JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2024

B.Tech-IV Semester (ECE/CSE)

COURSE CODE (CREDITS): 18B11EC413 (4)

MAX. MARKS: 25

COURSE NAME: Modern Analog and Digital Communication

COURSE INSTRUCTORS: Dr. Alok Kumar

MAX. TIME: 1 Hour 30 Minutes

Note: (a)All questions are compulsory.

(b)Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.1 Define the modulation index β in frequency modulation. How the modulation index affects the bandwidth of an FM signal? Provide mathematical expressions to support your explanation. Given an FM signal with modulation index β =0.5 and a maximum frequency deviation Δf =10 KHz. Calculate the bandwidth of the FM signal using Carson's rule. **[CO2] [3 Marks]**

Q2 A modulating signal given by x(t)=5Sin($4\pi10^3t - 10\pi Cos(2\pi10^3t)$) is fed to a phase modulator with phase deviation constant K_p=5 rad/V . If the carrier frequency is 20KHz, find the instantaneous frequency at t=0.5 ms. **[CO1, CO2] [3 Marks]**

Q.3 A 2 MHz sinusoidal carrier is amplitude modulated by a symmetrical square wave of period 200 μsec. Find out which frequencies will be present in the modulated signal? **[CO2] [3 Marks]**

Q.4 A sinusoidal message signal m(t) with amplitude A_m =2 V and frequency f_m =1 KHz is frequency modulated on to a carrier signal c(t) with frequency f_c =100 KHz and amplitude A_c =10 V. The frequency deviation constant K_f is 10Hz/V. Determine

a) The maximum frequency deviation Δf of the FM signal
b) The modulation index β
c) The bandwidth required to transmit the FM signal

[CO2] [3 Marks]

Q.5 How we can demodulate the AM signal with the help of envelope detector? A message signal $m(t) = Cos2000\,\pi t + 4Cos4000\pi t$ modulates the carriers $c(t) = cos2\pi f_c t$ where $f_c = 1MHz$ to produce an AM signal. For demodulating the generated AM signal using an envelope detector, find the range of time constant RC of the detector circuit. **[CO2] [4 Marks]**

Q.6 Explain the concept of frequency modulation (FM) and how it differs from amplitude modulation (AM). Provide a diagram illustrating the modulation process for both FM and AM.

[CO1, CO2] [4 Marks]

Q.7 What is sampling theorem? Prove the sampling theorem with the help of suitable example. A continuous-time signal x(t) has a maximum frequency of 2000 Hz. Determine the minimum sampling frequency required to accurately represent this signal according to the Nyquist-Shannon sampling theorem. If the sampling frequency used is double the minimum required, how many samples would be taken in duration of 0.1 seconds?

[CO3] [5 Marks]