Bundelkhand Institute of Engineering and Technology, Jhansi

Class Test-2, 2023

(Bachelor of Technology)

Branch:	Electronics and Communication Engineering	**Sem:**	IV^{th}
Subject:	Communication Engineering	**Sub. Code:**	KEC 401
Max. Marks:	10	**Time:**	1 Hour

Note: Attempt *all* questions. Each questions carry equal marks. Assume suitable data wherever required and mention it clearly.

1. The carrier $c(t) = 100\cos(2\pi f_c t)$ is frequency modulated by the signal $m(t) = 5\cos 20000\pi t$, where $f_c = 10^8$ Hz. The peak frequency deviation is 20kHz. (a) Determine the amplitude and frequency of all signal components that have a power level of at least 10 % of the power of the unmodulated carrier component. (b) from Carson's rule, determine the approximate bandwidth of the FM signal. Use the table 3.1 for Bessel's function coefficient. [CO2]

OR

Discuss the demodulation of FM signal using Phase Locked Loop (PLL) with required equations. [CO2]

2. An angle modulated signal has the form $s(t) = 100\cos[2\pi f_c t + 4\sin 2\pi f_m t]$ where $f_c = 10$ MHz and $f_m = 1000$ Hz. (a) Assuming that this is an FM signal, determine the modulation index and the transmitted signal bandwidth. (b) Assuming that this is an PM signal, determine the modulation index and the transmitted signal bandwidth. [CO2]

3. What is Slope overload and Granular noise? Discuss how these problems can be alleviated? [CO4]

4. A Television signal has a bandwidth of 4.5 MHz. This signal sampled, quantized and binary encoded to obtain a PCM signal. (a) Determine the sampling rate if the signal is to be sampled at a rate 20% higher than the Nyquist rate. (b) If the samples are quantized into 1024 levels, how many binary pulses will be required to encode these samples? (c) Determine the binary pulse rate (bit rate) of the binary coded signal, and the minimum bandwidth required to transmit this signal? [CO4]

TABLE 3.1 TABLE OF BESSEL FUNCTION VALUES

n	$\beta = 0.1$	$\beta = 0.2$	$\beta = 0.5$	$\beta = 1$	$\beta = 2$	$\beta = 5$
0	0.997	0.990	0.938	0.765	0.224	−0.178
1	0.050	0.100	0.242	0.440	0.577	−0.328
2	0.001	0.005	0.031	0.115	0.353	0.047
3				0.020	0.129	0.365
4				0.002	0.034	0.391
5					0.007	0.261
6					0.001	0.131
7						0.053
8						0.018
9						0.006
10						0.001
11						
12						
13						
14						
15						
16						

Bundelkhand Institute of Engineering and Technology, Jhansi

Class Test-1, 2023

(Bachelor of Technology)

Branch:	Electronics and Communication Engineering	**Sem:**	IV[th]
Subject:	Communication Engineering	**Sub. Code:**	KEC 401
Max. Marks:	10	**Time:**	1 Hour

Note: Attempt any *four* questions. Each questions carry equal marks. Assume suitable data wherever required and mention it clearly.

1. The message signal $m(t) = 2\cos 400t + 4\sin(500t + \frac{\pi}{3})$ modulates the carrier signal $c(t) = A\cos(8000\pi t)$, using DSB amplitude modulation. Find the time domain and frequency domain representation of the modulated signal and plot the spectrum (Fourier transform) of the modulated signal. What is the power content of the modulated signal? [CO1]

2. Suppose the signal $x(t) = m(t) + \cos 2\pi f_c t$ is applied to a non-linear system whose output is $y(t) = x(t) + \frac{1}{2}x^2(t)$. Determine and sketch the spectrum of $y(t)$ when $M(f)$ is as shown in Figure Q2 and $W \ll f_c$. [CO1]

