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Roll no :- 52
Subject :- PCE
Assignment 03.

(Q.1)
Ans (i) Modulation index :- It is defined as the ratio of frequency duration (δ) to the modulating frequency (f_m).

$$M.I = \frac{\text{frequency duration}}{\text{modulating frequency}} = \left[\frac{\delta}{f_m}\right]$$

(ii) Frequency duration :- The amount of change in carrier frequency produced by the modulating signal is known as frequency duration.

(iii) Deviation ratio :- It is the worst case modulation index and is equal to the maximum peak frequency deviation divided by the maximum modulating signal frequency - producing the widest frequency spectrum.

$$\left[DR = \frac{\Delta f(max)}{f_m(max)}\right]$$

(Q.2)
Ans (i) Pre-emphasis :-
The artifical boosting of higher audio modulating frequencies in accordance with prearranged response curve is called pre-emphasis.

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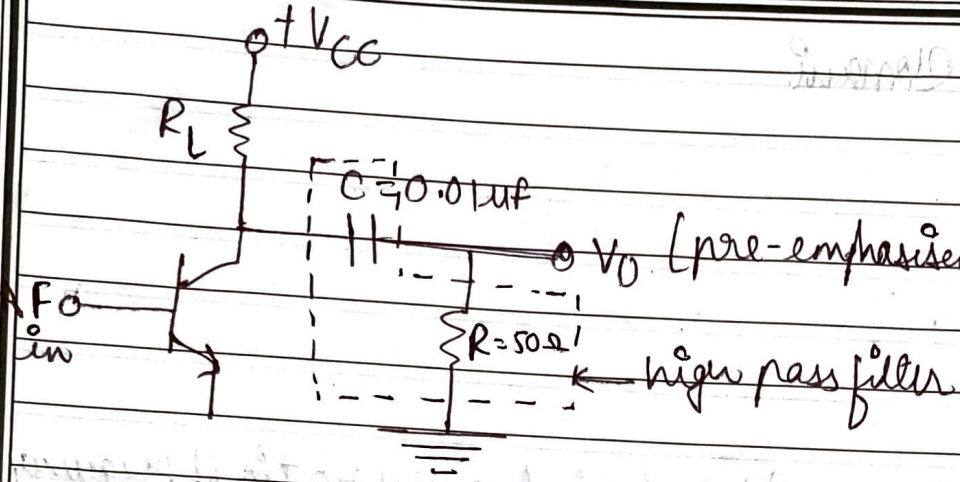
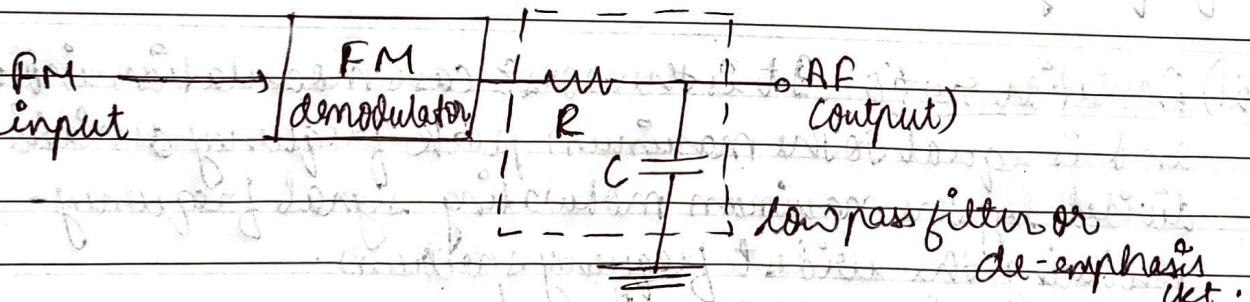


→ AF is passed through a high-pass filter, before applying to FM modulator.

→ As modulating frequency (f_m) increases, capacitive reactance decreases and modulating voltage goes on increasing.

→ $f_m \propto$ voltage of modulating signal applied to FM modulator.

(ii) De-emphasis :-



→ De-modulated FM is applied to the de-emphasis circuit where with increase in f_m, capacitive reactance X_C decreases. So that output of de-emphasis circuit also reduces.

