Unit - II

What is filter and write different types of filters

A) A filter is an electronic network which allows the signal within certain frequency and attenuates the signals outside this freq range. A range where attenuation is zero called passband and attenuation is infinite called stop band. Freq which seperates pass band and stop band is called cut-off-freq.

According to the design (construction) filter are classified.

(1) Constant k type (2) m-derived (3) Composite (4) ladder type (5) crystal (6) Mechanical

According to frequency range

(1) Low pass filters (2) high pass filter (3) Band pass filters (4) Band stop filter (5) Notch filter (6) All pass filters

(2) Define Decibel and Neper. Give the relation between neper and decibel.

Ans> Attenuation is defined as the power reduction (loss) in any network. The attenuation has been expressed in decebles or nepers

Neper is defined as the natural logarithm of the ratio of i/p power / voltage / current of the o/p power / voltage / current, provided the network is properly terminated with Zo. It

$$Neper = \log_e \frac{V_1}{V_2} \text{ or } \log_e \frac{I_1}{I_2} \text{ or } \frac{1}{2} \log_e \frac{P_1}{P_2}$$

Decebel is defined as the ten times common logarithm of the ratio of the i/p power to o/p power

$$D = 10 \log_{10} \frac{P_1}{P_2}$$

$$= 20 \log_{10} \frac{V_1}{V_2} \text{ or } 20 \log_{10} \frac{I_1}{I_2}$$

Relationship between Decibel and Neper

$$D = 8.686\, N$$

Attenuation in dB = 8.686 x attenuation in Neper

Attenuation in neper = 0.115 x attenuation in dB.

(3) Write the characteristics of filter

Ans (1) Pass band chs :- Filter should have minimum attenuation in pass band and very high attenuation in stop band.

(2) cut-off freq chs :- The filter should ~~posses~~ posses the frequency distinguishing property in the pass band and stop band.

- It should be able to identify lower as well as higher cutoff freq of transmitting signal through it.

The transition freq region between the pass-band and stopband must be very small.

(3) Chs Impedance (Z_0) : The chs impedance of filter should match with the network to which it is connected throughout the passband. this prevents reflection loss in the combinations.

(4) Write any four applications of filters.

Ans 1) In telephony or radio and T.V broadcasting several no of informations (channels) are Tx ed by using diff modulation techniques with different carrier frequencies, which can be received by utilizing filters

2) In radio receivers, IF carrier freqency selection is also provided by using filters.

3) In audio amplifiers, filters are used to reduce harmonic distortion and voice rejection

4) In regulated power supply units filters are used to provide smooth dc o/p from ac input

5) In electronic equipment filter are used to protect the circuits

(6) In measurements of signal, filter are used to select particular range freq to study.

(5) Comparision between active and passive filter

Active Filters	Passive filters
(1) small in size	1) large in size
(2) gain can be obtained	2) gain can't be obtain
(3) Easily integratable (fabricated on IC)	(3) It is very difficult to to Integrate (almost impossible)
(4) low sensitivity	(4) high sensitivity
(5) operated in low freq range	(5) Operated in high freq range
(6) Consumes low power	(6) consumes high power

(6) Describe constant K filter. Write the Advantages and disadvantages of constant K-type.

A constant-K filter is a T-N/w or π N/w in which the series and shunt impedance Z_1 & Z_2 are connected by the relationship

$$Z_1 Z_2 = R_k^2 \text{ (or) } Z_1 Z_2 = K$$

$$R_K = \sqrt{L/C}$$

The other name for constant K is prototype because other more complex networks can be derived from it

Advantage of Constant K type filter

① simple ② Easy to construct.

③ It is prototype, using this we can construct complex N/w

Disadvantages of Constant-K filter

1) The attenuation does not increase rapidly beyond cut off frequencies

(2) Chs impedance (Z_0) varies widely in pass-band from the design impedance R_K.

