PART-A
Important Questions & Answers

UNIT-1

1. Does the modulation technique decide the antenna height? If so, justify it.

Yes. Because the antenna height is depends on the wavelength of the wave. Wavelength depends on its frequency of operation i.e Higher the frequency of operation less will be the antenna height and vice-versa.

2.What is meant by modulation?

Modulation is the process of changing some characteristics [amplitude (or) frequency (or) phase] of the carrier wave in accordance with the message signal.

3. If a 10 kW amplitude modulated transmitter is modulated sinusoidally by 50%, What is the total RF power delivered?

Soln:

Given

P_c=10KW μ=50% =50/100=0.5 $P_{t=?}$

WKT, $P_t/P_c = 1+(\mu^2/2)$

$P_t = p_c\ (1+(\mu^2/2)) = 10*10^3\ (1+(0.5^2/2)) = 11250$ W **= 11.25 KW**

4. Define modulation index for AM.

The Modulation index (m or μ) of an AM is the ratio of the maximum amplitude of the modulating signal to the maximum amplitude of the carrier signal. i.e

$m=\mu= V_m/ V_c$

5. List the drawbacks of DSB-SC system.

i. Increased power & bandwidth requirement as the two bands are transmitted
ii. Fairly complicated circuitry.
iii.

6. Compare bandwidth and power requirement for AM, DSB-SC, SSB and VSB.

Type	Transmission bandwidth	Power saving
AM with carrier	$2f_m$	-
DSB-SC	$2f_m$	66.66%
SSB-SC	f_m	83.33%
VSB	$f_m<B_T<2f_m$	75%

7.State the necessary and sufficient condition for the envelope of AM wave to have the same shape as the baseband signal.

The charging time constant in the envelope detector should satisfy

$R_sc<<1/f_c$

Where R_s is the source impedance and f_c is the carrier frequency and discharging time constant of the envelope detector should satisfy

$1/f_c<<R_lc<<1/w$

Where R_l is the load impedance and w is the message bandwidth.

8. A commercial AM station is broadcasting with an unmodulated carrier power of 10 KW. The modulation index is set at 0.7 for a sinusoidal message signal. Find the transmission efficiency.

Soln:

Given:

$P_c=10KW =10*10^3W$

$\mu= 0.7$

Transmission efficiency=$\eta= [\mu^2/(2+\mu^2)]*100$

$= [0.7^2/(2+(0.7^2))]*100$

$= 19.67\%$

9. **Mention the need for modulation in communication systems.**

Modulation is needed

- To Reduce Antenna length
- To increase operating range
- For multiplexing
- For wireless communication.
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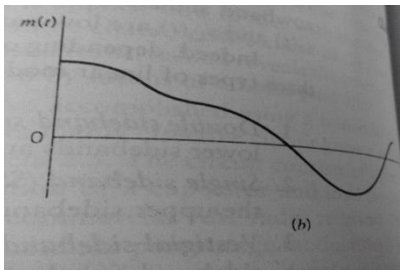
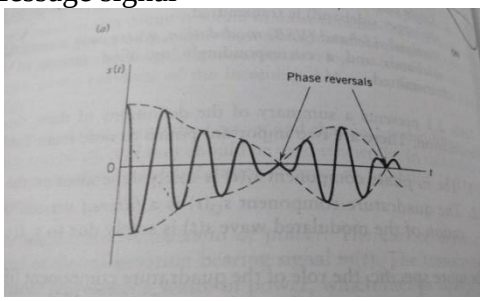
10. Draw the DSB-SC waveform.



[a] Message signal



[b] DSB-SC signal

11. Define coherent detection.

In coherent detection, the carrier used at the receiver is synchronized (same frequency & phase) with that of the carrier used at the transmitter to produce the modulated signal.

12. If the RMS value of a signal before modulation is 12.5A and after modulation is 14A. Calculate the percentage of modulation.

