Transmission Line And Wave Guides

27)

Unit 1. Filters

PART - A

Q1. Neper :- It is defined as

$$N \text{ nepers} = \ln\left(\frac{V_1}{V_2}\right) = \ln\left(\frac{I_1}{I_2}\right)$$

Also,
It is defined as the natural logarithm of input voltage or current to the output voltage or current.

Bel :- The bel is defined as the logarithm of a power ratio,

$$\text{no. of bels} = \log \frac{P_1}{P_2}$$

Q2. Decibel :- It is the 10 times of common logarithm of ratio of input power to output power.

i.e.

$$D = 10 \log\left(\frac{P_1}{P_2}\right)$$

where,

P_1 = i/p power

$$D = 8.686\ N$$

$\overline{\ln}$

Q3. Filter :- It is the electronics device which is designed to separate and pass or supress a group of signal through a mixer of signals. And it also passes freely a desired band of frequency. While almost suppressed other band of frequency.

Q11.

Q12.

Q4. Types of filters :-

a) Active Filters - They contains transistor, inductors and op-amp.

b) Passive Filters - They contains resistor, capacitor.

Q5. When $Z_1 = Z_2$ or the two series arms of a T network are equal, or $Z_a = Z_0$ and the shunt arms of a π network are equal the network works are said to be symmetrical.

Q6. 1 Neper = 8.686 db.

or,

$N = 0.115 D$

Q13.

Q11. The characteristic impedance of symmetrical network is the impedance measured at the input terminal of the 1st channel in the chain of infinite network in cascade and it is represented by Z_0.

Q12. Progation constant is defined as the natural logarithm of the ratio of sending end current or voltage to receiving end current or Voltage.

$$\gamma = \ln \frac{I_S}{I_R} \quad \text{or,} \quad \gamma = \ln \frac{V_S}{V_R}$$

$$\text{or,} \quad \gamma = \alpha + j\beta$$

It is also Known as

$$\gamma = \sqrt{ZY}$$

$$= \sqrt{(R + j\omega L)(G + j\omega C)}$$

Q13. If Z_1 and Z_2 of a reactance n/w are unlike reactance arms, then

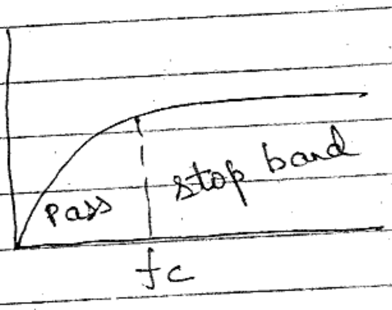
$$Z_1 Z_2 = K^2$$

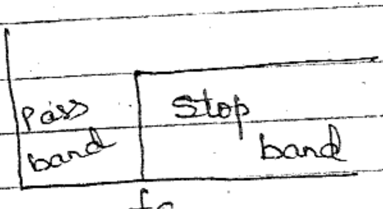
where K is a constant indepdent of frequency. N/w or filter sections for which this relation hold are called constant - K filters.

Q14. Types of constant K filter Q18.

- The const K low pass filter } T, π
- The const K high pass filter }

Q15. The low pass filters passes all frequencies upto the cut off frequency. Also attenuates all frequencies above the cut off frequency. Q19.



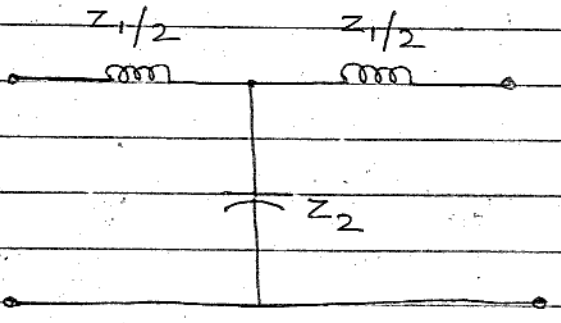


Q21.

Q17. Disadvantage of const K filters -

- The attenuation does not rise very rapidly at cut off, so that frequencies just outside the pass band are not appreciably attenuated with respect to frequencies just inside the pass band.
- The characteristic impedance varies widly over the pass band, so that a satisfactory impedance match is not possible.

Q18.