(7) Write advantages and disadvantages of 'm' derived filters

Ans) Advantage of 'm'-derived filter

1) It is possible to get very rapid attenuation in stop band. (α = more)

2) Sharp transition band is possible at low order of filter

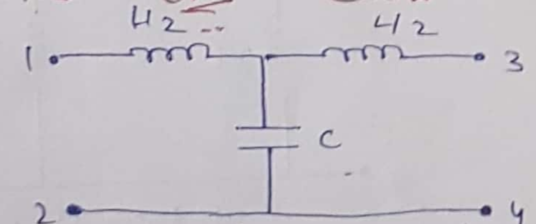
Disadvantages of m-derived filter

① It fails to provide constant chs impedance (Z_0) over the entire pass band

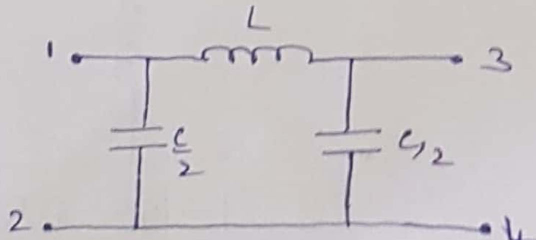
② Network complexity is increased (no of elements are increased)

(8) Write constant K - low pass filter circuit, formulae and chs curves

Ans →

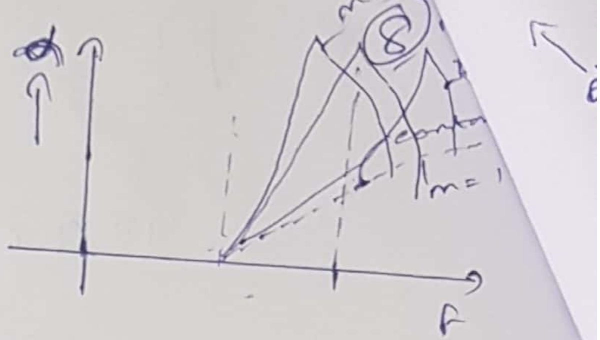


T-type



π-Type

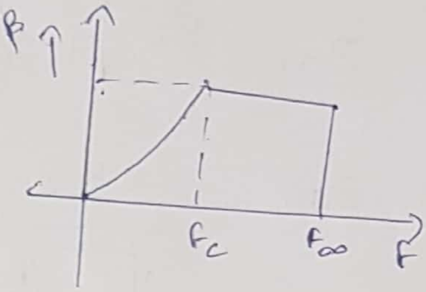
$$F_\infty = \frac{1}{\pi\sqrt{1-m^2}\sqrt{LC}}$$

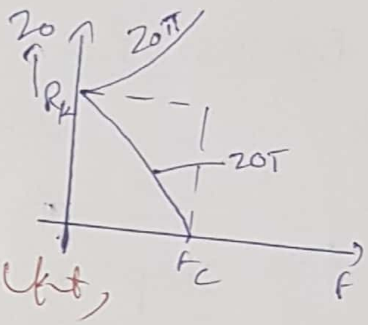


$$F_c = \frac{1}{\pi\sqrt{LC}}$$

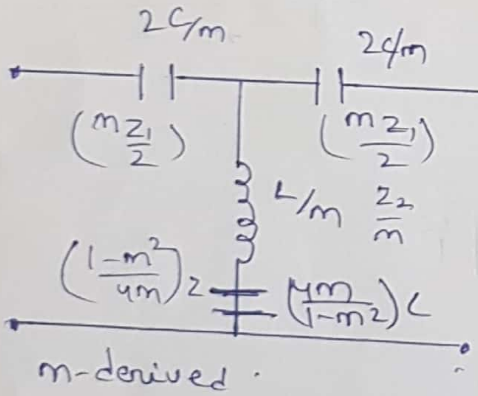
$$F_\infty = \frac{f_c}{\sqrt{1-m^2}}$$

$$m = \sqrt{1-\left(\frac{f_c}{f_\infty}\right)^2}$$

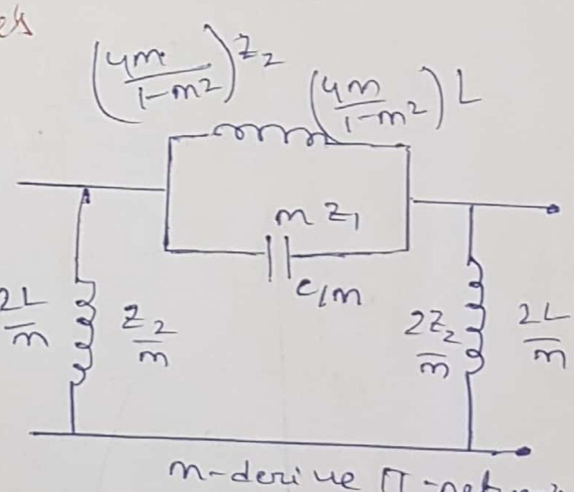




11) Write m-derived high pass filter ckt, design formulae, chs curves



m-derived.