Given:

I_c=12.5 A

I_t=14 A

$$I_t/ I_c = \sqrt{1+(\mu^2/2)}$$

$$1+(\mu^2/2) = (I_t/ I_c)^2$$

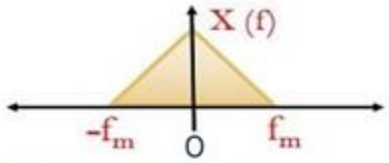
$$\mu^2/2=(I_t/ I_c)^2-1$$

$$= (14/12.5)^2-1 \ =0.254$$

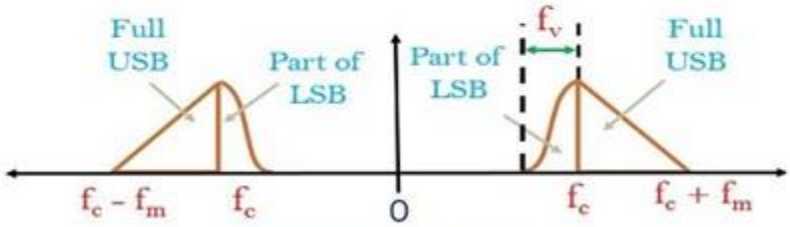
$$\mu^2/2= 0.254$$

$$\mu=\sqrt{2*0.254} = \textbf{0.713 or 71.3\%}$$

13. Draw the frequency spectrum of VSB. Where it is used?



Spectrum of message signal



Spectrum of VSB signal

It is used for the transmission of TV and telegraphic signal.

14. Define amplitude sensitivity of AM.

WKT, The AM signal can be expressed as

$$s(t)=V_c [1+K_a m(t)] \cos 2\pi f_c t$$

Where K_a is called amplitude sensitivity of AM signal. It is basically variation in the amplitude of the carrier with respect to the modulating signal and expressed in $volt^{-1}$.

15. How much power can be saved, when only the carrier component is suppressed from AM wave? Assume modulation index is 1.

WKT, $P_t/P_c = 1+(\mu^2/2)$

Since $\mu=1$

$P_t/P_c = 1+(1/2) =3/2$

$P_c= 2/3\ P_t$

Hence two third of total power i.e 66.7% of power can be saved.

16. Calculate the modulation index if the carrier wave is amplitude modulated by three modulating signals with modulation indexes of 0.6, 0.3 and 0.4 respectively.

Soln:

$$\mu_t = \sqrt{\mu_1^2+\mu_2^2+\mu_3^2}$$

Since $\mu_1=0.6$, $\mu_2=0.3$ and $\mu 3=0.4$

$$= \sqrt{0.6^2+0.3^2+0.4^2} = \mathbf{0.78}$$

17. A transmitter radiates 9 kW of power with carrier unmodulated and 10.125 kW when modulated. Calculate depth of modulation

WKT, $P_t/P_c = 1+(\mu^2/2)$

$\mu^2/2=(P_t/P_c)^2-1$

$$\mu = \sqrt{2((P_t/P_c)-1)} = \sqrt{2((10.25/9)-1)}$$

= **0.5 or 50%**

18. How many AM broadcast stations can be accommodated in a 100 kHz bandwidth, if the highest frequency modulating a carrier is 5 kHz?

f_m= 5 KHz (given)

For transmitting AM, bandwidth needed is $2*f_m$

=2*5kHz=**10kH**z

Therefore 10 AM broadcast stations can be accommodated in the 100 KHz of bandwidth.

