COMMUNICATION ENG.

ANSWERS

1. **Why is a sinusoidal signal classified as analog?**
   a) It moves in both positive and negative directions
   b) It is positive for half of its cycle
   c) It is negative for half of its cycle
   d) It has an infinite number of amplitude values within its range
   Answer: d) It has an infinite number of amplitude values within its range

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2. **What is analog communication?**
   a) A technique where a carrier signal's property changes in proportion to the instantaneous value of the message signal
   b) A method used for data and computer communication
   c) A form of numerical coded communication
   d) A communication method ideal for long-distance transmission
   Answer: a) A technique where a carrier signal's property changes in proportion to the instantaneous value of the message signal

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3. **What is a drawback of amplitude modulation?**
   a) Suppression of sidebands
   b) Intra-pulse modulation issues
   c) Cross modulation interference
   d) Carrier suppression
   Answer: c) Cross modulation interference

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4. **In what form do cell phones transmit information?**
   a) Microwaves
   b) Electrical signals
   c) Infrared waves
   d) Radio waves
   Answer: d) Radio waves

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5. **Where is modulation carried out in a communication system?**
   a) At the receiver
   b) In a transducer
   c) Between the transmitter and receiver

d) At the transmitter
Answer: d) At the transmitter

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6. **What is the primary application of square law modulators?**
   a) Frequency modulation
   b) Pulse width modulation
   c) Amplitude modulation
   d) Phase modulation
   Answer: c) Amplitude modulation

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7. **What is the purpose of an amplitude limiter in an FM receiver?**
   a) To filter unwanted signals
   b) To maintain consistent gain in the receiver
   c) To amplify weaker signals
   d) To demodulate the signal
   Answer: b) To maintain consistent gain in the receiver

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8. **Where is noise typically introduced in a receiver?**
   a) Audio stage
   b) Receiving antenna
   c) RF stage
   d) IF stage
   Answer: c) RF stage

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9. **What is the purpose of a varactor diode in a radio receiver?**
   a) Demodulation
   b) Mixing
   c) Multiplexing
   d) Tuning
   Answer: d) Tuning

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10. **When is noise added to a signal?**
    a) In the channel
    b) At the receiving antenna
    c) At the transmitting antenna
    d) During regeneration of information
    Answer: a) In the channel

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11. **What does the AM spectrum consist of?**
    a) Carrier frequency
    b) Upper sideband
    c) Lower sideband
    d) Carrier frequency with both upper and lower sidebands
    Answer: d) Carrier frequency with both upper and lower sidebands

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12. **For 100% modulation, the power in each sideband is _____ of the carrier power.**
    a) 50%
    b) 70%
    c) 60%
    d) 25%
    Answer: a) 50%

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13. **What is the effect of overmodulation?**
    a) Distortion
    b) Weakens the signal
    c) Strengthens the signal
    d) Provides immunity to noise
    Answer: a) Distortion

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14. **To achieve 100% modulation, the carrier amplitude should _____.**
    a) Exceed the signal amplitude
    b) Be equal to the signal amplitude
    c) Be less than the signal amplitude
    d) Be equal to 0
    Answer: b) Be equal to the signal amplitude

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15. **In frequency modulation (FM):**
    a) The amplitude of the carrier remains the same
    b) The frequency of the carrier varies with the modulating signal
    c) The number of sidebands is infinite
    d) All of the above
    Answer: d) All of the above

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16. **What determines the amount of frequency deviation in an FM signal?**
    a) Amplitude of the modulating signal
    b) Carrier frequency
    c) Modulating frequency

d) Transmitter amplifier
Answer: a) Amplitude of the modulating signal

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17. **What is an advantage of the direct method for generating an FM signal?**
a) It provides high stability to the FM signal frequency
b) It generates a distortion-free FM signal
c) It allows high-power FM generation
d) None of the above
Answer: b) It generates a distortion-free FM signal

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18. **What does the DSB-SC signal consist of?**
a) Two sidebands and the carrier
b) One sideband and the carrier
c) Two sidebands
d) None of the above
Answer: c) Two sidebands

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19. **In which type of modulation is the frequency of the modulated wave equal to the carrier wave frequency?**
a) Frequency modulation
b) Amplitude modulation
c) Phase modulation
d) None of the above
Answer: a) Frequency modulation

