Roll No. 1613

M.Sc.(Informatics)/I-Sem.-2013

Paper:IT-13

INTRODUCTION TO COMMUNICATION AND SYSTEMS

Time:3 hours *Maximum Marks:75*

Write your Roll No. on the top immediately on receipt of this question paper

Attempt **five** *questions in all. All symbols used have their usual meanings.*

Q.1(*a*) What do you understand by a periodic signal (2)

(*b*)Obtain the exponential Fourier series for the rectangular pulse train shown in Fig.1 and sketch its spectrum. (8)

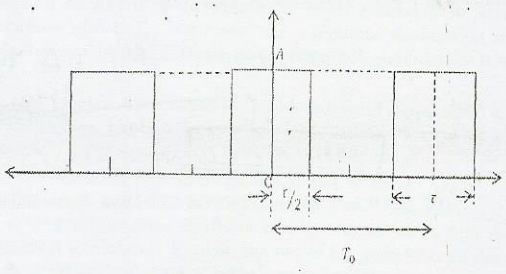

Fig.1

(*c*) A saw tooth signal $y(t)$ may be represented as:

$$y(t) = \frac{A}{T}t \quad \text{for} \quad 0 < t < T$$

and one cycle period $T_0 = T$. Sketch the signal for more than one cycle. Find an expression for the amplitude spectrum. (5)

Q.2(*a*) A unit step function may be defined as: (6)

$$u(t) = \begin{cases} 1. & t > 0 \\ 0. & t < 0 \end{cases}$$

(*i*) Sketch the following function

$$g(t) = \exp(-t)u(t)$$

(*ii*) Find the Fourier transform of the function $g(t)$. Sketch the corresponding amplitude and phase curve.

(*b*) If $g(t) \rightleftharpoons G(f)$, then for a constant time shift t_0,

$$g(t - t_0) \rightleftharpoons G(f)\exp(-j2\pi f t_0)$$

(4)

(*c*) Consider the rectangular pulse $g(t)$ which starts at time $t = 0$ and terminates at $t = T$. This pulse is defined by (5)

$$g(t) = A \quad rect\left(\frac{t - T/2}{T}\right)$$

Show that

$$G(f) = AT\,sinc(ft)\exp(-j\pi fT)$$

Q.3(*a*) Write down the various properties of Dirac delta function. Show that

$$\sin(2\pi f_c t) \rightleftharpoons \frac{1}{2j}\left[\delta(f - f_c) - \delta(f + f_c)\right]$$

(5)

(*b*) The generating function of a periodic signal is given by:

$$g(t) = \begin{cases} 1 + \cos(2\pi t). & -\frac{1}{2} \le t \le \frac{1}{2} \\ 0. & \text{for remainder of the period} \end{cases}$$

Determine the Fourier transform of the generating function $g(t)$. (4)

(*c*)Explain as to how the convolution integral

$$y(t) = \int_{-\infty}^{\infty} x(\tau)h(t - \tau)d\tau$$

represent the output when an input signal $x(t)$ passes through a medium with impulse response $h(t)$. (3)

(*d*)Deduce the conditions for distortionless transmission. (3)

Q.4(*a*)Describe the spectrum of AM wave. Consider a message signal $m(t) = A_m \cos(2\pi f_m t)$, where A_m and f_m denote the amplitude and frequency of the signal. If the sinusoidal carrier wave amplitude and frequency are respectively A_c and f_c, derive an expression of the resulting AM wave. Also show its Fourier spectrum. (6)

(*b*) A modulating signal $10\sin(2\pi \times 10^3 t)$ is used to modulate a carrier signal $20\sin(2\pi \times 10^4 t)$. Determine the modulation index , percentage modulation, frequencies of the side band components and their amplitudes. What will be the bandwidth of the modulated signal? (4)

(*c*) Explain the use of square law modulator for modulating a message signal. The load on an AM detector consists of $50k\Omega$ resistance in parallel with a capacitance of $0.1\mu F$. Determine the maximum modulation index that the detector can handle without distortion when modulation frequency is $10kHz$. (5)

Q.5(*a*) What do you understand by double sideband suppressed carrier (DSBSC) modulation. Explain the generation of DSBSC waves using a balanced modulator. (4)

(*b*)Let $A_m \cos(2\pi f_m t)$ be a message signal and $A_c \cos(2\pi f_c t)$ be the carrier signal. What will be the DSBSC modulated wave? Assuming perfect synchronism between the local oscillator and the carrier wave, find the output of the product modulator. Explain the use of low pass filter in the coherent detection of DSBSC modulated wave. (5)

(*c*) How do you obtain the SSB modulated wave. Draw the spectrum of SSB modulated wave with the upper sideband transmitted. (3)

(*d*)Using the single -tone modulating signal $\cos(2\pi f_m t)$, verify that the output of the SSB generator is indeed an SSB signal , and show that an upper-sideband (USB) or a lower-sideband (LSB) signal results from subtraction or addition at the summation junction. (3)

Q.6(*a*) What is the difference between (*i*)phase modulation(PM) and (*ii*) frequency modulation(FM) .Draw schematic diagram for generation of PM using FM and vice-versa. Deduce an expression for the spectrum of sinusoidal FM wave. (9)

(*b*) In an FM system, if the maximum value of deviation is $75kHz$ and the maximum modulating frequency is $10kHz$, calculate the deviation ratio and bandwidth of the system using Carson's rule. (2)

(*c*)Write short note on any one of the following: (4)

(*i*) Pulse code modulation.
(*ii*)Pulse width modulation.
(*iii*)Pulse position modulation.