M.Sc (Informatics) Ist Semester, 2016

Paper: IT-13, Introduction to Communication Systems

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

Time: 3.00hrs **Max.Marks:75**

Attempt five questions in all. Q.1 is compulsory

Q.1 (a) Sketch the spectrum of the following signal: (3)

$$S(t) = 4 - 5cos(30\pi t + 30°) + 4\,sin\,(120\pi t - 60°)$$

(b) Obtain the exponential Fourier series for the rectangular pulse , shown in Fig.1, and sketch the spectrum. (6)

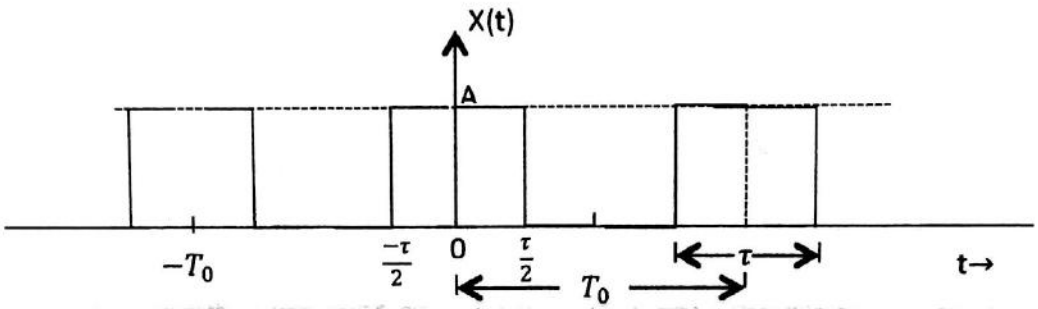

Fig.1

(c) Let $X(f)$ be the Fourier transform of $x(t)$. Find the Fourier transform of (βt) ? (3)

(d) Define the Dirac delta function. Write at least two properties of Dirac delta function. Find the Fourier transform of the delta function , $\delta(t)$. (3)

Q.2(a)Sketch the output of a Full-wave rectifier. Obtain the Fourier series of the following signal: (6)

$$x(t) = \begin{cases} Asin\left(\frac{\pi t}{T_0}\right); t > 0 \\ 0 \quad ; \; t \leq 0 \end{cases}$$

(b) Find the Fourier transform of the following signal: (4)

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

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where $u(t)$ is a unit step function defined as:

$$u(t) = \begin{cases} 1 \; ; t > 0 \\ 0.5 \; ; t = 0 \\ 0 \; ; t < 0 \end{cases}$$

(c)The generating function of a signal is given by: (3)

$$g(t) = \begin{cases} 1 + cos(2\pi t), & -0.5 \leq t \leq 0.5 \\ 0, & \text{for remainder of the period} \end{cases}$$

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

(d) Consider the $sinc$ pulse (2)

$$g(t) = A\, sinc(2Wt)$$

The duration of the pulse is defined as the duration of the main lobe of the pulse. Hence, show that the time-bandwidth product of the $sinc$ pulse equals unity.

Q.3 (a) Consider a modulating signal $m(t)$ that consists of a single tone or frequency component, that is,

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

Where A_m is the amplitude and f_m the frequency of the modulating signal. Find an expression for the spectrum of the AM wave. Also sketch the spectrum . (5)

(b) Explain by a suitable circuit the generation and detection of AM signal. (3)

(c) Explain the use of the Balanced Modulator to generate the DSBSC waves. Describe the method of coherent detection of DSBSC modulated waves. (4)

(d) Explain the working of Costas loop in obtaining a practical synchronous receiving system suitable for DSBSC modulated wave. (3)

Q.4(a) What do you understand by quadrature –carrier multiplexing ? Describe the phase discrimination method for generating SSB signals. How do you demodulate SSB waves? (7)

(b) Show that an AM signal with large carrier can be demodulated by squaring it and then passing the resulting signal through a low –pass filter (LPF) . (4)

(c) An SSB signal is demodulated by using a synchronous demodulator. However , the locally arranged carrier has a phase error θ. Determine the effect of the error on demodulation. What will be the effect of this error if the input is DSB-SC in place of SSB. (4)

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Q.5(a)Distinguish between PM and FM wave. Write expressions for the FM and PM waves. Describe the generation of FM and PM wave using respective block diagram. (5)

(b) The FM wave for sinusoidal modulation is given by (5)

$$s(t) = A_c cos[2\pi f_c t + \beta sin(2\pi f_{mt})].$$

The Fourier series representation of the above single tone FM wave may be written as:

$$s(t) = A_c \sum_{n=-\infty}^{\infty} J_n(\beta) cos[2\pi(f_c + nf_m)t]$$

where β is the modulation index and other symbols have their usual meanings. If $J_0(\beta) \simeq 1$, $J_1(\beta) \simeq {}^{\beta}/_{2}$ and $J_n(\beta) \simeq 0, n > 1$, then determine the discrete amplitude spectrum of the FM wave. What is the amplitude of the upper and lower side band frequency component. Sketch the amplitude spectrum of the FM wave for $\beta = 1$. State the approximate rule for the transmission bandwidth of an FM wave and write an expression for it.

(c) A single tone FM signal is given by (5)

$$s_{FM}(t) = 10 \sin(16\pi \times 10^6 t + 20 \sin 2\pi \times 10^3 t)\ Volts.$$

Find the modulation index , modulating frequency deviation, carrier frequency and power of the FM signal.

Q.6(a) What do you understand by pulse amplitude modulation (PAM)? Describe the sample and hold circuit generating flat top sampled PAM. What are the drawbacks in PAM? (5)

(b) Describe the PWM , its generation and detection using block diagram in each case. Compare the advantages/ disadvantages of PWM and PPM. (5)

(c) For a pulse –amplitude modulated (PAM) transmission of voice signal having maximum frequency equal to $f_m = 3kHz$, Calculate the transmission bandwidth. It is given that the sampling frequency $f_s = 8kHz$ and the pulse duration $\tau = 0.1T_s$. (5)

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