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20. **Why is AM used for broadcasting in communication systems?**
a) It reduces receiver complexity
b) It is more immune to interference from other modulation systems
c) It requires less transmitting power
d) It eliminates noise disturbances
Answer: a) It reduces receiver complexity

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21. **What does the AM spectrum consist of?**
a) Carrier frequency
b) Upper sideband frequency
c) Lower sideband frequency
d) All of the above
Answer: d) All of the above

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22. **What is the bandwidth in amplitude modulation?**
    a) Twice the audio signal frequency
    b) Thrice the audio signal frequency
    c) Thrice the carrier wave frequency
    d) Twice the carrier wave frequency
    Answer: a) Twice the audio signal frequency

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23. **What is the ratio between the modulating signal voltage and the carrier voltage called?**
    a) Amplitude modulation
    b) Modulation frequency
    c) Modulation index
    d) Ratio of modulation
    Answer: c) Modulation index

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24. **What does the DSB-SC signal consist of?**
    a) Two sidebands and carrier
    b) One sideband and carrier
    c) Two sidebands
    d) None
    Answer: c) Two sidebands

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25. **What determines the amount of frequency deviation in an FM signal?**
    a) Amplitude of the modulating signal
    b) Carrier frequency
    c) Modulating frequency
    d) Transmitter amplifier
    Answer: a) Amplitude of the modulating signal

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26. **What is the process of converting a word into a stream of bits called?**
    a) Binary coding
    b) Source coding
    c) Bit coding
    d) Cipher coding
    Answer: b) Source coding

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27. **If a 120 V carrier peak changes from 170 V to 50 V due to a modulating signal, what is the modulation factor?**
    a) 0.5
    b) 1.5

c) 2.5
d) 3.5
Answer: a) 0.5
Explanation: Modulation factor = (170 - 50) / (170 + 50) = 120 / 240 = 0.5

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28. **ASK (Amplitude Shift Keying) is a combination of shift keying and _____.**
a) Analog modulation
b) Amplitude modulation
c) Digital modulation
d) None of these
Answer: b) Amplitude modulation

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29. **Which modulation techniques are used to convert analog signals to digital signals?**
a) Delta modulation
b) Adaptive delta modulation
c) Pulse code modulation
d) All of the above
Answer: d) All of the above

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30. **What does a VCO (Voltage-Controlled Oscillator) generate?**
a) Direct FM
b) Indirect FM
c) SSB-SC
d) DSB-SC
Answer: a) Direct FM

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31. **Which principle is used to construct a binary code that satisfies the prefix condition?**
a) Information rate
b) Noiseless channel
c) Channel coding theorem
d) Kraft inequality
Answer: d) Kraft inequality

In which technique does quantization occur?

a) TDM

b) FDM

c) PCM

d) PWM

Answer: c) PCM

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33. **What techniques are used for sampling?**
    a) Instantaneous sampling
    b) Natural sampling
    c) Flat-top sampling
    d) All of these
    Answer: d) All of these

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34. **What are the characteristics of the compressor in μ-law companding?**
    a) Continuous in nature
    b) Logarithmic in nature
    c) Linear in nature
    d) Discrete in nature
    Answer: b) Logarithmic in nature

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35. **Which technique is most affected by noise?**
    a) ASK
    b) PSK
    c) FSK
    d) DPSK
    Answer: a) ASK

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36. **In an M-array PPM waveform, modulation is affected by:**
    a) Delaying
    b) Advancing
    c) Delaying & Advancing
    d) None of the mentioned
    Answer: c) Delaying & Advancing

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37. **What is the carrier frequency in the FM signal v(t)=5cos⁡(6600t+12sin⁡2500t)v(t) = 5 \cos(6600t + 12\sin2500t)v(t)=5cos(6600t+12sin2500t)?**

a) 1150 Hz
b) 6600 Hz
c) 2500 Hz
d) 1050 Hz
Answer: b) 6600 Hz

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38. **Why are guard bands provided in FM signals?**
a) To prevent interference from adjacent channels
b) To increase noise
c) To increase bandwidth
d) None of the above
Answer: a) To prevent interference from adjacent channels

