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21EC44

Fourth Semester B.E. Degree Examination, June/July 2023
Communication Theory

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Explain the time domain and frequency domain analysis of AM wave for a single modulating signal with neat diagrams and necessary equations. **(10 Marks)**
   b. Explain the operation of envelope detector with neat diagrams and waveforms. Also mention the significance of RC-time constant. **(05 Marks)**
   c. An audio frequency signal $10\sin 2\pi(500)t$ is used to amplitude modulate a carrier of $50\sin 2\pi(10^5)t$. Assume modulation index $= 0.2$. Determine sideband frequencies, amplitude of each side band, bandwidth required, Efficiency of AM wave. **(05 Marks)**

OR

2 a. With relevant diagrams, explain the operation of the quadrature carrier multiplexing transmitter and receiver schemes. **(07 Marks)**
   b. Explain the concept of FDM with neat block diagram. **(06 Marks)**
   c. A carrier wave $4\sin(2\pi*500*10^3 t)$ volts is amplitude modulated by an audio wave $[0.2\sin 3(2\pi*500t)+0.1\sin 5(2\pi*500t)]$ volts. Determine upper and lower sidebands and sketch the complete spectrum of the modulated wave. Estimate the total power in the sideband (R = 1 Ω). **(07 Marks)**

Module-2

3 a. Define the following :
   (i)   Instantaneous frequency
   (ii) Maximum frequency deviation
   (iii) Modulation index. **(06 Marks)**
   b. Explain the generation of narrow band FM wave with neat block diagram, necessary equations and phasor diagrams. **(08 Marks)**
   c. When a 50.4 MHz carrier is frequency modulated by a sinusoidal AF modulating sinal, the highest frequency reached is 50.405 MHz. Calculate
   (i)   The frequency deviation produced.
   (ii) Carrier swing of the wave.
   (iii) Lowest frequency reached. **(06 Marks)**

OR

4 a. Explain the demodulation of FM signal using the nonlinear and linear model of PLL with neat diagrams and equations. **(10 Marks)**
   b. Explain the FM stereo multiplexer and demultiplexer operation with neat diagrams. **(08 Marks)**
   c. An FM wave is defined by $s(t)=10\cos[2+\sin 6\pi t]$. Find the instantaneous frequency of s(t). **(02 Marks)**

Module-3

5 a. Write short notes on :
   (i)   Thermal noise
   (ii) Shot noise.
   (iii) White noise.   (06 Marks)

   b. Derive the noise equivalent bandwidth equation $B = \dfrac{1}{4CR}$ Hz for low pass filter. (08 Marks)

   c. Three 5 KΩ resistors are connected in series. For room temperature $\left(KT = 4 \times 10^{-21}\right)$ and an effective noise bandwidth of 1 MHz, determine
   (i)   The noise voltage appearing across each resistor.
   (ii) The noise voltage appearing across the series combination.
   (iii) What is the rms noise voltage which appears across same three resistors connected in parallel under the same conditions?   (06 Marks)

OR

6 a. Show the figure of merit for DSBSC system is unity.   (08 Marks)
   b. Obtain the expression for FOM of AM receivers using envelope detector. (08 Marks)
   c. An AM receiver operating with a sinusoidal wave of 80% modulation has an output signal to noise ratio of 30 dB. Calculate the corresponding channel S/N ratio.   (04 Marks)

Module-4

7 a. What are the advantages of digitizing the analog sources?   (06 Marks)
   b. State and explain the sampling theorem for the band limited signal. Also explain the under sampling, over sampling and Nyquist rate with neat diagram.   (14 Marks)

OR

8 a. Explain the pulse amplitude modulation with neat diagram and equations. (08 Marks)
   b. Explain the Time Division Multiplexing (TDM) with neat block diagram.   (08 Marks)
   c. An analog signal is expressed by the equation, $x(t) = \dfrac{1}{2\pi}\cos(4000\pi t)\cos(1000\pi t)$. Calculate the nyquist rate and nyquist interval for this signal.   (04 Marks)

Module-5

9 a. Explain the construction and regeneration of PCM signal.   (10 Marks)
   b. Explain the different line codes. To transmit a bit sequence 01101001 draw the resulting waveforms using,
   (i)   Unipolar NRZ
   (ii) Polar NRZ.
   (iii) Unipolar RZ
   (iv) Bipolar RZ
   (v)   Manchester   (10 Marks)

OR

10 a. Explain the concept and operation of delta modulation in detail.   (10 Marks)
   b. Explain quantization process with neat diagrams. Also explain the types of quantizer with neat diagrams.   (06 Marks)
   c. Write a short note on Vocoder.   (04 Marks)

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