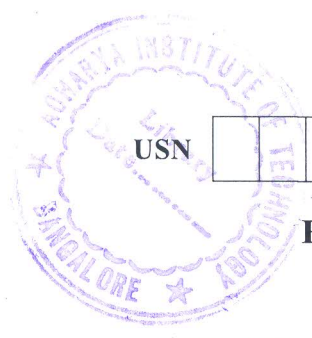


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10EC53

**Fifth Semester B.E. Degree Examination, Jan./Feb.2021**  
**Analog Communication**

Time: 3 hrs.

Max. Marks:100

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

**PART - A**

- 1 a. What is cumulative distribution function? List the properties. (07 Marks)
- b. The pdf of a random variable is given as  $f_x(x) = \begin{cases} K & \text{for } a \leq x \leq b \\ 0 & \text{otherwise} \end{cases}$   
where K is constant
  - (i) Sketch the pdf and determine the value of K.
  - (ii) If  $a = -1$  and  $b = 2$ , calculate  $P(1 \times 1 \leq C)$  for  $C = \frac{1}{2}$ . (06 Marks)
- c. What is Gaussian process? List the properties of Gaussian process. (07 Marks)
- 2 a. Show that the output of the switching modulator is  $V_0(t) = \frac{A_c}{2} \left[ 1 + \frac{4}{\pi A_c} m(t) \right] \cos 2\pi f_c t$  by considering  $m(t)$  is the message signal and  $C(t) = A_c \cos 2\pi f_c t$  is the carrier signal. (07 Marks)
- b. A 250 W carrier of 1000 kHz is simultaneously modulated by sinusoidal signals of 2 kHz, 6 kHz and 8 kHz with modulation index of 35%, 55% and 75% respectively. What are the frequencies present in the modulated wave and what is the radiated power. (06 Marks)
- c. With block diagram, explain the generation of DSBSC waves using balanced modulator and show that output of the subtractor is  $s(t) = 2K_a A_c m(t) \cos 2\pi f_c t$ . (07 Marks)
- 3 a. What is Hilbert transform? Show that if  $\hat{x}(t)$  is the Hilbert transform of  $x(t)$  then the Hilbert transform of  $\hat{x}(t)$  is  $-x(t)$ . (06 Marks)
- b. Derive an expression for SSB modulated wave for which upper sideband is retained. (08 Marks)
- c. Explain the process of demodulation of SSB waves and show that the output of the filter is  $\frac{A_c}{4} m(t)$  (scaled message signal). (06 Marks)
- 4 a. Show that a VSB modulated wave  $s(t)$  containing,  
 $s(t) = \frac{A_c}{2} [m(t) \cos 2\pi f_c t - m_Q(t) \sin 2\pi f_c t]$   
using time domain description. (10 Marks)
- b. With block diagram and expression, explain the process of frequency translation. (06 Marks)
- c. The incoming signal has a midband frequency that may lie in the range of 530 kHz to 1650 kHz. The associated a bandwidth in 10 kHz. This is to be translated to a fixed frequency band centered at 470 kHz. Determine the range must be provided by the local oscillator. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**PART - B**

- 5 a. Sketch the FM and PM waves for the modulating signal  $m(t)$  shown in Fig. Q5 (a)-(i) and Fig. Q5 (a)-(ii). The constants  $K_f = 10^5$  Hz/volt and  $K_p = 5$  radians/volt. The carrier frequency  $f_c = 100$  MHz. (06 Marks)

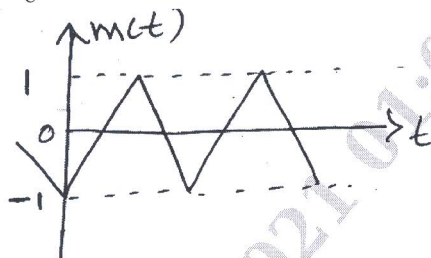


Fig.Q5 (a) - (i)

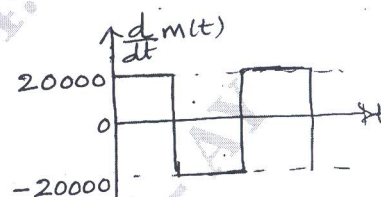


Fig.Q5 (a) - (ii)

- b. With block diagram and necessary equations, explain the generation of Narrowband frequency modulation. (07 Marks)
- c. Explain the generation of frequency stabilized FM wave using Direct FM method. (07 Marks)
- 6 a. With circuit diagram, explain FM stereo transmitter and receiver system. (08 Marks)
- b. What is phase locked loop? With necessary mathematical equations and equivalent non-linear and linear model of PLL show that output of the PLL is the scaled version of the original message signal  $m(t)$ . (12 Marks)
- 7 a. Write a short note on white noise. (06 Marks)
- b. Define noise-factor. Derive the expression for noise factor for cascade connection of two port networks. (06 Marks)
- c. Consider a receiver system consisting of an antenna with lead in cable having a loss factor of  $L = 1.5$  dB =  $F_1$  an RF pre-amplifier with a noise figure of  $F_2 = 7$  dB and a gain of 20 dB followed by a mixer with a noise figure  $F_3 = 10$  dB and a conversion gain of 8 dB and finally an integrated circuit IF amplifier with a noise figure of  $F_4 = 6$  dB and a gain of 60 dB. [Assume Room temperature  $25^\circ\text{C}$ ].
- Find the overall noise figure and noise temperature of the system. (08 Marks)
  - Find the noise figure and noise temperature of the system with preamplifier and cable interchanged. (08 Marks)
- 8 a. Derive the expression for the figure of merit for DSBSC receiver. (08 Marks)
- b. The carrier reaching an envelope detector in an AM receiver has an RMS value equal to 1 V 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 at a depth of 100% and message bandwidth,  $W = 3.2$  KHz, find  $[\text{SNR}]_0$ . (04 Marks)
- c. Write a short notes on pre-emphasis and de-emphasis. (08 Marks)

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