19. Sketch the AM wave for m=0.5.

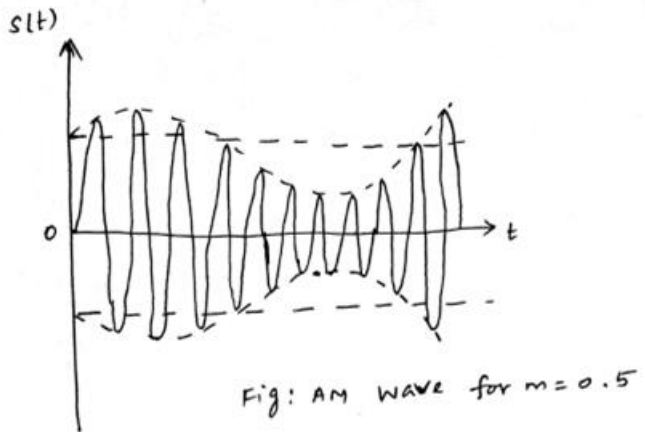


Fig: AM wave for m = 0.5

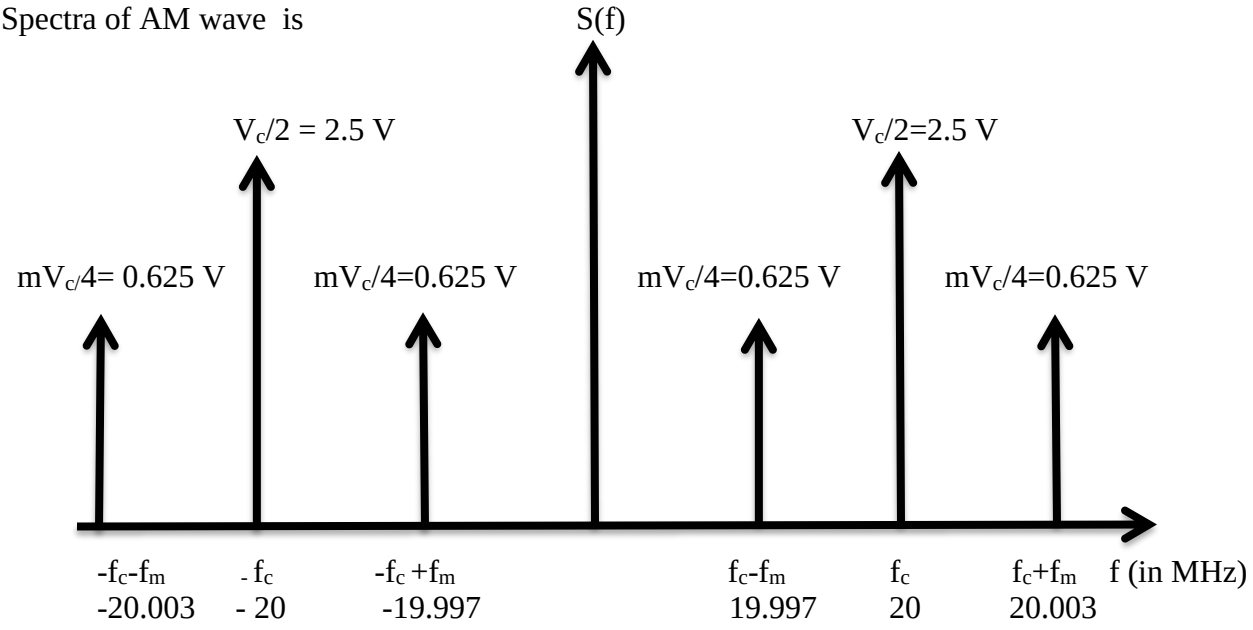
20. Mention the drawbacks of AM systems.

Drawbacks of AM system are:

1. AM is wasteful of power
2. AM is wasteful of bandwidth

21. A carrier of 20 MHz is amplitude modulated with a signal frequency of 3 KHz and amplitude 5volts. If m=0.5, Sketch the spectra of AM wave.

Spectra of AM wave is



f_c=20 MHz , μ=0.5, V_c=5v, f_m=3KHz

$V_c/2$ = 5/2= 2.5V

$\mu V_c/4$= 0.5*(5/4)=0.625 V

$-f_c-f_m$= -20,000 KHz-5KHz = -20.003 MHz

f_c+f_m= -20,000 KHz+3KHz = -19.997 MHz

f_c-f_m = 20,000 KHz-3KHz = 19.997 MHz
f_c+f_m= 20,000 KHz+3KHz = 20.003 MHz
-f_c-f_m= 20,000 KHz+3KHz = 20.003 MHz

22. A 400 watts carrier is modulated to a depth of 75 percent. Calculate the total power in the modulated wave.

Soln: P_c = 400 watts, μ = 75/100=0.75
WKT, $P_t/P_c = 1+(\mu^2/2)$
P_t = 512.5 watts

23. Suggest a modulation scheme for the broadcast video transmission and justify.

In TV transmission, significant picture details are represented by low frequencies. These frequencies well preserved by vestigial sideband transmission.

24. What are the advantages of vestigial side band modulation?

- Conserving Bandwidth as effectively as SSB
- Improved low frequency response and
- Reduced power requirement

25. State the differences between single side band and vestigial side band modulation systems.

S. No.	Single Sideband transmission	Vestigial Sideband transmission
1.	Only one sideband is transmitted.	In VSB modulation, one sideband is passed almost completely whereas just a trace or vestige of the other sideband is transmitted.
2.	Frequencies near edge are attenuated.	Frequencies near edge are not attenuated.
3.	Bandwidth (BW) is f_m	$f_m < BW < 2f_m$
4.	Transmission Efficiency (η) is 83%	$33.3\% < \eta < 100\%$
5.	It is used in Two way radio Communication and military communications.	It is used for transmitting Television signals.

26. Define pre-envelope & complex envelope.

Pre-envelope or analytic signal of the signal is defined as the complex valued function,

$$g_+(t)=g(t)+jg^{\wedge}(t)$$

Where $g^{\wedge}(t)$ is the Hilbert transform of g(t) and $g_+(t)$ is the pr envelope in communication systems theory.