m-derive π-network

$$F_\infty = \frac{\sqrt{1-m^2}}{4\pi\sqrt{LC}}$$

$$F_c = \frac{1}{4\pi\sqrt{LC}}$$

$$F_\infty = \left(\sqrt{1-m^2}\right)F_c$$

$$m = \sqrt{1-\left(\frac{F_\infty}{F_c}\right)^2}$$

$$R_K = \sqrt{\frac{L}{C}}$$

$$f_c = \frac{1}{4\pi\sqrt{LC}}$$

$$Z_{0T} = R_K\sqrt{1-\left(\frac{f_c}{f}\right)^2}$$

$$Z_{0\pi} = \frac{R_K}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}}$$

$$L = \frac{R_K}{4\pi f_c}$$

$$C = \frac{1}{4\pi R_K f_c}$$

For pass band

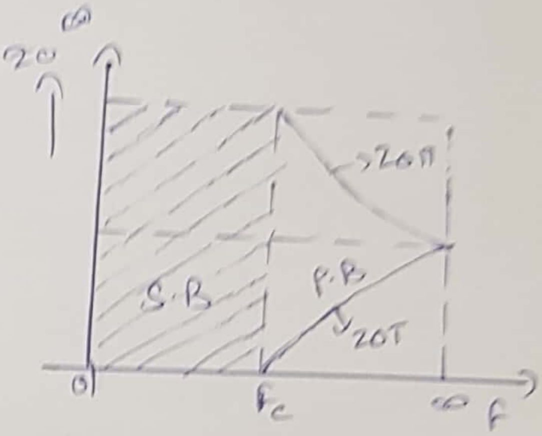
$$\alpha = 0$$

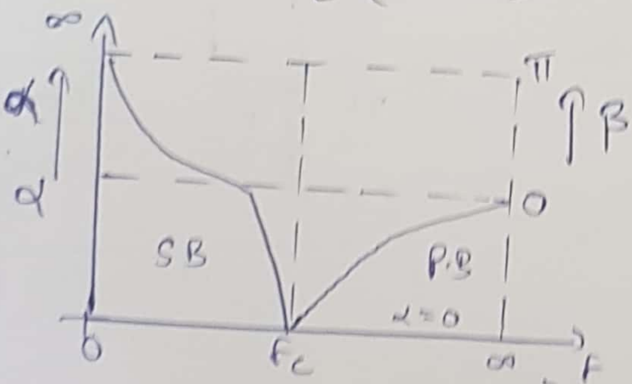
$$\beta = 2\sin^{-1}\left(\frac{f_c}{f}\right)$$

For stop band (or) Attenuation band

$$\beta = \pi$$

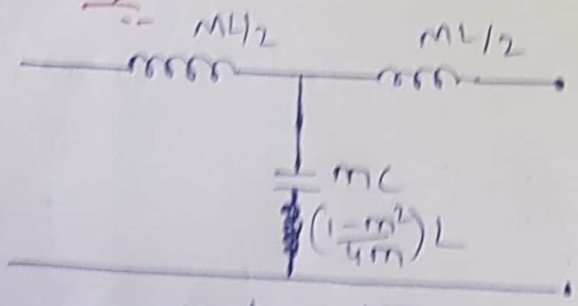
$$\alpha = \cosh^{-1}\left[2\left(\frac{f_c}{f}\right)^2 - 1\right]$$



