DEPARTMENT OF ELECTRONICS & COMMUNICATION TECHNOLOGY

Mid Term Test

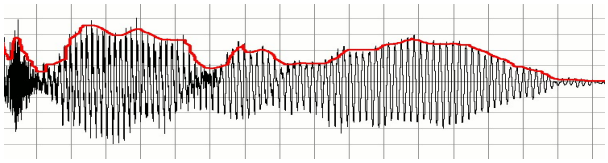
V SEM –ECE --- Analog Communication

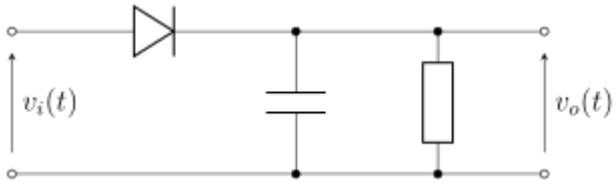
TIME: 1 Hours M.M.- 10 Marks

Note: - 1. All question carry equal marks.

Q-1 Explain working of Envelope detector for AM detection.

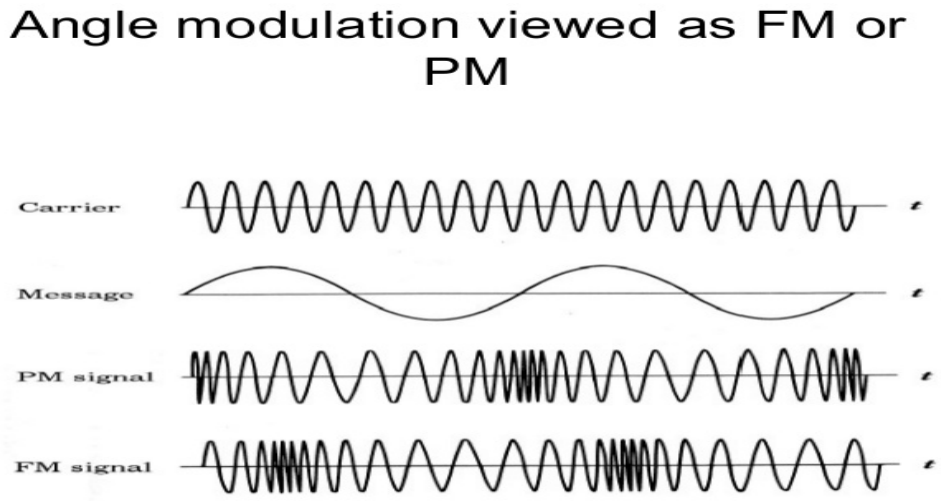
Ans. An envelope detector is an electronic circuit that takes a high-frequency signal as input and provides an output which is the envelope of the original signal. The capacitor in the circuit stores up charge on the rising edge, and releases it slowly through the resistor when the signal falls. The diode in series rectifies the incoming signal, allowing current flow only when the positive input terminal is at a higher potential than the negative input terminal.





Q-2 Sketch FM and PM waves for the modulating signal m(t). The constant K_f and K_p are ($\prod * 10^5$) and ($\prod$) respectively, and f_c = 200 MHz.

Ans.



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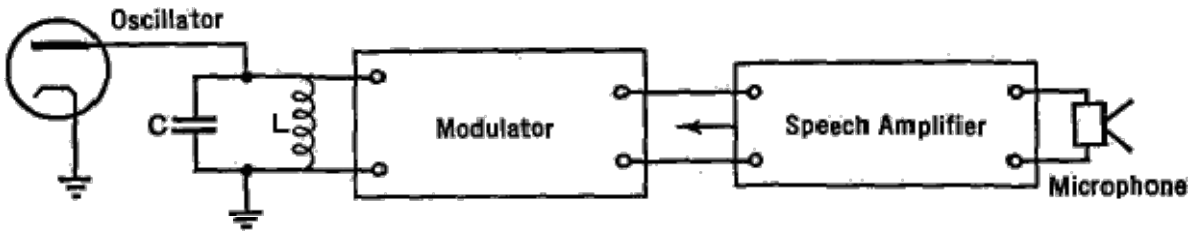
Q-3 Explain working of Reactance Modulator for FM generation with suitable diagrams.

