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17EC44

Fourth Semester B.E. Degree Examination, July/August 2022
Principles of Communication Systems

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Define amplitude modulation and modulation index sketch the standard AM wave for $\mu < 1$, $\mu = 1$ and $\mu > 1$. Also derive the equation for μ in terms of A_{\max} and A_{\min} . (06 Marks)
- b. With the help of necessary circuit diagram, waveforms and equations, explain the generation of standard AM signal. Using switching modulator. (07 Marks)
- c. An audio frequency signal $10 \sin 2\pi 500t$ is used to amplitude modulate a carrier signal $50 \sin 2\pi \times 10^5 t$. If $\mu = 0.2$, determine sideband frequencies, amplitude of each sideband, bandwidth required, PC and PT. Also sketch frequency spectrum. Assume $R = 600\Omega$. (07 Marks)

OR

- 2 a. Explain the operation of QCM system. (06 Marks)
- b. What is quadrature null effect of the coherent detector? Explain the practical synchronous receiving system. (07 Marks)
- c. Explain the VSB transmission of analog and digital television signals. (07 Marks)

Module-2

- 3 a. Derive the equation of signal tone frequency modulated signal. Also explain the relationship between FM and PM. (06 Marks)
- b. With the help of necessary circuit diagram and equations, explain the working FM generation using VCO. Draw the block diagram of feedback scheme for generation of frequency stabilized FM wave. (07 Marks)
- c. An angle modulated signal is represented by,
 $s(t) = 10 \cos [2\pi \times 10^6 t + 5 \sin 2000\pi t + 10 \sin 3000\pi t]$ volts. Determine the following :
i) The power in the modulated signal
ii) The frequency deviation
iii) The deviation ratio
iv) The phase deviation
v) Transmission bandwidth. (07 Marks)

OR

- 4 a. Explain the operation of FM stereo multiplexing. (06 Marks)
- b. What is PLL? Explain the linear model and nonlinear model of PLL for demodulation of FM signals. (09 Marks)
- c. Write short notes on nonlinear effects in FM systems. (05 Marks)

Module-3

- 5 a. Describe mean autocorrelation and co-variance functions with respect to random process. (06 Marks)
- b. What is noise equivalent bandwidth? Derive the expression for noise equivalent bandwidth of low pass filter. (08 Marks)
- c. A random variable 'X' has the following distribution function :

$$F_X(x) = \begin{cases} 0 & ; \quad x < 0 \\ x/8 & ; \quad 0 \leq x \leq 2 \\ x^2/16 & ; \quad 2 \leq x \leq 4 \\ 1 & ; \quad 4 \leq x \end{cases}$$

Determine mean, variance and standard deviation. (06 Marks)

OR

- 6 a. Explain the following :
- Short noise
 - Thermal noise
 - White noise. (06 Marks)
- b. What is cross correlation? Explain the properties of cross-correlation. (08 Marks)
- c. Calculate the RMS noise voltage and thermal noise power appearing across a 20KΩ resistor at 25°C temperature with an effective noise bandwidth of 10KHz. (06 Marks)

Module-4

- 7 a. Discuss the noise in DSBSC receiver with a model receiver using coherent detection. Prove that the figure of merit for such a receiver is unity. (07 Marks)
- b. Derive the expression for output signal – to – noise ratio of an AM receiver using an envelope detector. (08 Marks)
- c. A carrier reaching an envelope detector in an AM receiver has an RMS value equal to 1 volt in the absence of modulation. The noise at the input of the envelope detector has a PSD equal to 10^{-3} watts/Hz. If the carrier is modulated to a depth of 100% and message bandwidth $W = 3.2$ KHz, determine output signal – to – noise ratio. (05 Marks)

OR

- 8 a. Explain the concepts of capture effect, FM threshold effect and FM threshold reduction. (07 Marks)
- b. Derive the expression for figure of merit of a noisy FM receiver using the frequency discriminator. (08 Marks)
- c. An FM signal with a deviation of 75KHz is applied to an FM demodulator. When the input SNR is 15dB, the modulating frequency is 10KHz determine the SNR at the demodulator output. (05 Marks)

Module-5

- 9 a. State sampling theorem for low pass signals find the Nyquist rate and Nyquist interval of $m(t) = \frac{1}{2\pi} \cos 4000\pi t \cdot \cos 1000\pi t$. (05 Marks)
- b. With the help of relevant block diagram and waveforms, explain the generation and detection of PAM signal. (08 Marks)
- c. Explain the operation of TDM system. (07 Marks)

OR

- 10 a. An analog waveform with bandwidth 15KHz is to be quantized with 200 levels and transmitted via binary PCM signal. Find the rate of transmission and bandwidth required. If 10 such signals are to be multiplexed, find the bandwidth requirement. (05 Marks)
- b. Explain the generation and detection of PPM waves. (08 Marks)
- c. With the help of block diagram explain the working VOCODER. (07 Marks)