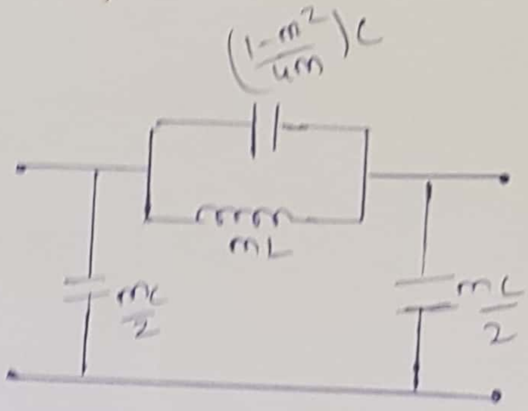


10 (a) Write m-derived lowpass filter ckt, formulae and chs curves

Ans

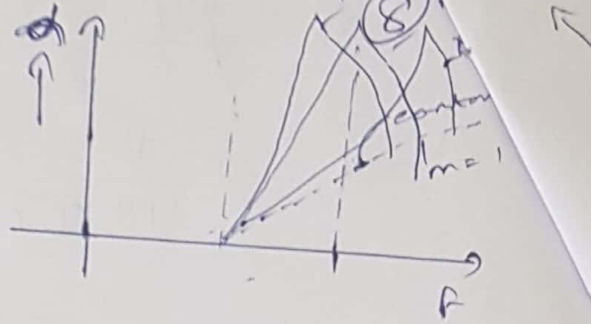


m-derived T-n/w



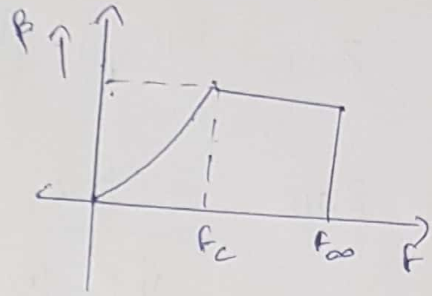
m-derived π-n/w

$$F_\infty = \frac{1}{\pi\sqrt{1-m^2}\sqrt{LC}}$$

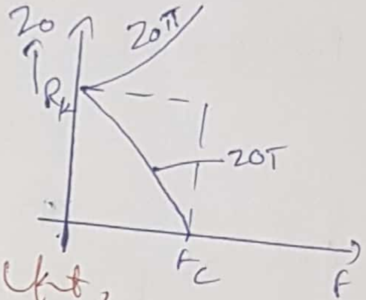


$$F_c = \frac{1}{\pi\sqrt{LC}}$$

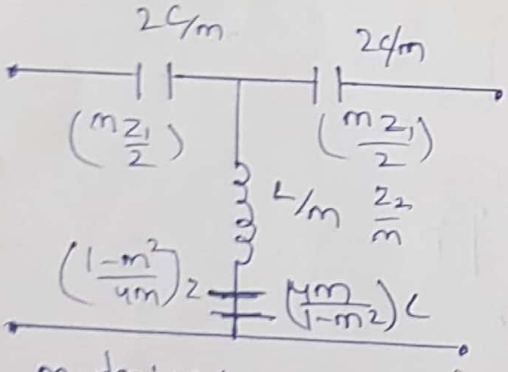
$$F_\infty = \frac{f_c}{\sqrt{1-m^2}}$$



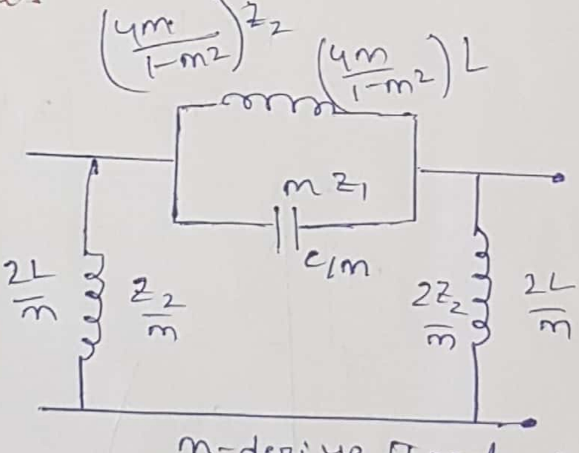
$$m = \sqrt{1-\left(\frac{f_c}{f_\infty}\right)^2}$$



11) Write m-derived high pass filter ckt, design formulae, chs curves



m-derived.

