PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester IV - 2021   **Date :** 9-JUN-2023
Course Code : ECE3005   **Time :** 9.30AM - 12.30PM
Course Name : Sem IV - ECE3005 - Analog Communication   **Max Marks :** 100
Program : ECE   **Weightage :** 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS   (5 X 4 = 20M)

1. A RED FM station in Bangalore uses 93.2MHz carrier; which is frequency modulated by an audio signal of 5kHz sine wave. The resultant FM signal has frequency deviation of 40kHz.
   a.Find the carrier swing of the FM signal.
   b.What are the highest and lowest frequencies attained by the frequency modulated signal?
   c.Calculate the modulation index for the wave.

   (CO3,CO5,CO4,CO2,CO1) [Knowledge]

2. Single sideband modulation is advantageous with respect to power and bandwidth. Illustrate SSB waves in time and frequency domain.

   (CO1,CO2) [Knowledge]

3. An AM signal with no carrier and one sideband is called a single sideband (SSB) signal. The upper and lower sidebands contain the same information and one is not preferred over the other. List the advantages of SSB modulation over general AM

   (CO1) [Knowledge]

4. The term modulate means regulate.The process of regulating is modulation.The modulation process is the most important operation in the modern communication.Hence explain the need of modulation with an example.

   (CO5) [Knowledge]

5. An angle-modulated signal is varying frequency or phase of the carrier in accordance with the instantaneous value of message signal. If a frequency modulated signal is defined by S(t)=10 cos (2π10^6 t+0.2 sin 2000πt).
a.Find the power in the modulated signal
b.The frequency deviation
c.The approximate transmission bandwidth

(CO2,CO1) [Knowledge]


PART B

ANSWER ALL THE QUESTIONS   (4 X 15 = 60M)

6. (i)Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulses. It can be used to transmit analog information. In pulse modulation, continuous signals are sampled at regular intervals. Students have the liberty to take analog message signal of their choice.
a) Identify the form of signal modulation where the message information is encoded in the amplitude of a series of signal pulses.
b)Explain the above modulation with the help neat diagrams.
c)List any 2 advantages and disadvantages of the above mentioned pulse modulations.
(ii)Analog information must be transformed into a digital format. The process starts with sampling the waveform to produce a discrete pulse-amplitude-modulated waveform. The sampling process is usually described in a time domain. Using the sampling process, we convert the analog signal in a corresponding sequence of samples that are usually spaced uniformly in time. The samples are obtained by multiplying the analog signal with an impulse or pulse signal in time domain. Students have the liberty to take analog message signal of their choice.
a) Illustrate the sampling process where the samples are obtained by multiplying with sequences of impulses(both in time and frequency domain).
b) If sampling signal frequency is less than the twice of the input signal frequency they were unable to recover the signal input signal x(t). Identify this effect. List the conditions to remove this effect. Draw the spectrum for various sampling conditions.
(iii) Use of pre-emphasis and de-emphasis filters in FM increases the signal-to-noise ratio (SNR) value and make the system quiet robust in an hostile environment with low signal power and high multipath effects. An engineer wishes to develop a FM broadcast system at an urban (low signal power) area. Will you advice him/her to use pre-emphasis and de-emphasis filters? Briefly explain the concept of pre-emphasis and de-emphasis.

(CO3,CO4,CO5,CO1,CO2) [Comprehension]

7. (i) An engineer wishes to install and commission an AM broadcasting station in any area. But he/she is not sure which AM modulation method would be most suitable in terms of transmission power and bandwidth. Please provide a proper advice to him/her with justifications.
(ii)A Zero Crossing Detector Circuit is used to track the changing in the sine/pulse waveform from positive to negative or vice versa while it crosses Zero voltage. With a neat block diagram and waveform show zero cross detector for frequency demodulation.
(iiiIn FM system,the instantaneous frequency of the carrier wave is varied directly in
accordance with the message signal by means of device known as voltage controlled osciallator.However to attain good oscillator stability series of mulitipler and mixers are used as shown in below fig.Find out the carrier frequency,frequency deviation and modulation index at the points A and B.Assume that at the output of the mixer, the additive frequency component is being selected

FM input
$f_c = 10MHz$
$\Delta f = 10\ kHz$
$m_f = 5$

Multiplier ×3 → (A) → Mixer → (B)

