Code : 041603

B.Tech 6th Semester Exam., 2019

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 any *seven* of the following : 2×7=14

(a) What is aliasing effect?

(b) What are the applications of FM?

(c) What is white noise?

(d) What are the applications of AM?

(e) What is the difference between SSB and DSB?

(f) Draw pre/de-emphasis response.

(g) What is sensitivity in communication receiver?

(h) What is the main purpose of using source encoder in a communication system?

2. (a) Determine the Fourier series of periodic impulse train defined by

$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$$ 5

(b) Explain any four properties of Fourier series expansion of a continuous and periodic signal. 4

(c) State and prove time scaling property of Fourier series. 5

3. *(a)* Draw the block diagram of a superheterodyne receiver and explain its functioning. How and why is constant IF achieved in this receiver? What is the criterion for IF selection? Why is the rejection of image frequency so important in superheterodyne receiver? 5

(b) Explain the filtering method of SSB generation. 4

(c) With a neat block diagram, explain Armstrong's method of FM generation. 5

4. *(a)* Discuss the bandwidth requirements for the wideband FM system in detail. 5

(b) An angle-modulated signal is described by $S(t) = 10\cos[2\pi(10^6)t + 0{\cdot}1\sin(10^3)t]$. Find the message signal $m(t)$ considering $S(t)$ is FM with $k_f = 5$. 4

(c) Explain difference between wideband FM and narrowband FM. 5

5. *(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. 6

(b) What are the desirable features of a communication receiver? Explain its any two features in detail. A super-heterodyne receiver with $f_{IF} = 500$ kHz and $3{\cdot}5 < f_{LO} < 4{\cdot}0$ MHz has a tuning dial calibrated to receive signals from 3 MHz to 3·5 MHz. It is set to receive a 3·0 MHz signal. The receiver has a broadcast RF amplifier and it has been found that the local oscillator (LO) has a significant third harmonic output. If a signal is heard, what are all its possible carrier frequencies? 8

6. *(a)* Give examples of balanced modulator circuit. Explain the operation of ring modulator circuit used for DSB-SC generation. 8

(b) Given the following SSB signal with a carrier (SSB+C) :

$$x(t) = A_c \cos(2\pi f_c t) + m(t)\cos(2\pi f_c t) - m_h(t)\sin(2\pi f_c t)$$

Can it be demodulated using envelope detector? Find the condition for which the envelope detector would produce a good approximation of message signal $m(t)$. 6

7. (a) The signal

$$\varphi_{AM}(t) = 2(1 + 0{\cdot}4\cos 6000\pi t)\cos 10^6 \pi t$$

is applied to a square law device having a transfer characteristic $y = (x+4)^2$. The output of the square law device is filtered by an ideal LPF with a cut-off frequency of 8000 Hz. Sketch the amplitude spectrum of the filter output. 6

(b) Explain the basic principle of frequency discriminator and prove that it works as an FM demodulator. Show that balance slope detector works as an FM demodulator. 8

8. (a) Draw and explain each block of communication system. 8

(b) In an envelope detector, the input is an AM signal which is expressed as

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

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

9. (a) The single-tone modulating signal

$$m(t) = A_m \cos(2\pi f_m t)$$

is used to generate the VSB signal

$$s(t) = 0{\cdot}5aA_m A_c \cos[2\pi(f_c + f_m)t] + 0{\cdot}5A_m A_c(1-a)\cos[2\pi(f_c - f_m)t]$$

where a is a constant, less than unity, representing the attenuation of the upper side frequency.

(i) Find the quadrature component of the VSB signal $s(t)$.

(ii) The VSB signal, plus the carrier $A_c\cos(2\pi f_c t)$ is passed through an envelope detector. Determine the distortion produced by the quadrature component.

(iii) What is the value of constant a for which this distortion reaches its worst possible condition? 8

(b) What is the difference between SSB and VSB modulation? 6

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