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39. **What does the information rate represent?**
a) The amount of information generated per second by the source
b) The amount of information generated per minute by the source
c) The amount of information generated per hour by the source
d) None of the above
Answer: a) The amount of information generated per second by the source

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40. **In polar RZ format, how is symbol '0' represented?**
a) Zero voltage
b) Negative voltage
c) Pulse is transmitted for half the duration
d) Both b) and c) are correct
Answer: d) Both b) and c) are correct

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41. **What is the unit of average mutual information?**
a) Bits
b) Bytes
c) Bits per symbol
d) Bytes per symbol
Answer: c) Bits per symbol

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42. **The event with minimum probability has the least number of bits.**
a) True
b) False
Answer: b) False

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43. **What is the process of converting a word into a stream of bits called?**
a) Binary coding
b) Source coding
c) Bit coding
d) Cipher coding
Answer: b) Source coding

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44. **When the probability of error during transmission is 0.5, what does it indicate?**
a) The channel is very noisy
b) No information is received
c) Both the channel is very noisy and no information is received
d) None of the mentioned
Answer: c) Both the channel is very noisy and no information is received

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45. **What is the unit of average mutual information?**
a) Bits
b) Bytes
c) Bits per symbol
d) Bytes per symbol
Answer: c) Bits per symbol

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46. **What type of code is binary Huffman coding?**
a) Prefix condition code
b) Suffix condition code
c) Both prefix and suffix condition code
d) None of the mentioned
Answer: a) Prefix condition code

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47. **When the base of the logarithm is 2, what is the unit of measure for information?**
a) Bits
b) Bytes
c) Nats
d) None of the mentioned
Answer: a) Bits

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48. **What is the process of converting a word into a stream of bits called?**
a) Binary coding
b) Source coding
c) Bit coding

d) Cipher coding
Answer: b) Source coding

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49. **When XXX and YYY are statistically independent, what is I(X,Y)I(X, Y)I(X,Y)?**
a) 1
b) 0
c) ln2\ln 2ln2
d) Cannot be determined
Answer: b) 0

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50. **What is the entropy of a random variable?**
a) 0
b) 1
c) Infinite
d) Cannot be determined
Answer: d) Cannot be determined

SECTION B

MODULE 1

1.**What is the role of a channel in a communication system?**
Answer:
A channel in a communication system acts as the medium that carries the signal from the transmitter to the receiver. It can be a physical medium like a wire, optical Fiber, or wireless medium like air. Its primary role is to transmit the information signal while minimizing loss, noise, and distortion.

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2. Why is AM used for broadcasting?
Answer:
Amplitude Modulation (AM) is used for broadcasting because:

- It is simple to implement and demodulate.
- AM signals can travel long distances, especially at lower frequencies, as they reflect off the ionosphere.
- AM broadcasting requires less bandwidth compared to Frequency Modulation (FM).

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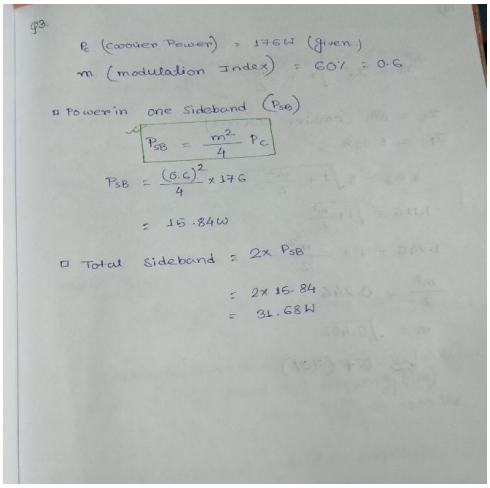
3. Calculate the power in each sideband if the power of the carrier wave is 176 W and there is 60% modulation in the amplitude-modulated signal. Draw the spectrum diagram.



Solution:

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4. Advantages of FM over AM.
Answer:

Frequency Modulation (FM) has the following advantages over Amplitude Modulation (AM):

1. **Improved Noise Immunity**: FM is less susceptible to noise and interference as it depends on frequency variations rather than amplitude.
2. **Better Sound Quality**: FM provides higher fidelity audio signals due to larger bandwidth.
3. **Efficient Power Usage**: The transmitted power in FM remains constant regardless of the modulation index.