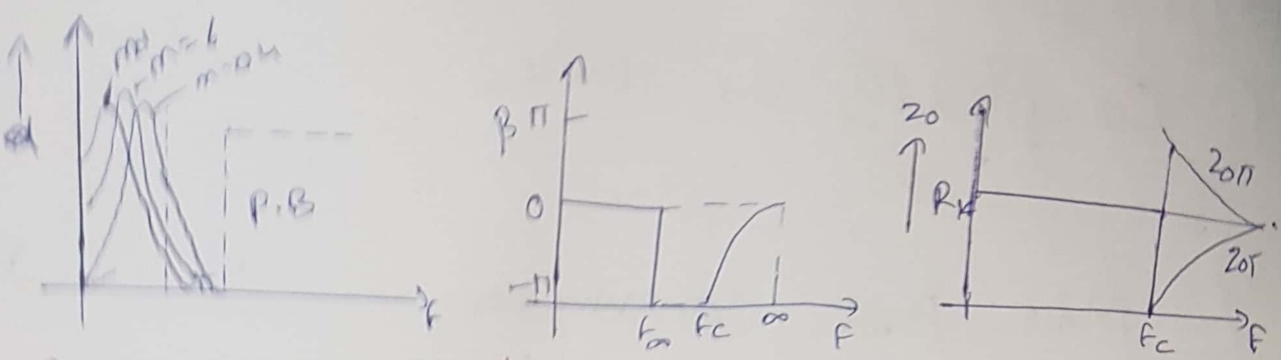


m-derive π-network

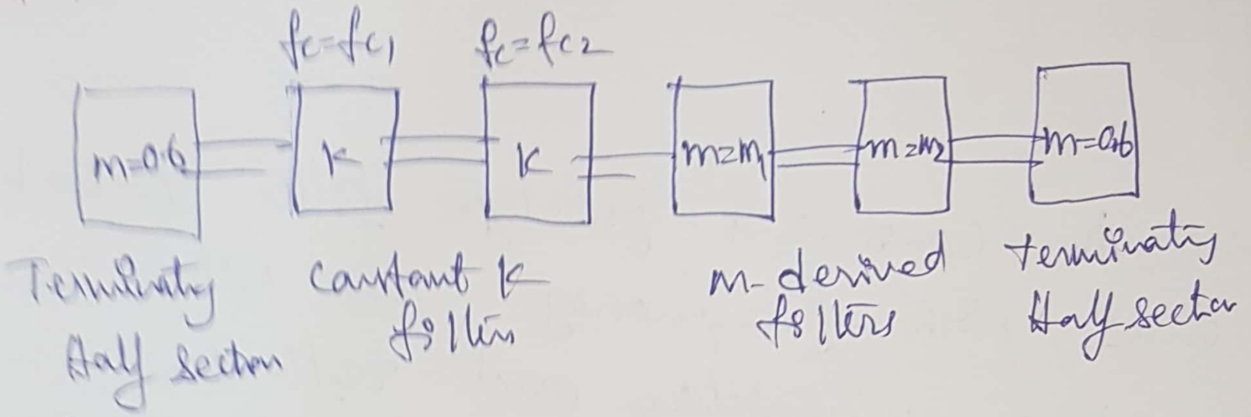
$$F_\infty = \frac{\sqrt{1-m^2}}{4\pi\sqrt{LC}}$$