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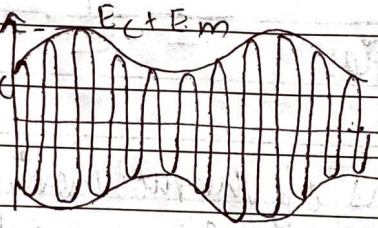
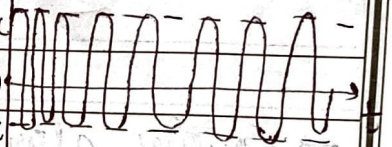
(Q.3)

Ans

	AM	FM
(1) parameters / definition.	Amplitude of carrier is varied in accordance with amplitude of modulating signal keeping frequency & phase constant.	Frequency of carrier is varied in accordance with the amplitude of modulating signal keeping amplitude and phase constant.
(2) constant parameters.	Frequency and phase.	Amplitude and phase.
(3) modulating signal. →		
(4) modulation index	$m = \frac{E_m}{E_c}$	$m = \frac{\delta}{f_m}$
(5) No. of sidebands	only two	infinite & depends on m_f.
(6) Bandwidth.	$BW = 2f_m$	$BW = 2(\delta + f_{m(max)})$
(7) Application	MW, SW band broadcasting video transmission in TV	broadcasting FM, radio (audio) transmission in TV.

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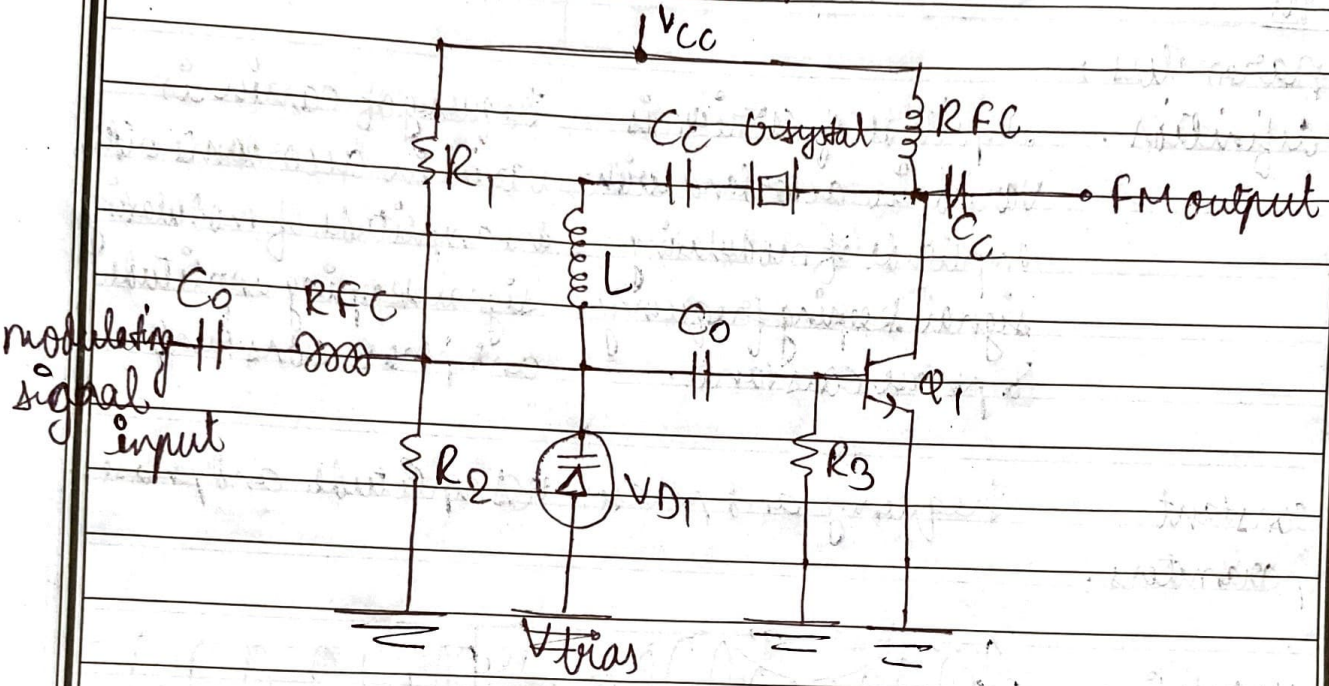
(7.4)

(i) Varactor diode modulator :-



→ positive alterations of the modulating signal increase the reverse bias of VD_1, which decreases its capacitance and increase the frequency of the oscillation.