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5. Differences between FM and PM.
Answer:

Aspect	Frequency Modulation (FM)	Phase Modulation (PM)
Modulation Parameter	Frequency of the carrier varies with input signal amplitude.	Phase of the carrier varies with input signal amplitude.
Noise Resistance	Better noise resistance than PM.	Slightly less resistant to noise compared to FM.

Aspect	Frequency Modulation (FM)	Phase Modulation (PM)
Applications	Widely used in radio broadcasting.	Used in telemetry and digital communication systems.

6. Draw and explain the basic block diagram of a communication system.

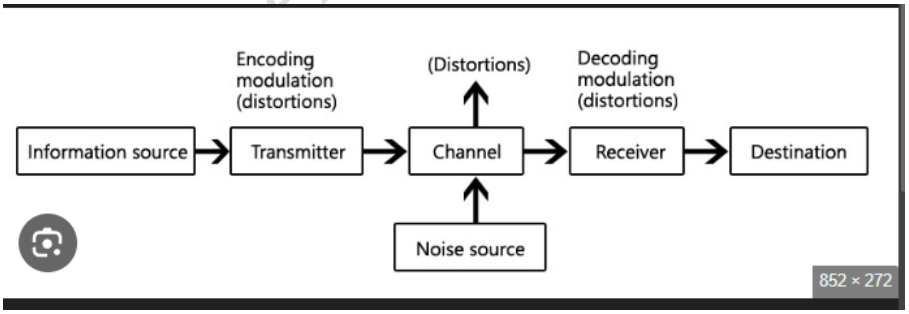
Answer:

The basic block diagram of a communication system consists of the following components:

1. **Information Source:** Produces the message signal to be transmitted, such as voice, text, video, etc.
2. **Transmitter:** Converts the message signal into a suitable form for transmission by modulating it with a carrier signal.
3. **Channel:** The medium through which the signal travels. It can be wired (e.g., cables) or wireless (e.g.air)
4. **Noise:** Any unwanted signal that interferes with the transmission of the original signal.
5. **Receiver:** Extracts and demodulates the original signal from the received waveform.
6. **Destination:** The endpoint where the message signal is delivered to the intended recipient.

Diagram:

Information → Transmitter → Channel → Receiver → Destination
↳ Noise



7. Define modulation.

Answer:
Modulation is the process of varying a carrier wave's properties (amplitude, frequency, or

phase) according to the message signal. It ensures efficient transmission of the signal over long distances.

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8. Why is modulation needed?

Answer:

1. **Reduction in Antenna Size:** Modulation increases the frequency, reducing the required antenna size.
2. **Minimizing Interference:** It allows multiple signals to be transmitted simultaneously without interference.
3. **Efficient Power Transmission:** High-frequency signals travel more efficiently in free space.
4. **Improved Signal Quality:** Modulation helps in reducing noise interference.

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9. What are the types of analog modulation?

Answer:
The types of analog modulation are:

1. **Amplitude Modulation (AM):** The amplitude of the carrier signal is varied in accordance with the message signal.
2. **Frequency Modulation (FM):** The frequency of the carrier signal is varied based on the message signal.
3. **Phase Modulation (PM):** The phase of the carrier signal is varied according to the message signal.

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10. What is the difference between high-level and low-level modulation?

Aspect	High-Level Modulation	Low-Level Modulation
Power Amplification	Occurs after modulation.	Occurs before modulation.
Efficiency	Higher efficiency for high-power transmitters.	Less efficient for high-power systems.
Complexity	Requires high-power amplifiers for modulated signals.	Simpler circuitry as modulation occurs at low power levels.

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11. Derive an expression for amplitude-modulated wave and define the term modulation index.

Answer:
An amplitude-modulated wave is given by:

s(t)=Ac[1+mcos⁡(2πfmt)]cos⁡(2πfct)s(t) = A_c \left[1 + m \cos(2\pi f_m t)\right] \cos(2\pi f_c t)s(t)=Ac[1+mcos(2πfmt)]cos(2πfct)

Where:

- AcA_cAc: Carrier amplitude.
- mmm: Modulation index.
- fmf_mfm: Message signal frequency.
- fcf_cfc: Carrier signal frequency.