$$F_c = \frac{1}{4\pi\sqrt{LC}} \qquad F_\infty = \left(\sqrt{1-m^2}\right)F_c$$

$$m = \sqrt{1-\left(\frac{F_\infty}{F_c}\right)^2}$$

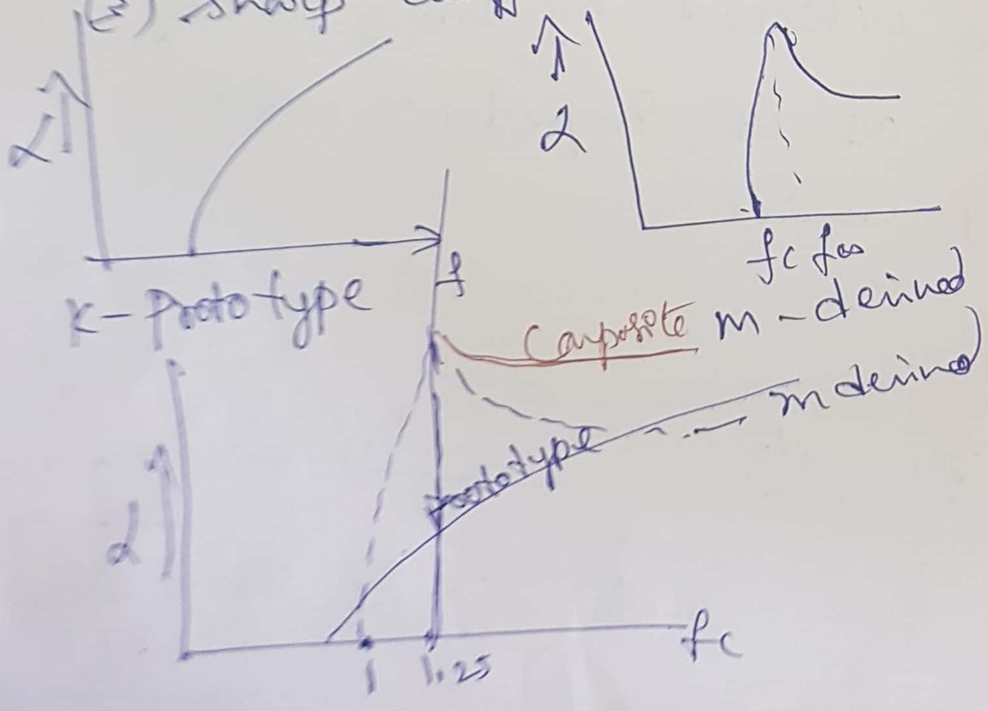


12) Draw the Block diagram of composite filter:



13) Advantages of composite filter

1) High and constant attenuation in stop band.
(2) transition band is small.
(3) Sharp cutoff are possible (accurate filtering is possible)



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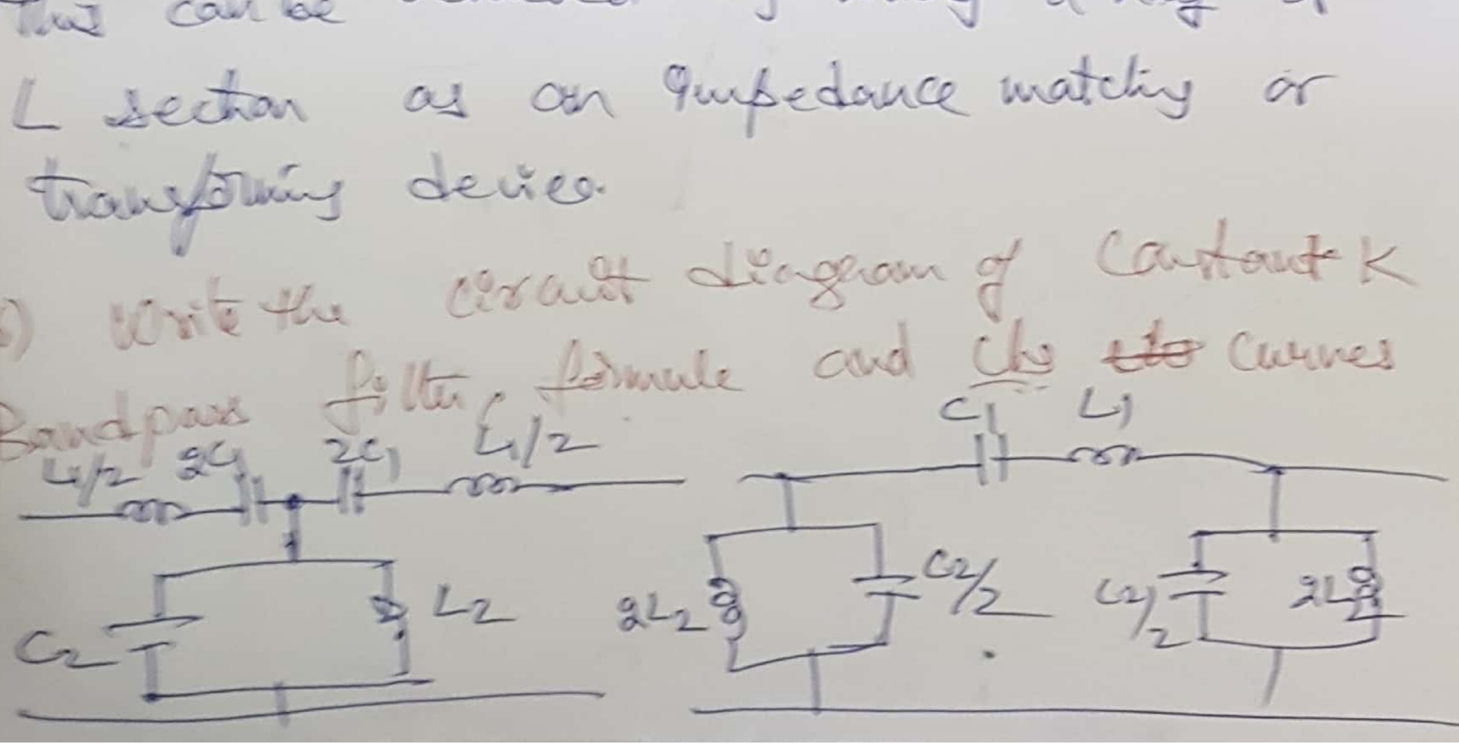
(14) Write the disadvantages of composite
① Complexity is more (no of filter sections are more)