3. The message signal *m(t)* has a Fourier transform shown in Figure Q-3(a). This signal is applied to the system shown in Figure to generate the signal *y(t)*. a. Plot *Y (f)*, the Fourier transform of *y(t)*. b. Show that if *y(t)* is transmitted, the receiver can pass it through a replica of the system shown in Figure Q-3(b) to obtain *m(t)* back. This means that this system can be used as a simple scrambler to enhance communication privacy. [CO1]

4. A SSB AM signal is generated by modulating an 800-kHz carrier by the signal signal $m(t) = \cos(2000\pi t) + 2\sin(2000\pi t)$. The amplitude of the carrier is $A_c = 100$. are used to generate AM signal with modulation index is 0.5.
   (i) Determine the signal $\hat{m}(t)$. [CO1]
   (ii) Determine the (time domain) expression for the lower sideband of the SSB AM signal.
   (iii) Determine the magnitude spectrum of the lower sideband SSB signal.

5. Draw the circuit diagram of Envelope detector and explain it's working with required equations? [CO1]

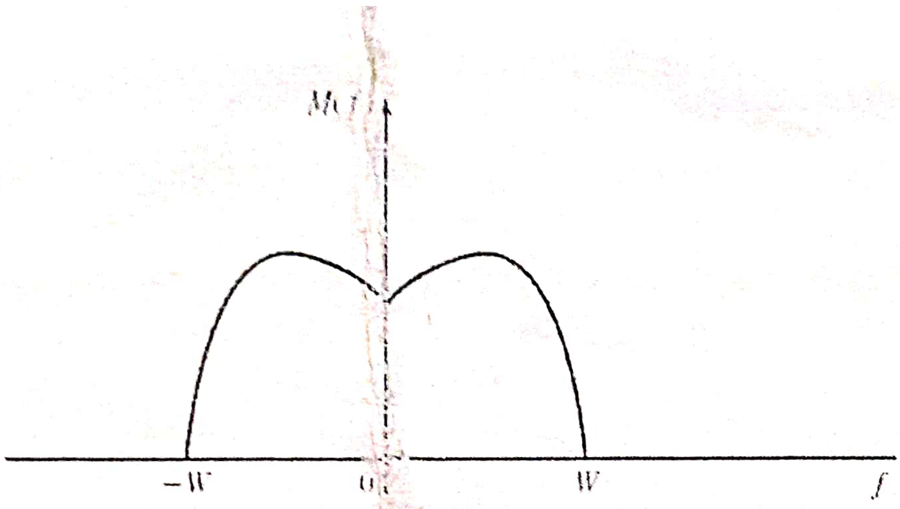
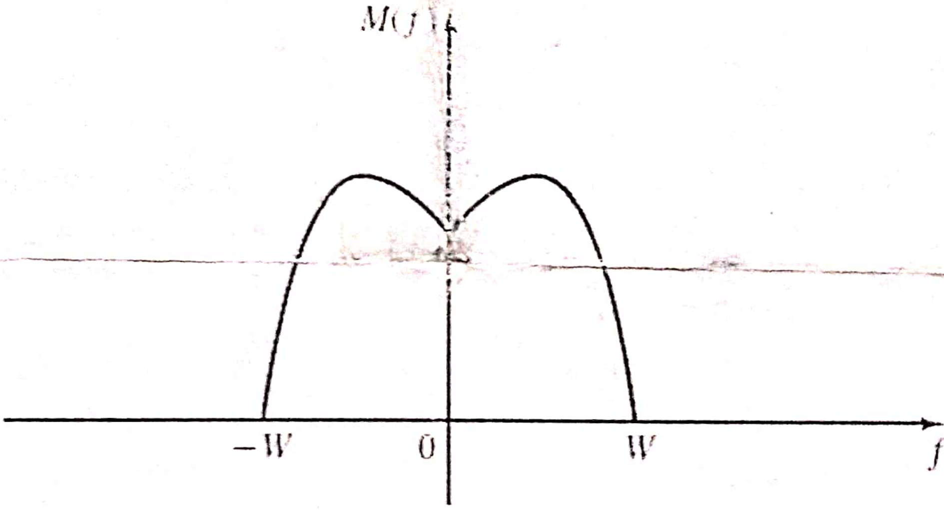
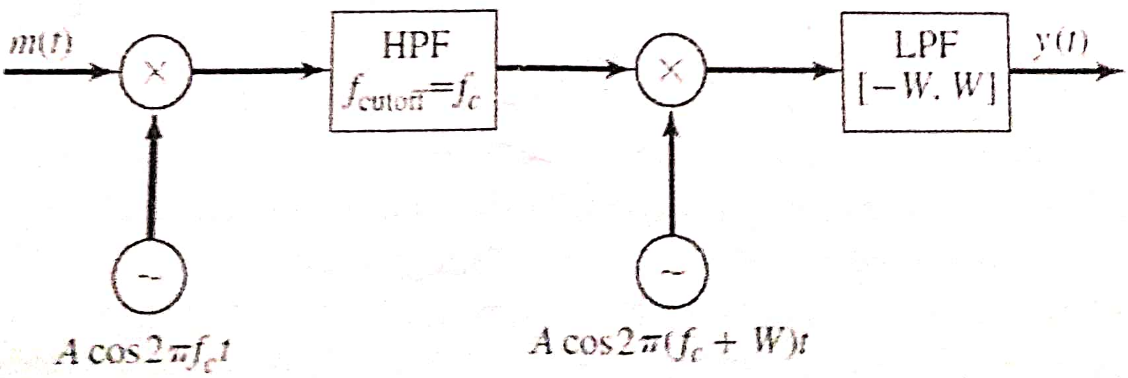