Modulation Index (mmm):

m=AmAcm = \frac{A_m}{A_c}m=AcAm

Where AmA_mAm is the amplitude of the message signal and AcA_cAc is the carrier amplitude.

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12. What are the disadvantages of DSB-FC?

Answer:

1. **Inefficient Power Usage:** A significant amount of power is used in the carrier signal without conveying useful information.
2. **Bandwidth Requirement:** Double Sideband Full Carrier (DSB-FC) requires twice the bandwidth of the message signal.
3. **Susceptibility to Noise:** The presence of the carrier makes it more prone to interference.

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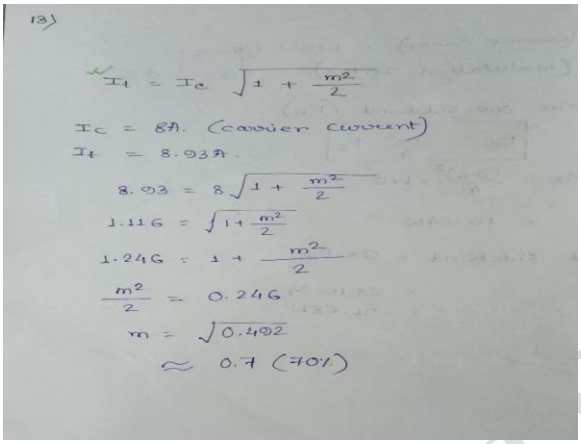
13. The antenna current of an AM transmitter is 8A when only the carrier is sent, but it increases to 8.93A when the carrier is sinusoidally modulated. Find the % modulation.



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14. An AM wave is represented by v=5(1+0.6cos6280t)sin211×104tv = 5 (1 + 0.6 \cos 6280t) \sin 211 \times 10^4tv=5(1+0.6cos6280t)sin211×104tvolts.

Commented [lp1]:

Commented [lp2]:

14)

$v = 5(1+0.6\cos 6280t)\sin 211 \times 10^4 t$ volts.

i) Maximum amplitude

I. $A_{max} = A_c(1+m)$

$= 5(1+0.6) = 8V$

Minimum Amplitude

II. $A_{min} = A_c(1-m)$

$= 5(1-0.6) = 2V$

Carrier frequency

$f_c = \frac{211 \times 10^4 \text{ Hz}}{2\pi} \approx 3.36 \times 10^4 \text{ Hz}$

~~Lower Sideband~~ frequency (LSB)

$f_{LSB} = f_c - f_m$ Modulating frequency (f_m)

$f_m = \frac{6280}{2\pi} \approx 1000 \text{ Hz}$

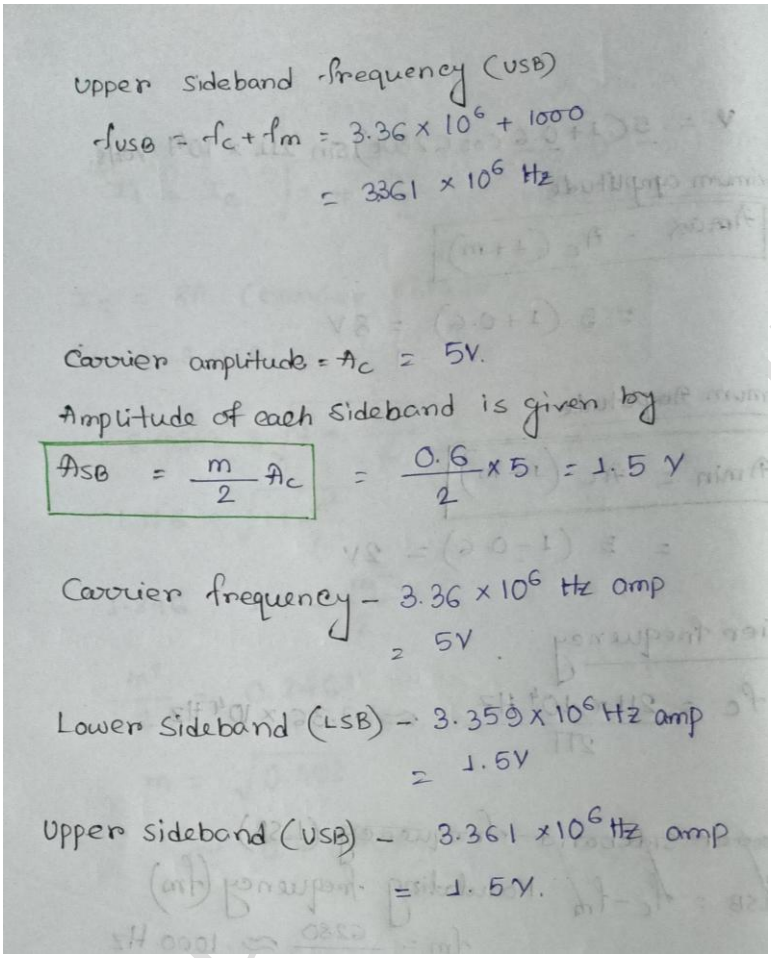
ii) Frequency Components and their amplitude.