② More power consumption and cost (high) bulky (no of elements are more)

(15) Necessity of Terminating half section in composite filter

Ans) In constant k - prototype filter impedance varies with frequency. This will cause impedance mismatching and reflections in the network. Therefore it is difficult to terminate constant k sections properly; it would be desirable to use fixed resistance as termination. This can be achieved by using a half or L section as an impedance matching or transforming device.

(16) Write the circuit diagram of constant K Bandpass filter, formula and the curves



$$\omega_0 = \frac{1}{\sqrt{L_1 C_2}} = \frac{1}{\sqrt{L_2 C_2}}$$

$$R_K = \frac{L_1}{C_2} = \frac{L_2}{C_1}$$

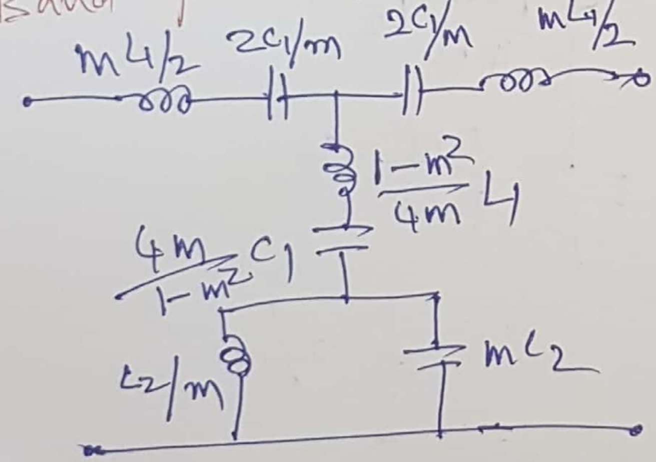
$$C_1 = \frac{f_2 - f_1}{4\pi R_K f_1 f_2}$$

