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Question Paper Code : 90476

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third / Fourth Semester

EC 8491 — COMMUNICATION THEORY

(Common to : Computer and Communication Engineering / Electronics and Communication Engineering / Geinformatics Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by modulation index of Amplitude modulation?

2. Determine the Hilbert transform of the signal $x(t) = \sin(300\pi t)$.

3. What is meant by FM to AM conversion?

4. The power requirement of FM signal is independent of modulation index. Justify the statement.

5. What is meant by wide sense stationary Process?

6. Determine the mean and variance of random variable $z = x + y$, where x and y are independent random variables with mean values of 3 and 5 and variance values of 15 and 45 respectively.

7. What is need for pre emphasis in FM systems?

8. Calculate the noise figure of an amplifier if its input SNR is 10 dB and output SNR is 3 dB.

9. State the condition to avoid aliasing in sampling.

10. Distinguish non uniform quantization from uniform quantization.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain the phase shift method of generation of SSB signal. (7)

(ii) Consider that a message signal $m(t) = 2\cos(200\pi t) + \sin(300\pi t)$, modulates the amplitude of the carrier signal $c(t) = 2\cos(10000\ \pi t)$ with modulation index of 0.6,

(1) Write down the time and frequency domain expression for the modulated signal

(2) Determine the plot the spectrum of message and modulated signal. (3 + 3)

Or

(b) (i) Explain the working of ring modulator used to generate DSBSC signal in detail. (7)

(ii) Consider that a diode detector is used to demodulate the AM signal with carrier frequency of 1 MHz, message with highest frequency of 5 kHz. Design the circuit for the proper demodulation of signal with justification. (6)

12. (a) Derive the expression for the FM signal with arbitrary modulation index. Draw the spectrum of the signal. (9 + 4)

Or

(b) Explain the concept of FM demodulation using balanced frequency discriminator in detail. (13)

13. (a) (i) Let random variables X and Y be defined as $X = A\cos(\omega t + \Theta)$ and $Y = B\sin(\omega t + \Theta)$ where, A and ω are constants, the Θ is a random variable uniformly distributed over $[-\pi, \pi]$. Determine, Autocorrelation function $R_{XX}(\tau)$ and Cross correlation function $R_{XY}(\tau)$. (8)

(ii) State and explain the properties of power spectral densities of random process $X(t)$. (5)

Or

(b) (i) Let $X(t)$ is a random process with a constant mean value of 2 and the auto-correlation function $R_X(T) = 4\left(e^{-0.5|t|} + 1\right)$. Derive the power spectral density. (5)

(ii) A WSS process, $X(t)$ with mean μ_X and variance σ_x^2 is applied as input to linear time invariant filter. The output process obtained is $Y(t)$. Obtain the relationship between the statistical parameters of input and output processes. (8)

14. (a) Derive the figure of merit of AM receiver. (13)

Or

(b) Derive the Figure of merit of SSB SC receiver using the receiver system. (13)

15. (a) With neat block diagram illustrate the function of Differential pulse code modulation and also explain how it is made adaptive. (13)

Or

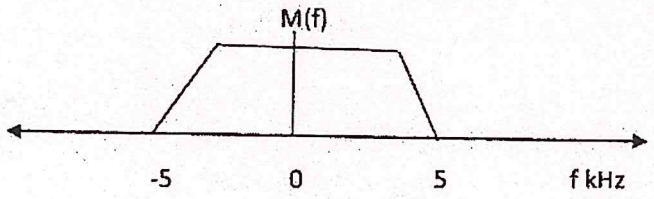
(b) Draw the block diagram of Delta Modulator. Explain its operation and also discuss the need for making DM adaptive. (5 + 8)

PART C — (1 × 15 = 15 marks)

16. (a) (i) A DSBSC signal $s(t)$ is generated by modulating the sinusoidal carrier signal of frequency $fc = 20\ MHz$ by the message signal $m(t)$ with spectrum $M(f)$ given in figure below. The modulated signal $s(t) = 10\, m(t) \cos 2\pi f ct$ is fed to a 50 Ω load. Draw the schematic of modulator.

(1) Determine the bandwidth and power requirements of the modulated signal.

(2) Draw the spectrum of carrier and modulated signal. (Refer Figure 1)



(3 + 4)

Figure 1

(ii) The modulated signal of part (i) is received by a receiver. The received signal need to be converted to 455 kHz before demodulation. Draw the neat block diagram of appropriate receiver and give the specifications of each block so that image frequency rejection is achieved. (8)

Or

(b) With suitable diagram and equations explain the transmission of a random process through a LTI filter. (15)

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