Fig. Q2



(a)



(b)

Fig. Q3

(Roll No. to be filled by candidate)

B. TECH.
FOURTH SEMESTER THEORY EXAMINATION, 2022-23
KEC-401
COMMUNICATION ENGINEERING

Time: 03 Hours **Max. Marks: 100**

Note:

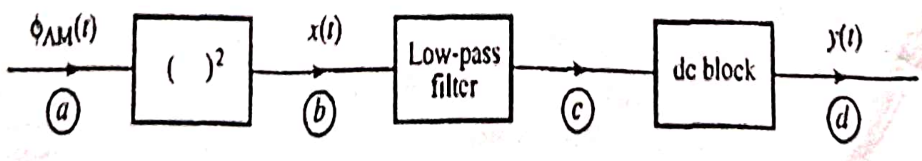
- Attempt all questions. All questions carry equal marks.

1. Attempt any *FOUR* parts of the following: 4×5 CO

a. What is energy signal and power signal? Explain with suitable example. CO1

b. You are asked to design a DSB-SC modulator to generate a modulated signal $km(t)\cos 2\pi f_c t$ with the carrier frequency $f_c = 300$ kHz. The following equipment is available in the stock room: (i) a square wave generator of frequency 100 kHz, (ii) a ring modulator, (iii) a bandpass filter tuned to 300 kHz. (a) Show how can you generate the desired signal? (b) If the output of the modulator is $km(t)\cos 2\pi f_c t$, find k? CO1

c. In the early days of radio, AM signal were demodulated by a crystal detector followed by a low pass filter and a dc blocker as shown in the figure below. Assume crystal oscillator detector to be basically a squaring device. Determine the signal at point *a*, *b*, *c*, and *d*. Point out the distortion term in the output *y(t)*. CO1



d. Explain the scheme of generation and demodulation of VSB signal with suitable diagram. CO1

e. Suppose that a nonlinear devices are available for which the output current i_o and input voltage v_i are related by $i_o = a_1 v_i + a_3 v_i^3$ where a_1 and a_3 are constants. Explain how these devices may be used to provide: (a) a product modulator (b) an amplitude modulator. CO1