The complex envelope of a signal g(t) with respect to the carrier frequency is defined as

$$g^{\sim}(t)=g_+(t)\, e^{-jw_c t} = g_+(t)e^{-j2\pi f_c t}$$

$g^{\sim}(t)$ represents the complex envelope of the signal g(t).

27. Define sensitivity of a radio receiver.

The ability of the receiver to pick up weak signals and amplify them is called sensitivity.

28. State the significance of Hilbert transforms.

Shifting of all the components of a given signal by ±90 degrees results in a function of time is called Hilbert transform of the signal. It produces a phase shift of -90 degree for all positive frequencies and +90 degree for all negative frequencies.

29. What is meant by fidelity of the receiver?

The ability of the receiver to reproduce all the range of modulating frequencies equally is called fidelity of the receiver.

30. State heterodyne principle.

The heterodyne principle is the mixing of different (i.e two) frequencies to produce intermediate frequency (IF).
Hetero---- Different or two
Dyne----- Mixing

31. Mention the advantages of super heterodyne receiver over tuned radio frequency receiver.

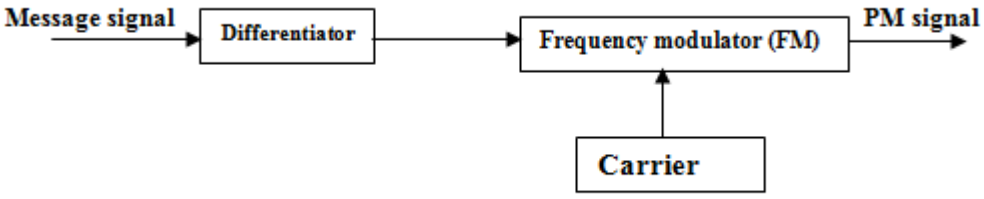
- Improved stability
- Improved selectivity in terms of adjacent channel (i.e the interference of adjacent stations are reduced)
- Improved sensitivity
- Uniform bandwidth because of fixed IF
- Improved image frequency rejection
- Low cost
- Improved gain per stage.

32. What is meant by image frequency?

Image frequency is the signal frequency plus twice the intermediate frequency. i.e $f_{si}= f_s+2f_i$ where f_{si} is the image frequency, f_s is the signal frequency and f_i is the intermediate frequency.

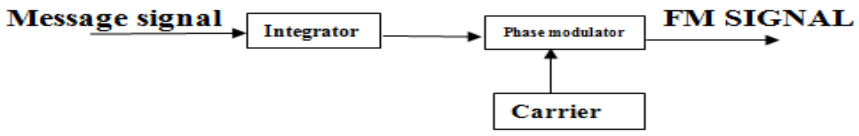
UNIT – II

33. Draw the block diagram for generation of PM from FM.



CONVERSION OF FM TO PM

34. Draw the block diagram for generation of FM from PM.



35. Define frequency modulation.

Frequency modulation (FM) is the process by which the frequency of the carrier wave is varied in accordance with the instantaneous value of the modulating signal.

36. Define Phase modulation.

Phase modulation (FM) is the process by which the phase of the carrier wave is varied in accordance with the instantaneous value of the modulating signal.

37. What are the types of Frequency Modulation? Brief about it.

Narrowband FM: When the modulation index β of an FM is smaller than 1 i.e $\beta<1$ said to be narrowband FM. It consists of one carrier component and two side bands.
Wideband FM: When the modulation index β of an FM is large when compared to 1radian i.e $\beta>1$ said to be wideband FM. It consists of one carrier component and infinite number of sidebands.

38. Define modulation index for FM.

Modulation index β for FM is defined as the ratio of frequency deviation (Δf) to the modulating signal frequency (f_m).

i.e $\beta = \Delta f/f_m$

39. Find the modulation index for an FM wave in which the modulating signal is 4 KHz and maximum frequency deviation is 8 KHz.

Modulation index $\beta = \Delta f/f_m = 8*10^3 /4*10^3 = 2$

40. Distinguish the features of Amplitude Modulation (AM) and Narrow Band Frequency Modulation (NBFM).

The basic difference between AM signal and Narrowband FM signal is that the algebraic sign of the lower side frequency in the narrow band FM is reversed.

