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**Fifth Semester B.E. Degree Examination, July/August 2022**  
**Analog Communication**

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO full questions from each part.

**PART - A**

- 1 a. Define the following terms with relevant equations for random variables:
  - i) Moments about the origin
  - ii) Central Moments
  - iii) Correlation
  - iv) Covariance. (08 Marks)
- b. Let X be a continuous random variable that is uniformly distributed in the interval  $(-\pi, \pi)$ . Find first moment of the random variable 'X'. (06 Marks)
- c. Define Gaussian process and state its properties. (06 Marks)
  
- 2 a. Show that a square law detector can be used for the detection of an AM-wave. With neat diagram and spectrum. Explain the working of the square law detector. Discuss the condition for distortion-less recovery. (08 Marks)
- b. An audio frequency signal  $10\sin(1000\pi t)$  volts is used to amplitude modulate a carrier of  $50\sin(20000\pi t)$  volts. Assume modulation index of 0.2. Find: i) Sideband frequencies ii) Amplitude of each side bands iii) Bandwidth required iv) Spectrum of modulated wave. (06 Marks)
- c. Explain the method of obtaining a practical synchronous (coherent detection) receiving system with DSBSC modulated wave using COSTAS loop. (06 Marks)
  
- 3 a. Define complex envelope of bandpass signal. Explain the generation of an SSB-wave using phase discrimination method, using appropriate equations and block diagram. (08 Marks)
- b. Given that  $m(t) = 5\cos(1000\pi t) + 3\sin(5000\pi t)$ , carrier  $c(t) = 10\cos(10000\pi t)$ .
  - i) Find the expression for  $s_f(t)$  (only lower sideband of SSB).
  - ii) Plot the spectrum.
  - iii) Find the power transmitted. (06 Marks)
- c. Explain the quadrature carrier multiplexing system with neat block diagrams. (06 Marks)
  
- 4 a. What is Frequency Division Multiplexing (FDM)? Explain FDM with block diagrams. (06 Marks)
- b. With neat spectrum and equations explain frequency translation process. Consider an incoming narrow band signal of band 0.535 – 1.605MHz. It is required to translate this to frequency band with midband frequency of 0.455MHz. Determine the range of tuning that must be provided in the local oscillator. (08 Marks)
- c. Write a short note on Vestigial Side Band (VSB) modulation. (06 Marks)

**PART – B**

- 5 a. Define narrow band FM. Explain indirect method of FM generation with block diagram and equations. (08 Marks)
- b. It is required to transmit a complex modulating signal in which the highest frequency component of the spectrum is 3kHz. Compare the bandwidth required for AM, SSB, FM given maximum frequency deviation in FM is 15kHz. (04 Marks)
- c. Design a 2 stage FM transmitter based on indirect method for the specifications given below. Also draw the block diagram. Audio frequency range: 100Hz – 15kHz. Overall frequency deviation  $\Delta f = 75\text{kHz}$ . Local oscillator frequency supplied to narrow band phase modulator  $f_{c1} = 0.1\text{MHz}$ . Local oscillator frequency supplied to mixer  $f_{c2} = 9.5\text{MHz}$ . Desired FM carrier frequency  $f_c$  at the output of transmitter = 100MHz. (08 Marks)
- 6 a. Deriving the equations used and explain the demodulation of FM using the balanced frequency discriminator. (12 Marks)
- b. Explain FM stereo multiplexing. (08 Marks)
- 7 a. The gain of cascade of 3 amplifier are  $G_1 = 20\text{dB}$ ,  $G_2 = 30\text{dB}$ ,  $G_3 = 40\text{dB}$  and noise factors are  $F_2 = 8\text{dB}$  and  $F_3 = 15\text{dB}$ . The equivalent noise temperature of the first stage is  $5^\circ\text{K}$ . Determine the equivalent noise temperature of the cascade. Assume the operating temperature to be  $300^\circ\text{K}$ . Also derive the expressions used. (08 Marks)
- b. Define figure of merit and explain its significance. Obtain an expression for the figure of merit in a noisy AM receiver, which uses envelope detection. For a single tone signal show that it reduces to  $\mu^2/(2 + \mu^2)$  where  $\mu$  is the modulation index of AM receiver. (12 Marks)
- 8 a. Explain pre-emphasis and de-emphasis in FM. (10 Marks)
- b. Write short note on:
- Thermal Noise
  - Amplitude limiters in FM system. (10 Marks)

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