$$L_1 = \frac{R_K}{\pi (f_2 - f_1)}$$

$$L_2 = \frac{R_K (f_2 - f_1)}{4\pi f_1 f_2}$$

$$C_2 = \frac{1}{\pi R_K (f_2 - f_1)}$$

(7) Write the circuit and formulae for m-derived Band pass filter



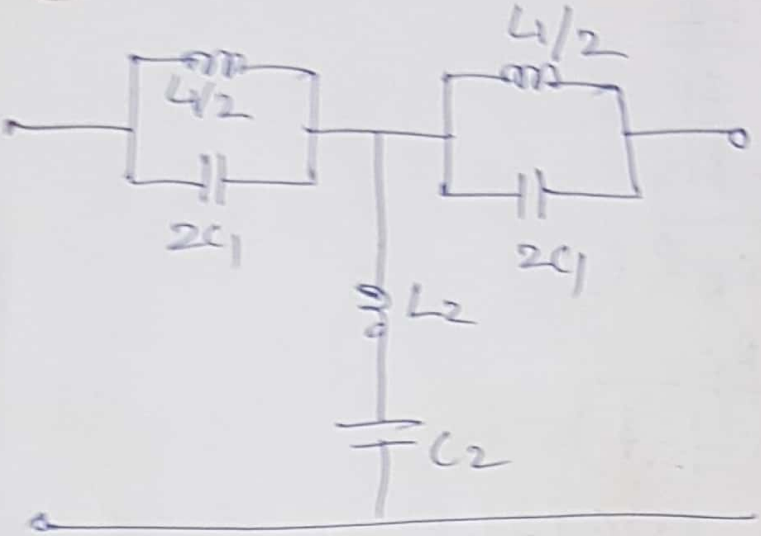
~~freq~~

$$m = \sqrt{1 - \frac{(f_2 - f_1)}{(f_{\infty_2} - f_{\infty_1})}}$$

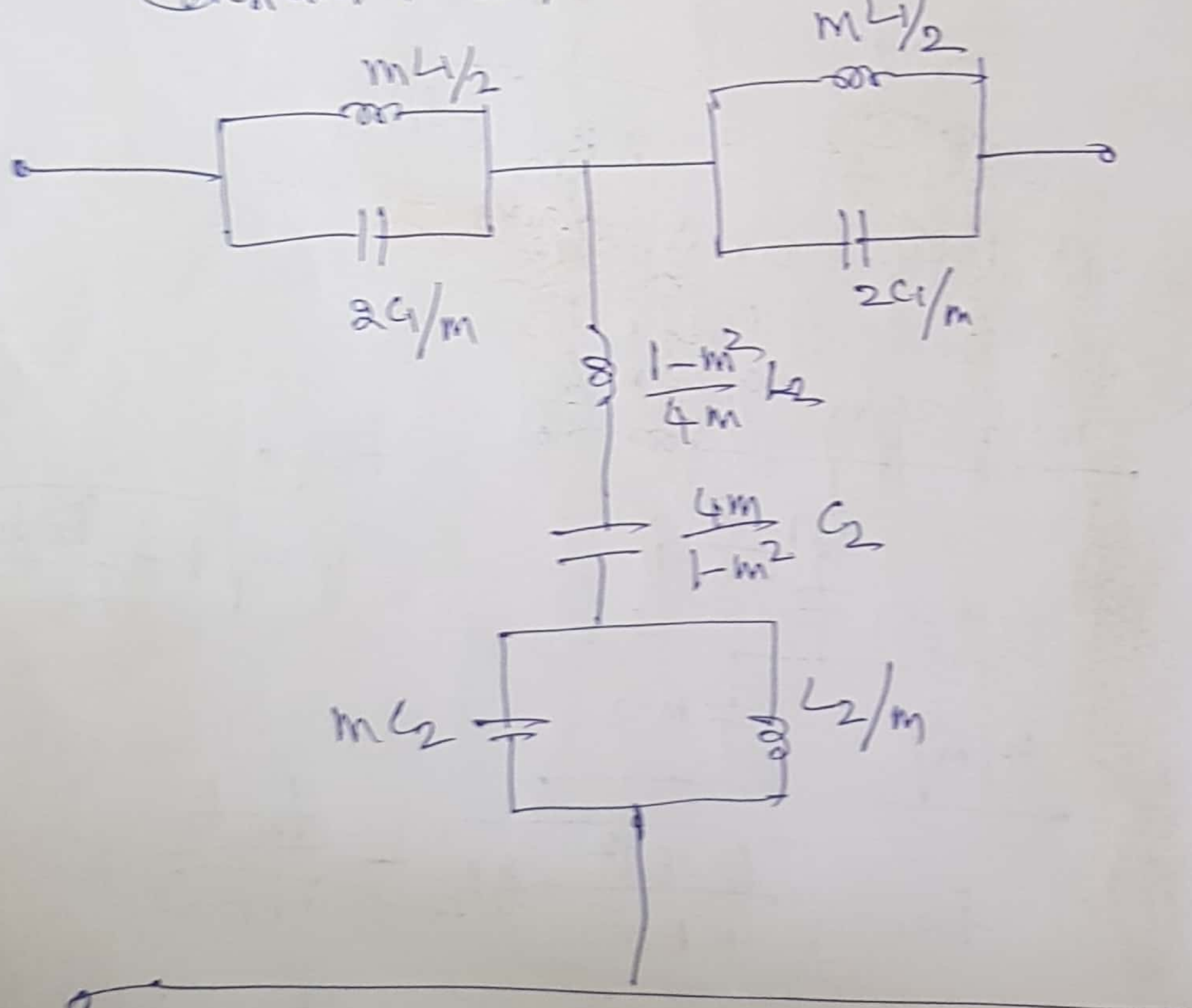
$$f_{\infty_1} = \sqrt{\frac{(f_2 - f_1)^2}{4(1-m^2)} + f_1 f_2} - \frac{f_2 - f_1}{2\sqrt{1-m^2}}$$

$$f_{\infty_2} = \sqrt{\frac{(f_2 - f_1)^2}{4(1-m^2)} + f_1 f_2} + \frac{(f_2 - f_1)}{2\sqrt{1-m^2}}$$

(18) Write ckt diagram of Band stop filter of Constant K and m-derived filter



Constant K BSF



m derive Band Stop filter