f. The input to an envelope detector is a single-tone AM signal $x_{AM}(t) = A(1 + \mu \cos \omega_m t) \cos \omega_c t$, where μ is a constant and $\omega_c \gg \omega_m$. Show that if the detector output is to follow the envelope at all times, it is required that CO1

$$RC \leq \frac{1}{\omega_m} \frac{\sqrt{1-\mu^2}}{\mu}$$

2. Attempt any *TWO* parts of the following: 2×10 CO

a. Derive the generalized time-domain expression of WBFM signal in terms of Bessel's function coefficients and discuss the properties of its frequency spectrum? CO2

b. An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation $s(t) = 10 \cos(\omega_c t + 5 \sin 3000t + 10 \sin 2000\pi t)$. (a) Find the power of the modulated signal. (b) Find the frequency deviation Δf. (c) Find the deviation ratio β. (d) Find the phase deviation $\Delta\varphi$. (e) Estimate the bandwidth of s(t). CO2

c. Design an Armstrong indirect FM modulator to generate an FM signal with carrier frequency 97.3 MHz and $\Delta f = 10.24$ kHz. A NBFM generator of $f_{c1} = 20$ kHz and $\Delta f = 5$ Hz is available. Only frequency doublers can be used as multipliers. Additionally, a local oscillator (LO) with adjustable frequency between 400 kHz to 500 kHz is readily available for frequency mixing. CO2

3. Attempt any *TWO* parts of the following: 2×10 CO

a. The noise voltage in an electric circuit can be modelled as Gaussian random variable with mean equal to 0 and variance equal to 10^{-8}. (a) What is the probability that the value of the noise exceeds the 10^{-4}? (b) What is the probability that the value of the noise exceeds the 4×10^{-4}? (c) What is the probability that the value of the noise will be in between the -2×10^{-4} and 10^{-4}? (Given Q-function values are Q(1)=0.1586, Q(2)=0.02275, Q(3)=0.00135, Q(4)=0.00003167) CO3

b. What is Random process? Explain the stationery, non-stationery, wide-sense stationery and Ergodic random process? CO3

c. A White noise process with double sided power spectral density function $\frac{N_o}{2}$ Watt/Hz is passed through an ideal BPF with central frequency f_c and bandwidth of B Hz. The output noise process is then multiplied by a carrier $\cos 2\pi f_c t$ and then again passed through an ideal LPF of bandwidth B Hz. Calculate the noise power available at the output of BPF and LPF? CO3

4. Attempt any *TWO* parts of the following: 2×10 CO

a. Discuss the ideal impulse sampling of an analog signal with required mathematical expressions and compare the result with sampling using rectangular pulse train? How does the spectrum of sampled signal in two cases are different? CO4

b. Five telemetry signals, each of bandwidth of 1 kHz are to be transmitted simultaneously by binary PCM. The maximum tolerable error in samples amplitude is 0.2% of the peak signal amplitude. The signal must be sampled at least 20% higher than the Nyquist rate. Framing and synchronization requires an additional 0.5% extra bit. Determine the minimum possible data rate (bits per second) that must be transmitted, and the minimum bandwidth required to CO4 transmit this signal?

c. Given the data stream 1110010100, sketch the transmitted sequence of pulses in each case- (a) Unipolar-NRZ, (b) Polar-NRZ, (c) Unipolar-RZ, (d) Bipolar-RZ, (e) Manchester code. CO4

5. Attempt any *TWO* parts of the following: 2×10 CO

a. Draw the transmitter and receiver section of BPSK modulation scheme and explain its working with the help of required mathematical expressions and waveform. CO5

b. What is quadrature amplitude modulation scheme (QAM)? Show that how it can be used to save the transmission bandwidth? CO5

c. Discuss the Minimum Shift Keying (MSK) technique. Also explain the constellation diagrams of MSK? CO5