→ negative alternations of the modulating signal decrease the reverse bias of VD_1, which increases its capacitance and decreases the frequency of the oscillation.

→ simple to use, stable and reliable but limited peak frequency deviation thus limited use to low index applications.

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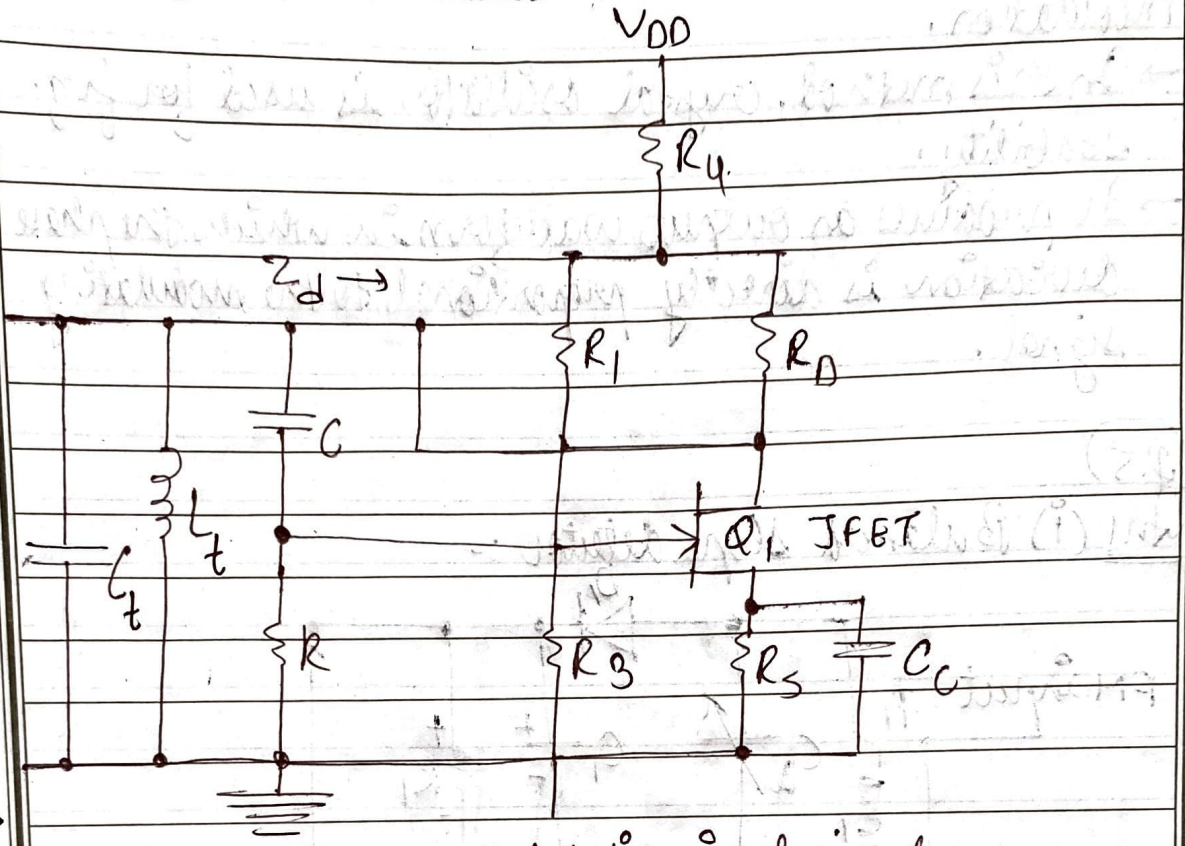
(ii) FET Reactance method :-



modulating signal input.

→ The circuit shown in figure is the basic circuit of a FET reactance modulator which behaves as a three terminal reactance that may be connected across the tank circuit of the oscillator to be frequency modulated.
→ It can be made inductive or capacitive by a simple component changes.
→ FET is used in the circuit here for simplicity only.

(iii) Armstrong method :-
→ Indirect method of FM generation is also known as Armstrong method of FM generation.