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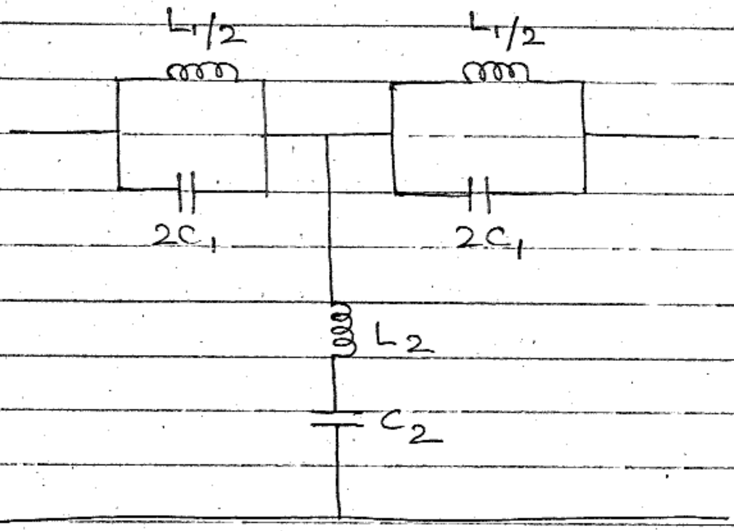
Q19.



Q21.

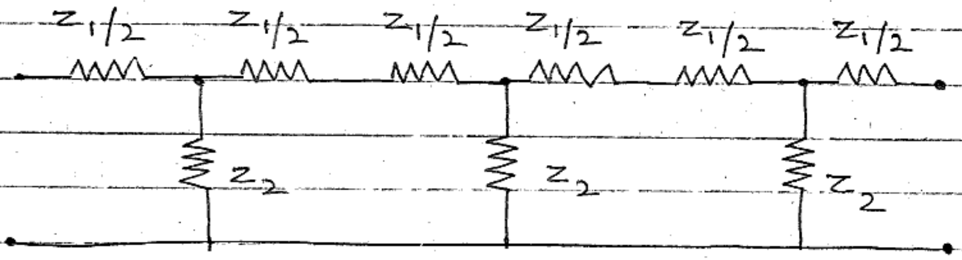


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Fig – Ladder n/w formed by symmetrical T-n/w

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Q23. It is a combination of constant K filters, m derived filters and m derived half sections. Q25.

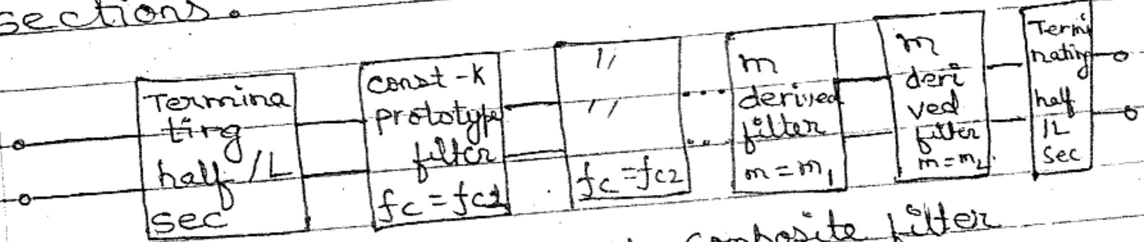
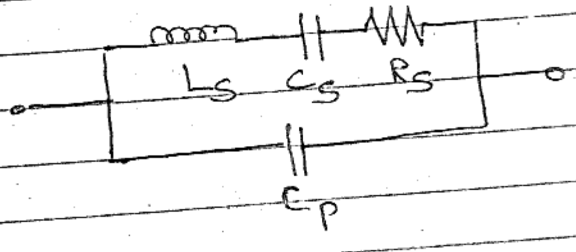


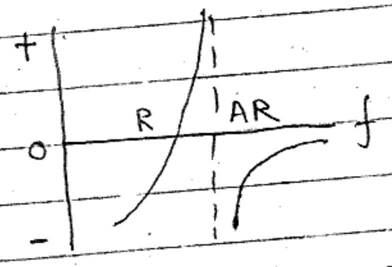
Fig - Block diagram of composite filter

In this, const K filters provides high attenuation away from cut-off freq, in stop band, m derived filters provides high attenuation close to f_∞ and m derived half sections with m = 0.6 provide uniform charteristic impedance in pass band.

Q20. Crystal filter is made up of piezo electric crystal with very high Q. It acts as a very narrow band filter. The equivalent ckt and reactance curve of crystal filter is shown below —



a) Equi ckt



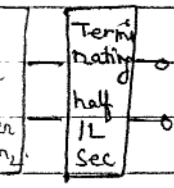
b) Reactance curve

Q10. When pass band starts at freq at which $Z_1 = 0$ and continues to freq (f_c) at which $Z_1 = -4Z_2$. This freq is called cut-off freq.

