VIT
Vellore Institute of Technology

Final Assessment Test – November 2024

Course: **BITE203L - Principles of Communication Systems**

Class NBR(s): **3286 / 3292 / 3298** Slot: **C2+TC2**

Time: **Three Hours** 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. a) Elaborate the process of generating a Double Sideband Suppressed Carrier (DSB-SC) modulated wave utilizing a Ring Modulator. Incorporate relevant mathematical expressions and illustrative waveforms to support your explanation. **[4]**

   b) An audio frequency signal 10Sin ($2\pi500t$) is used to amplitude modulate a carrier of 50Sin ($2\pi10^5t$). Calculate **[6]**

   i) Modulation Index

   ii) Sideband frequencies

   iii) Amplitude of each sideband frequencies

   iv) Bandwidth Required

   v) Total power delivered to the load of 600Ω.

   vi) Plot frequency spectrum.

2. a) Derive the power distribution for Amplitude Modulation (AM) and formulate the AM wave equation. Also, explain the significance of each term in the equation referencing the frequency spectrum. **[6]**

   b) Compare AM with DSB-SC and SSB-SC. **[4]**

3. a) Discuss the process of generating a Frequency Modulated (FM) wave using the direct method. Include the frequency spectrum of FM under sinusoidal modulation, accompanied by the relevant equations. **[5]**

   b) A modulating signal $5\cos(2\pi*15*10^3t)$, angle modulates a carrier $A\cos\omega_c t$. Find the modulation index and the bandwidth for the FM system. Determine the change in the bandwidth and modulation index if f_m is reduced to 5KHz. Compare the two results. Assume $k_p=k_f=15KHz/V$. **[5]**

4. Consider a receiving system consisting of an antenna with a leading cable having a loss factor L = 1.5 dB = F1, an RF pre-amplifier with a noise figure of F2=7 dB and a gain of 20 dB, followed by a mixer with a noise figure of F3= 10 dB and a conversion gain of 8 dB, and finally, an amplifier that has a noise figure F4 = 6 dB and a gain of 60 dB,

   a) Find the overall noise figure and noise temperature of the system.

   b) Find the noise figure and noise temperature of the system with pre-amplifier and cable interchanged.

5. Derive the figure of merit for a Double Sideband Suppressed Carrier (DSBSC) modulation system considering the following parameters:
   a) Carrier Power (Pc)
   b) Modulation Index (m)
   c) Signal-to-Noise Ratio (SNR)

6. Consider the input samples x(n)={2.1, 2.2, 2.3, 2.4, 2.8, 3.2, 3.4, 3.9, 4.2}. Construct the block diagram of a DPCM transmitter and a receiver and explain how encoding and decoding is carried out for the above input signal.

7. Explain the operational mechanism of FHSS. How does the system switch frequencies, and what role does the hopping sequence play.

8. a) Sketch the binary ASK, PSK and FSK waveform for the following binary sequence {1 0 0 1 1 0 1}. **[5]**

   b) Compare and contrast the constellation diagrams of different modulation schemes. **[5]**

9.a) Discuss the operational mechanism of a QPSK Transmitter and Receiver with a block diagram, and derive the Bit Error Probability.

OR

9.b) Explain how does the fixed step size in Delta Modulation contribute to its limitations, particularly in rapidly varying signals and explain how does Adaptive Delta Modulation utilize adaptive mechanisms to overcome the limitations of fixed step size in Delta Modulation.

10.a) A Television Signal with a bandwidth of 5.5 MHz is transmitted using binary PCM. The number of quantization level is 256.Determine

   i) Code word length **[2]**

   ii) Transmission bandwidth **[2]**

   iii) Final Bit rate **[3]**

   iv) Output Signal to quantization noise ratio. **[3]**

OR

10.b) Binary data has to be transmitted over a telephone link that has a usable bandwidth of 3000 Hz and a maximum achievable signal to noise power ratio of 6 dB at its output.

   i) Determine maximum signalling rate and probability of error if a coherent ASK scheme is used.

   ii) If data is maintained at 300 bits/sec, calculate error probability.

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