

(Set-1)

B.Tech-4th

Analog Communication Technique

Full Marks : 70

Time : 3 hours

Q. No. 1 is compulsory and answer any five from the rest

The figures in the right-hand margin indicate marks

All the symbols carry their usual meaning

1. Answer the following questions : 2 × 10
- (a) Sketch, to scale, the spectrum of a full wave rectifier output if its input is $20 \sin 400\pi t$.
 - (b) Mention two sets of orthogonal functions.
 - (c) Give two functions for which Dirichlet's conditions are not satisfied.
 - (d) Give the autocorrelation function of white noise. Justify your answer.

(Turn Over)

(e) Prove the differentiation theorem of Fourier transform.

(f) Between an integrator and a differentiator, which one is more immune to random noise? Why?

(g) Most often, white noise is modeled to be Gaussian distributed why?

(h) Why is the AM broadcast band chosen in the range of 535-1605 kHz?

(i) What are the two primary functions carried out by the RF amplifier?

(j) Is an FM system a linear one? Justify.

2. (a) Find out the Fourier transform of the following Gaussian pulse given as

$$g(t) = e^{-\frac{t^2}{2\sigma^2}} \quad 5$$

(b) Evaluate the energy contained in a Gaussian pulse given as

$$g(t) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{t^2}{2\sigma^2}} \quad 5$$

3. (a) Give the Fourier transform of a function given as

$$g(t) = \begin{cases} \sin c(2\omega t) \operatorname{sech}\left(\frac{t}{T}\right); & -\frac{T}{2} \leq t \leq \frac{T}{2} \\ 0 & ; \text{otherwise} \end{cases} \quad 3$$

$$(b) \int_{-\infty}^{\infty} \delta(t+3) e^{-t} dt \quad 2$$

(c) What is the power of a signal given as

$$g(t) = c_1 \cos(\omega_1 t + \theta_1) + c_2 \cos(\omega_2 t + \theta_2)$$

when $\omega_1 = \omega_2$. 5

4. (a) A signal $g(t) = [1 + m(t)] \cos \omega_c t$ is detected using a square-law detector. The Fourier transform of the signal $m(t)$ is a constant μ_0 in the frequency range of $-f_m$ to f_m . Evaluate and sketch the spectrum of the output. 6

(b) The signal $g(t) = \operatorname{sinc}(10^5 t)$ is used to DSB-SC modulate a carrier with a frequency of 10 MHz. Evaluate the bandwidth of the modulated signal and sketch its spectrum. 4

5. (a) A signal is given as

$$g(t) = 2 \cos w_c t + 0.4 \cos w_m t \sin w_c t$$

Determine the nature/type of modulation. 6

- (b) A phase modulator with $K_p = 4$ rad/V is fed with a sinewave modulating signal given as $3 \sin 4\pi \times 10^3 t$. What is the peak frequency deviation produced in the carrier frequency? 4
6. (a) Discuss the Foster-Seeley discriminator with the help of appropriate sketches and expressions (if any). 5
- (b) Discuss the primary differences between an AM and an FM superheterodyne receiver. 5
7. (a) Derive an expression for the figure of merit of envelope detection. 5
- (b) Evaluate the NEB of a first order RC low-pass filter. 5
8. (a) Discuss what do you mean by quadrature components of noise. What kind of noise is usually referred to here? 5

- (b) Explain SNR improvement made possible with pre-emphasis. 5