Code : 041603/041503

B.Tech 6th Semester Special Exam., 2020

INTRODUCTION TO COMMUNICATION SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Answer the followng questions (any *seven*) : 2×7=14

(a) Define Hilbert Transform.

(b) The amplitude modulated waveform

$$s(t) = A_c [1 + k_a m(t)] \cos \omega_c t$$

is fed to an ideal envelop detector. The maximum magnitude of $k_a m(t) > 1$. Find the detector output.

(c) What is sensitivity in communication receiver?

(d) Why the envelop detector is used in FM discriminator? Which device could you use to convert frequency variations into amplitude variations?

(e) Draw Pre/De-Emphasis response.

(f) A carrier is phase modulated with frequency deviation of 10 kHz by a single tone frequency of 1 kHz. If the single tone frequency is increased to 2 kHz, assuming that phase deviation remains unchanged, find the band-width of the PM signal.

(g) What is white noise?

(h) What is aliasing effect?

2. (a) Verify the duality property that is

$$X(t) \leftrightarrow 2\pi x(-\omega)$$ 5

(b) Explain difference between Wide Band FM and Narrow Band FM. 4

(c) Discuss the bandwidth requirements for the wideband FM system in detail. 5

3. (a) In a broadcast AM receiver, having an RF amplifier, loaded Q of antenna coil at the input of the mixer is 200. If the IF frequency is 455 kHz, find the image frequency and its image rejection ratio at 1000 kHz. 5

(b) Draw the block diagram of balanced frequency discriminator and explain its use for demodulation of FM signal. 4

(c) Draw the block diagram of super-heterodyne receiver and specify the importance of IF value in the receiver. What are the characteristics of a radio receiver? 5

4. (a) Explain delta modulation with its advantages and disadvantages. 5

(b) Explain the effect of random noise on the output of FM receiver fitted with amplitude limiter. Also explain the immunity of angle modulation to non-linearities. 4

(c) Discuss the bandwidth requirements for the wideband FM system in detail. 5

5. (a) Draw the block diagram of the transmitter and receiver of a PCM system. Describe non-uniform quantization and explain how it reduces the noise. 6

(b) In a superheterodyne receiver having no RF amplifier, the loaded Q of the antenna coupling circuit is 100 and the intermediate frequency is 455 kHz. The superheterodyne receiver is to be

improved for high frequency (HF) reception so that its image frequency rejection at 25 MHz is as good as it was at 1100 kHz (MF). Calculate *(i)* the loaded Q which an RF amplifier for this receiver would have to have and *(ii)* the new intermediate frequency that will be needed if there is no RF amplifier. 8

6. (a) Draw the block diagram of PLL and give its realization using mixer as phase detector. Also give the mathematical detail explaining basic PLL operation. 8

(b) Explain the operation of switching modulator circuit using appropriate circuit diagram and mathematical expressions. 6

7. (a) In an envelope detector, the input is an AM signal which is expressed as

$$\phi_{AM}(t) = A(1 + m\cos\omega_m t)\cos\omega_c t$$

Show that if the detector output is to follow the envelope at all times, it is required that

$$\frac{1}{RC} \geq \left(\frac{m\omega_m}{\sqrt{1-m^2}}\right)$$ 6

(b) The bandwidth allowed for the transmission of an FM radio signal is 200 kHz, assume that the FM radio station wants to transmit a stereo message signal of bandwidth equal to 52 kHz. Determine the maximum value of the message signal.

Assume $k_f = 4000$ V/s 8

8. (a) Draw the block diagram of a super-heterodyne receiver and explain its functioning. How and why constant IF is achieved in this receiver? What is the criteria for IF selection? Why is the rejection of image frequency so important in superheterodyne receiver? 8

(b) Draw and explain each block of communication system. 6

9. (a) Work out the time-domain representation of SSB signal using Hilbert transform. Also prove that SSB signal can be demodulated by envelope detector if carrier is re-inserted. 6

(b) Explain the following methods for generating AM-modulated signals with the help of suitable diagrams : 8

(i) Power-law AM modulator

(ii) Switching modulator

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