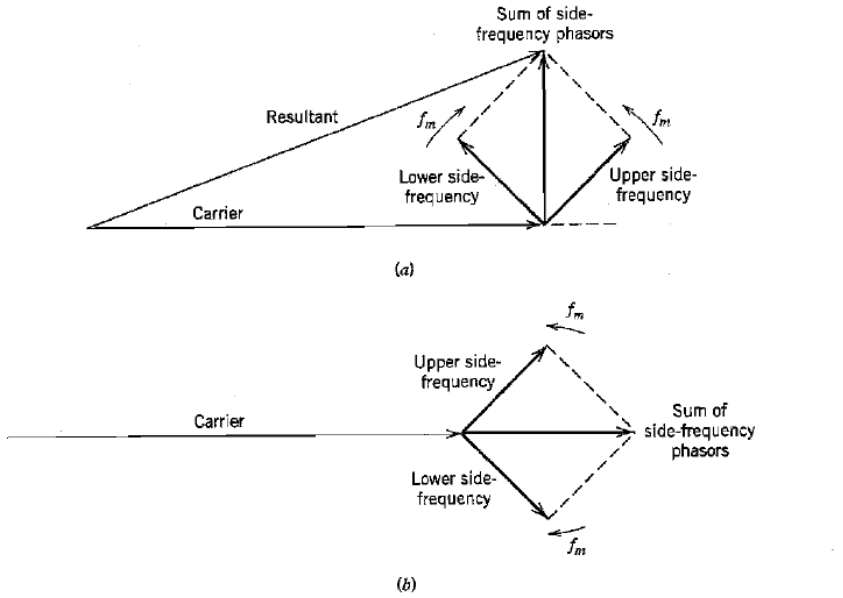


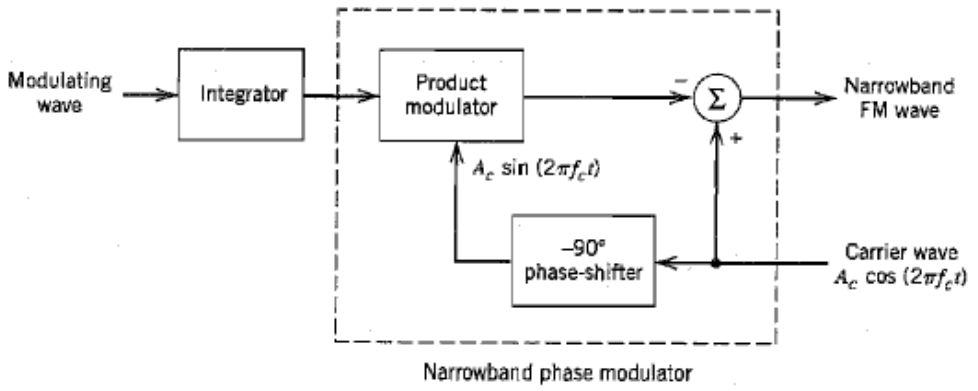
FIGURE A phasor comparison of narrowband FM and AM waves for sinusoidal modulation. (*a*) Narrowband FM wave. (*b*) AM wave.

41. State Carson's rule for FM bandwidth.

Carson's rule for FM bandwidth is defined as the twice the sum of frequency deviation and modulating signal frequency.

i.e Bandwidth = 2 (Δf+f m)

42. Draw the block diagram of generating narrowband FM signal.



Block diagram of a method for generating a narrowband FM signal.

43. A frequency modulated signal is given as s(t) = 20cos[2πfct + 4sin(200πt)]. Determine the required transmission bandwidth.

Given s(t) = 20cos[2πfct + 4sin(200πt)] Compare the given FM signal equation with standard FM signal, s(t) = $V_c \cos [2\pi f_c t + \beta \sin 2\pi f_m t)]$

Here $V_c = 20$ V, $\beta = 4$, $2\pi f_m t = 200\pi t \Rightarrow f_m = 100$ Hz

We know that, modulation index of FM $\beta = \Delta f / f_m$ Hence $\Delta f = \beta * fm = 4 \times 100$ Hz = 400 Hz.
Bandwidth of FM = $2(\Delta f + fm) = 2(400 + 100) = 2(500) = 1000$ Hz (or) 1 kHz.

44. Mention any two advantages of FM.

Advantages of FM are:

1. It gives noiseless reception.
2. The operating range (coverage area) is quite large.

45. Define frequency Deviation.

The amount of change in carrier frequency produced by the modulating signal is known as frequency deviation.

$\Delta f = K_f V_m$

The maximum frequency deviation occurs at the maximum amplitude of the modulating signal.