Carrier frequency $f_c = \frac{211 \times 10^4}{2\pi} \approx 3.36 \times 10^6 \text{ Hz}$

Lower Sideband frequency (LSB)

$f_{LSB} = f_c - f_m = 3.36 \times 10^6 - 1000$

$= 3.359 \times 10^6 \text{ Hz}$



15. Compare DSB-FC, DSB-SC, and SSB-SC

Aspect	DSB-FC (Double Sideband Full Carrier)	DSB-SC (Double Sideband Suppressed Carrier)	SSB-SC (Single Sideband Suppressed Carrier)
Carrier Presence	Contains a carrier signal	Carrier is suppressed	Carrier is suppressed
Bandwidth	2fm2f_m2fm	2fm2f_m2fm	fmf_mfm
Power Efficiency	Low (most power is in the carrier)	Higher (no carrier power, only sidebands)	Highest (only one sideband transmitted)

Aspect	DSB-FC (Double Sideband Full Carrier)	DSB-SC (Double Sideband Suppressed Carrier)	SSB-SC (Single Sideband Suppressed Carrier)
Applications	AM broadcasting	TV and radio transmission	Long-distance voice and data communication

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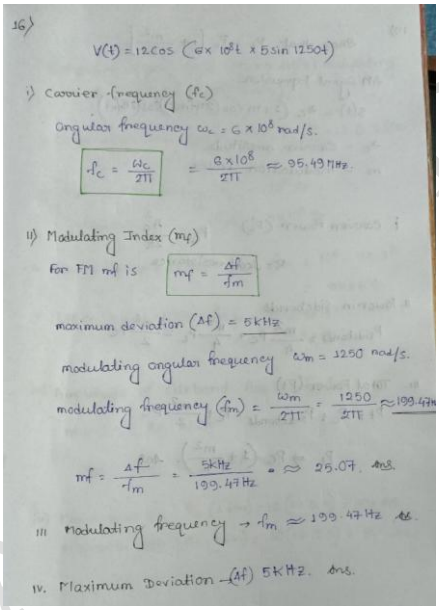
16.A single-tone FM is represented by v(t)=12cos(6×108t+5sin1250t)v(t) = 12 \cos(6 \times 10^8 t + 5 \sin 1250 t)v(t)=12cos(6×108t+5sin1250t):



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17. State Carson’s Rule.

Answer:
Carson's rule provides an estimate of the bandwidth required for Frequency Modulation (FM) signals. It states:

BT=2(Δf+fm)B_T = 2(\Delta f + f_m)BT=2(Δf+fm)

Where:

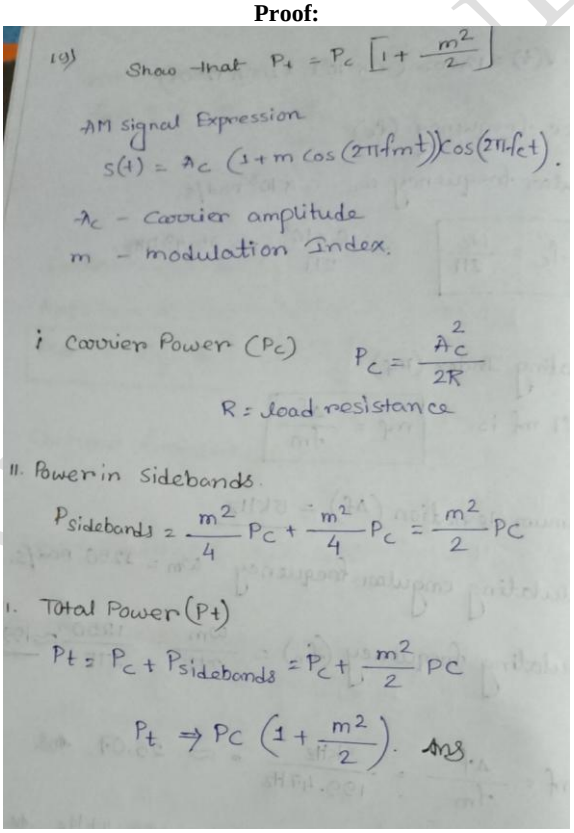
- BTB_TBT: Total bandwidth.
- Δf\Delta fΔf: Maximum frequency deviation.
- fmf_mfm: Maximum modulating signal frequency.

18. What are narrowband and wideband FM?

Aspect	Narrowband FM (NBFM)	Wideband FM (WBFM)
Bandwidth	Small bandwidth (<2fm< 2f_m<2fm).	Large bandwidth (typically much larger).
Modulation Index	mf<1m_f < 1mf<1.	mf>1m_f > 1mf>1.
Applications	Voice communication, e.g., walkie-talkies.	High-quality audio, e.g., FM radio.

19. Show that Pt=Pc[1+(m2/2)]P_t = P_c [1 + (m^2/2)]Pt=Pc[1+(m2/2)].

Proof:



20. Difference between AM and FM

Aspect	Amplitude Modulation (AM)	Frequency Modulation (FM)
Modulated Parameter	Amplitude of the carrier signal varies.	Frequency of the carrier signal varies.
Noise Resistance	More susceptible to noise.	Better noise immunity.
Bandwidth	Requires smaller bandwidth.	Requires larger bandwidth.
Applications	Radio broadcasting.	High-fidelity music and video systems.

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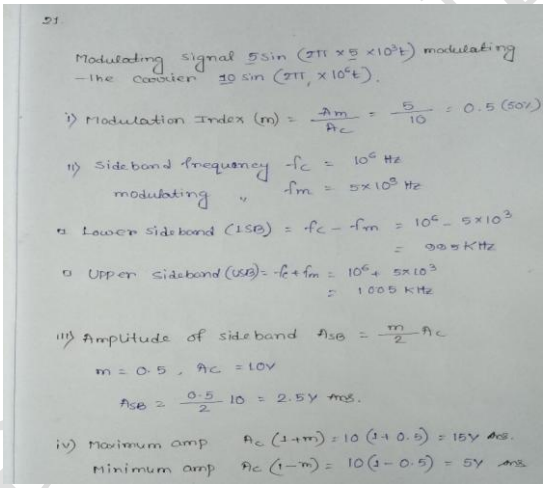
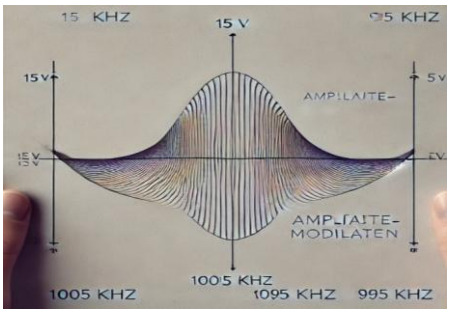
21. For the signal $5\sin(2\pi \times 5 \times 103t)$ modulating $10\sin(2\pi \times 106t)$:



(b) AM waveform:
An AM wave consists of a carrier plus the two sidebands. The plot would illustrate the combined signal over time, showing the envelope of the modulated signal.



22. Short Notes:

(a) Envelope Detector:
A circuit used to demodulate AM signals by extracting the envelope of the received waveform. Commonly used in radio receivers.

(b) Balanced Modulator:
A device that generates DSB-SC signals by suppressing the carrier and producing only the sidebands.

(c) Varactor Diode Frequency Modulator:
Uses a varactor diode to produce frequency modulation by varying its capacitance with the applied signal voltage.

(d) Foster-Seeley Discriminator:
An FM demodulator that converts frequency variations into amplitude variations to retrieve the original message signal.