Ans. A reactance modulator changes the frequency of the tank circuit of the oscillator by changing its reactance. This is accomplished by a combination of a resistor, a condenser, and a vacuum tube (the modulator) connected across the tank circuit of the oscillator and so adjusted as to act as a variable inductance or capacitance.



Q-4 Explain the difference between;

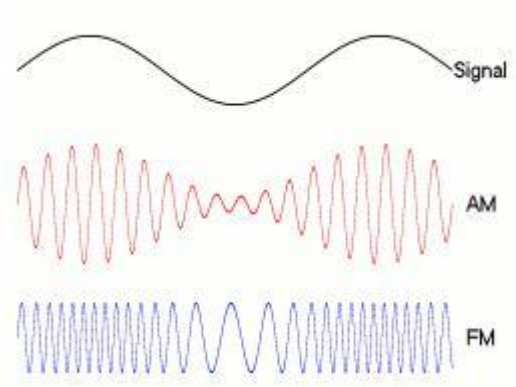
(i) AM and FM

(ii) FM and PM

Ans.

AM stands for **amplitude modulation** where the amplitude of the carrier is modulated as per the message signal. The other aspects of the carrier wave such as frequency phase etc. remain constant. On the other hand, **FM** means **frequency modulation** and in it only frequency of the carrier wave changes while amplitude, phase etc. remain constant.

(i)



Frequency range of working: Amplitude modulation works between 540-1650 KHz while FM works at 88-108MHz.

Power Consumption: FM based signal transmission consumes a higher amount of power than an equivalent AM based signal transmission system.

Signal Quality: Signal quality is a **lot superior in FM than AM** as amplitude based signals are more susceptible to noise than those which use frequency. Moreover, noise signals are difficult to filter out in AM reception whereas FM receivers easily filter out noise using the capture effect and pre-emphasis, de-emphasis effects. In capture effect, the receiver locks itself to catch stronger signal so that signals received are more synced with that at the transmitting end.

In pre-emphasis, de-emphasis process, the signal is further amplified to a higher frequency at sending end (pre-emphasis) and vice versa at receiver end (de-emphasis). These two processes reduce down the chances of a signal to get mixed with other signals and make FM more immune to noise than AM.

Fading: Fading refers to power variation during signal transmission. Due to fading, the power with the signal received can vary significantly and reception wouldn't be of a good quality. Fading is more prominent in amplitude modulation as compared to frequency modulation. That

is why, AM radio channels often face the problem where sound intensity varies while FM radio channels have constant good reception.

Wavelength Difference between AM and FM: AM waves work in the range of KHz while in FM waves work in MHz range. As a result, AM waves have a higher wavelength than the FM ones. A higher wavelength increases the range of AM signals as compared to FM which have a limited area of coverage.

Bandwidth consumption: AM signals consume 30KHz of bandwidth for each while in FM 80KHz is the bandwidth consumed by each signal. Hence, over a limited range of bandwidth, more number of signals can be sent in AM than FM.

Circuit Complexity: Aforesaid, Amplitude Modulation is an older process and has a very simple circuitry. On the other hand, frequency modulation requires a complicated circuitry for transmission and reception of signal. The signals sent in FM are more modulated and emphasized at the transmitter and they are thoroughly checked and corrected at the receiving end. This is why circuitry for FM signals is very complicated.

Commercial Aspects: Setting up an AM based radio communication system is very economic as there is no complicated circuitry and processes are easy to understand.

(ii) In FM, the information of a signal is encoded in its frequency. Similarly for PM, the information is encoded in its phase. Both modulation schemes use a carrier frequency as a reference. A FM modulated signal with message signal x(t) has the form A sin(2*pi*(fc+delta(f))*t) where delta(f) is the frequency deviation and is a function of x(t). A PM modulated signal with message signal x(t) has the form A sin(2*pi*fc*t + p) where p is the phase and is a function of x(t). Digital signals usually use PM as its possbile to formulate orthogonal codes which provide error correction capabilities in a noisy transmission channel.

In FM, modulation index is inversely proportional to the modulating frequency but in PM that is independent of the modulating frequency.