10MHz

Oscillator
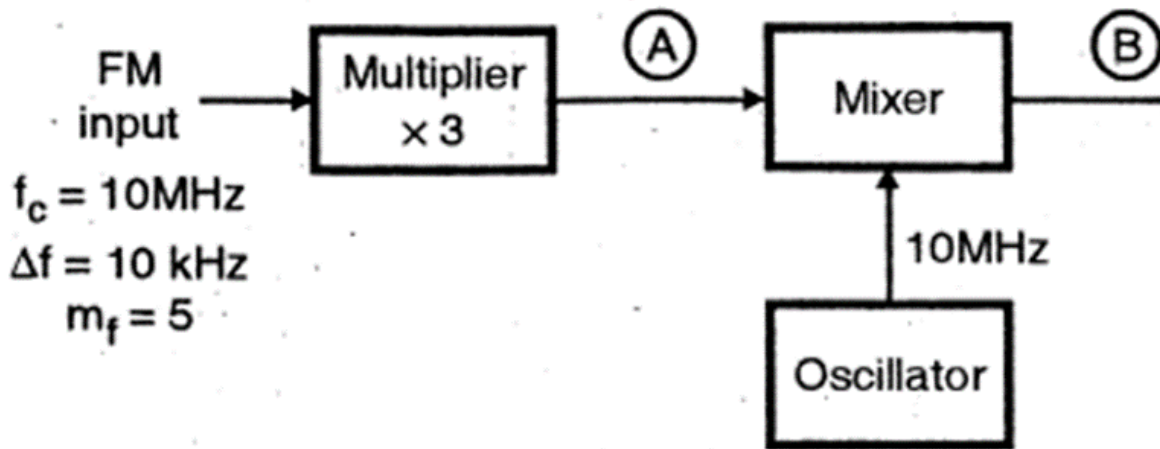
(CO2,CO1,CO3,CO5,CO4) [Comprehension]

8. (i) In standard Amplitude modulation (AM), carrier signal consumes a lot of power more than about 50%. Due to this facts, DSB-SC is a method of transmission where only two side bands are transmitted without the carrier. Mathematically bring the out time and frequency domain expression to overcome the drawback of power wastage in standard AM. Draw the frequency spectrum of DSB-SC.

(ii) A message signal m(t) with spectrum shown in the below figure is applied to a product modulator with a carrier wave Accos(2πfct) producing the DSB-SC modulated wave S(t). This modulated wave is then applied to a coherent detector. Assuming a perfect coherence between the transmitter and receiver, determine the spectrum of the detector output when

a) fc=1.25khz.
b) fc=0.75khz and sketch the same
c) The lowest fc so the m(t) is uniquely determined from s(t).

M(f)
1
0
1   -1   f(kHz)
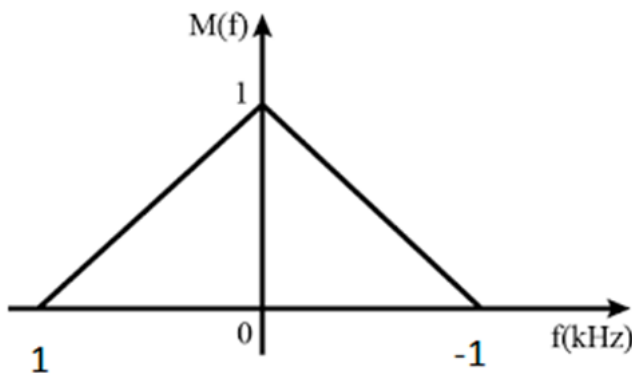
(iii) Draw the time and frequency domain representation of SSB waves.

(CO1) [Comprehension]

9. (i)Rekha wants to generate an FM signal but she was provided with a phase modulator.
   a. Can she generate a frequency-modulated signal using a Phase modulator? Justify the ans   .
   b. Which type of FM signal can be generated using above meth
   c. How to generate the WBFM from the above-generated sig

(ii)Frequency Multiplier is a device which converts from narrow band frequency Modulated signal to wideband frequency modulated signal. With the help a block diagram and mathematical expressions explain the generation of wideband FM signal using frequency multiplier.

(iii) The bandwidth of wideband band FM is ideally infinite. However, there is Carson's formula which gives defined bandwidth for FM. Derive Carson's formula for the bandwidth of wideband FM signal.

(CO2,CO3,CO4,CO5) [Comprehension]

ANSWER ALL THE QUESTIONS   **(2 X 10 = 20M)**

10.   (i) The specified voice spectrum is 300Hz-3.4kHz. The sampling frequency used is 8kHz. In practice the frequency spectrum of human voice extends much beyond the highest frequency necessary for communication. Let the input analog information signal contains 5kHz frequency component also. What would happen at the output of the sampler? How can this problem be prevented?

     (ii) Sampling theorem provides the link between analog world and digital world. Consider a continuous time signal $s(t)=10\cos(20\pi t)\cos(200\pi t)$ Determine

     The maximum frequency component present in the input signal.

     Nyquist rate

                                                    (CO1,CO4,CO5,CO3,CO2) [Application]

11.   (i)Angle modulation is a process of varying the angle of carrier in accordance with the instantaneous values of message signal. Obtain the modulated signal in which frequency is varied with respect to message signal for single tone modulation by using mathematical expressions and frequency spectrum.

     (ii)The FM wave can be generated by the indirect method as well as the direct method. Explain the concept of the direct method of FM signal generation using mathematical analysis.

                                                    (CO3,CO2,CO4,CO5,CO1) [Application]