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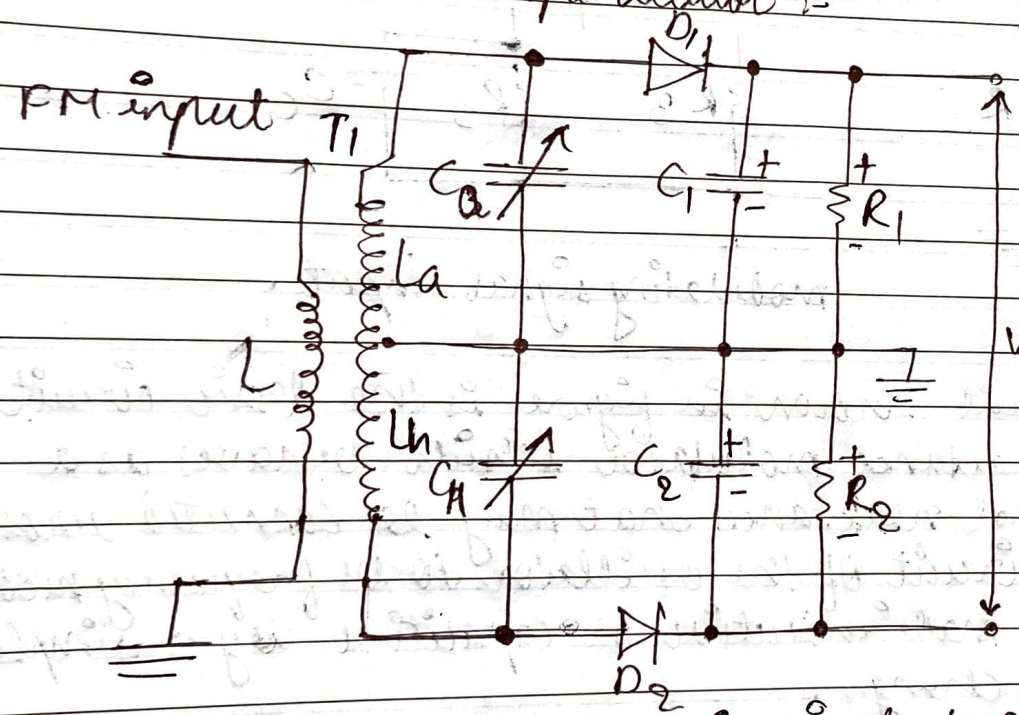
→ In this method, the FM is obtained through phase modulation.
→ In this method, crystal oscillator is used for freq. stability.
→ It produces an output waveform in which the phase duration is directly proportional to the modulating signal.

(Q.5)

Ans (i) Balanced slope detector :-



→ balanced slope detector is simply two single-ended slope detector connected in parallel and fed 180° out of phase.
→ phase inversion accomplished by centre tapping secondary windings of T_1.
→ tuned circuits (L_a, C_a & L_H, C_H) perform an FM-to-AM conversion.

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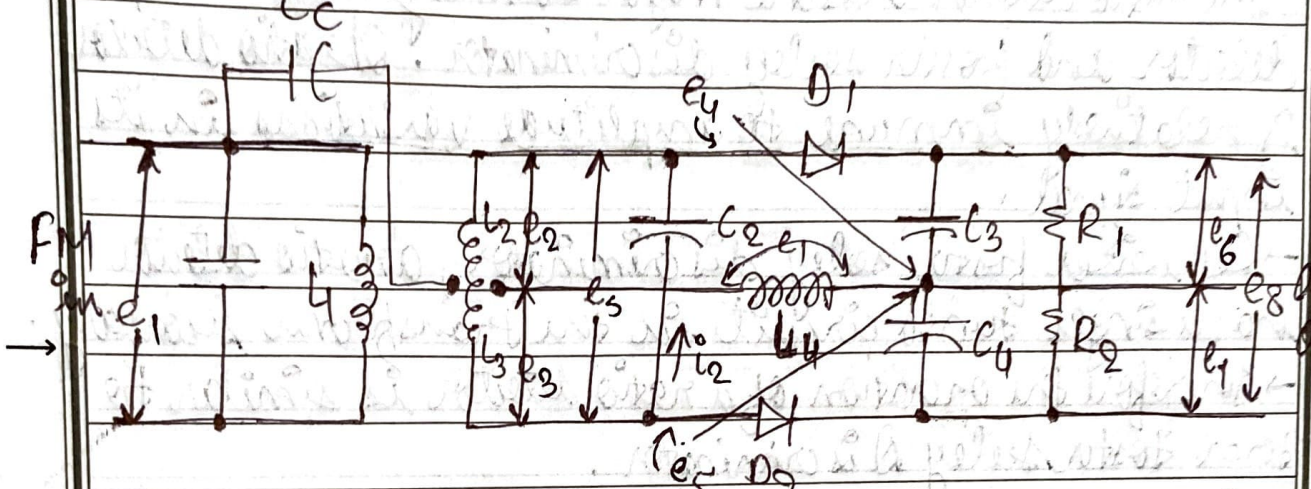
→ Balanced peak detectors (D_1, C_1, R_1 & D_2, R_2, C_2) remove the information from the AM envelope.
→ L_a & C_a is tuned to frequency f_a that is above the IF centre frequency (f_c).
→ L_b & C_b is tuned to frequency f_b that is below IF centre frequency (f_c).

