, the carrier frequency is to be 108

MHz and frequency deviation 80 KHz. (consider mixer oscillator frequency as 11.08 MHz). (2+3+3)

i) Draw the block diagram of the above system.
ii) Calculate the frequency multiplication ratios of the multiplier blocks.
iii) Find out the values of carrier frequency and frequency deviation at various stages of this system.

7. a) Consider a long uniform transmission line and find the expressions for voltage and current at any point on this transmission line. (10)

b) State the condition that needs to be fulfilled to maintain distortionless transmission along a transmission line. Can this condition be achieved in practice? (1+2)

c) How are standing waves formed in a transmission line? Define Standing Wave Ratio and explain its significance. (3+2+2)

8. a) Discuss the problem of selectivity associated with a Tuned Radio Frequency (TRF) Receiver. (4)

b) Explain, how the Superheterodyne Receiver overcomes the problems associated with TRF receiver. (9)

c) How does image station appear corresponding to a desired station? (4)

d) Why is high side injection preferred to low side injection? (3)