(ii) Foster-Seeley Discriminator :-



→ sometimes called as Phase shift Discriminator is a tuned circuit frequency discriminator whose operation is very similar to that of the balanced slope detector.
→ The capacitance values for C_c, C_1 & C_2 are chosen such that they are short circuits for IF center frequency.
→ therefore the right side of L_2 is at ground potential and the IF signal (V_{in}) is fed directly across L_3.
→ the incoming IF is inverted 180 degree by transformer T_1 and divided equally between L_a & L_b.

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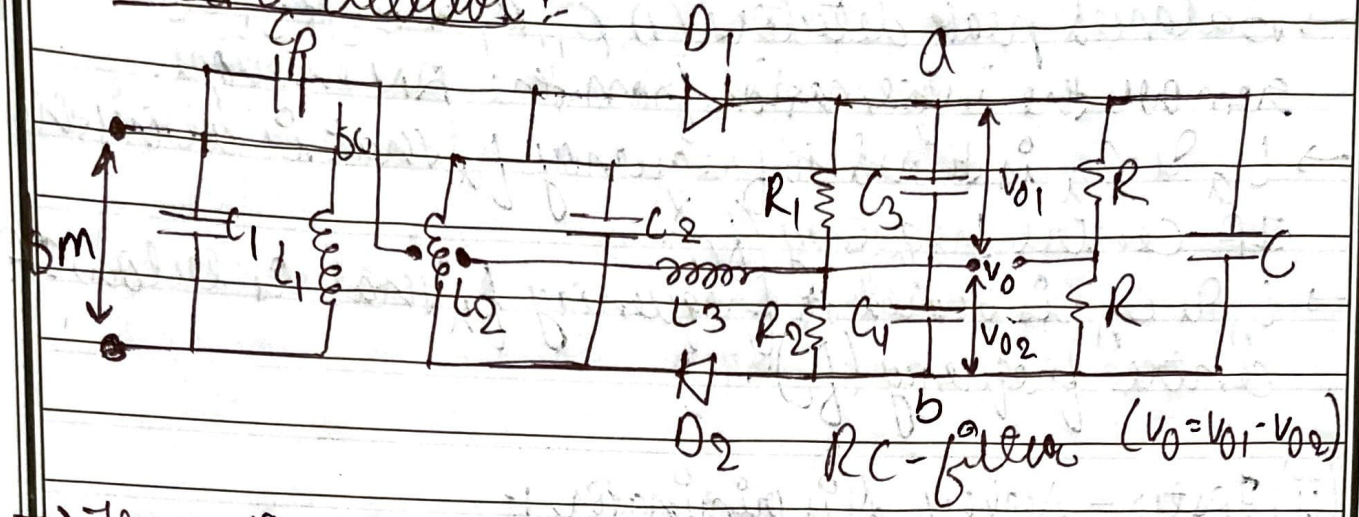
(iii) Ratio detector :-



→ The ratio detector has one major advantage over the slope detector and foster seeley discriminator. A ratio detector is relatively immune to amplitude variations in its input signal.

→ As with foster seeley discriminator, a ratio detector has a single tuned circuit in the transformer secondary.

→ Therefore the operation of a ratio detector is similar to that Foster Seeley Discriminator.

→ Voltage vectors for D_1 & D_2 are identical to those of the F.S discriminator.

→ However the ratio detector, one diode (D_2) is reversed and current (I_d) can flow around the outermost loop of the circuit.

→ Therefore after several cycles of the input signal, current capacitor C_3, charges to approximately the peak voltage across the secondary winding of T_1.

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Q.6)

(a)

Ans $[v_{fm} = 10 \sin 16\pi \times 10^6 t + 20 \sin 2\pi \times 10^3 t]$.