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

filters,

f



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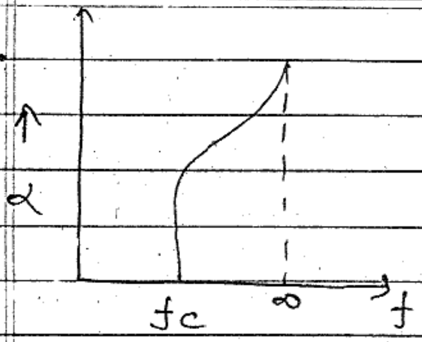
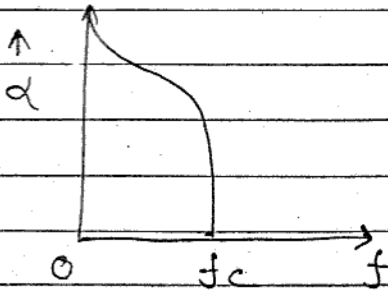
h $Z_1 = 0$

$= 4Z_2$.

Q25.



Low pass filter



High pass filter

Unit - 2
Part - A

Q1. The transfer of energy from one point to another through either transmission line or wave guide.
The electrical lines which transmit the electrical wave one place to another.

Q2. Types of Transmission line -
- Open wire line
- Cables
- Co-axial cable
- Wave guides.

Q3. Parameter of transmission line -
- Resistance (R)
- Inductance (L)
- Capacitance (C)
- Conductance (G) = $1/R$

Q4. Written in 1st unit.

Q9. The line in which there is no phase and frequency distortion is called distortion-less line.
It is also represented β.

$$\beta = \sqrt{\frac{(\omega^2 LC - RG) + \sqrt{(RG - \omega^2 LC)^2 + \omega^2 (LG + RC)^2}}{2}}$$ φ11.

Condition for distortionless line is

$$LG = RC$$

$$\text{i.e. } \boxed{\frac{G}{C} = \frac{R}{L}}$$ φ12.

φ10. In using ordinary telephone cable the wires are insulated with paper and twisted in pairs. This construction results in negligible values of inductance and conductance so that reasonable assumptions in the audio range of frequencies are that

$$Z = R$$
$$Y = j\omega C$$

φ7.

Velocity of propagation

$$v = \frac{\omega}{\beta} = \sqrt{\frac{2\omega}{CR}}$$

It should be observed that both α and the velocity are functions of freq., such that higher frequencies are attenuated more and travel faster than lower frequencies. φ18.

$\overline{G+RC)^2}$

Q11. It is necessary to increase L/C ratio to achieve distortionless condition in a transmission line. This can be done by increasing the inductance of transmission line. Increasing inductance by inserting inductances in series with line is termed as loading and such lines are loaded lines.

Q12. It is defined as the ratio of reflected voltage to the incident voltage at the receiving end. Denoted by K.

wires
in pairs.
values
reaso-
of.

$$K = \frac{\text{Reflected voltage}}{\text{Incident voltage}} = \frac{V_R}{V_0}$$

$$K = \frac{Z_R - Z_0}{Z_R + Z_0}$$

Q7. Line distortion types
- Frequency distortion
- Delay distortion

and
such
d more
ries.

Q18. Wave length :- The distance the wave travels along the line while the phase angle is changing through 2π radians is called wave length.

$$\lambda = \frac{2\pi}{\beta}$$

Q 19. Velocity of propagation is defined as :

$$V = \frac{\omega}{\beta}$$

Q8. Frequency distortion is reduced by the use of equalisers.

Q20. If the received waveform on a transmission line is not identical with the i/p waveform at sending end is called waveform distortion, this occurs in transmission line due to the fact that all frequencies applied on the transmission line are not equally attenuated and are not delayed equally.

Unit-3

PART-A

Q1.→ At very high frequencies the skin effect is considerable. Hence it is assume that the current may flow at the surface of the conductor when the internal inductance becomes zero.

→ Due to the skin the resistance R increases with the frequency. Hence $\omega_L >>> R$.

Q2. Nodes- The points along the line where magnitude of voltage and current is zero is known as nodes.

Antinodes- The point where the magnitude of voltage and current is maximum is known as antinodes.

Q3. When the transmission line is not terminat by Zo i.e. the load impedance is not equal to characteristic impedance

$$Z_0 \neq Z_R$$

The combination of incident and reflected waves give rise to the standing wave.

Q5. It is the ratio of maximum to mini the mag. of voltage or current. Q9. I

$$SWR = \left|\frac{V_{max}}{V_{min}}\right| \quad or \quad \left|\frac{I_{max}}{I_{min}}\right|$$

Q6. $$Z_S = R_o \left[\frac{1\angle\beta s + |K|\angle\phi - \beta s}{1\angle\beta s - |K|\angle\phi - \beta s}\right]$$

$$Z_{S(max)} = R_o\left[\frac{1+|K|}{1-|K|}\right] = SR_o$$ Q10. →

C

$$Z_{S(min)} = R_o\left(\frac{1-|K|}{1+|K|}\right) = \frac{R_o}{S}$$ →

Q11.

Q7. Application of quarter-wave matching section is to couple a transmission line to a resistive load such as an antenna.

- It is also used if the load is not pure resistance. →
- It is used as an insulator to support an open-wire line or the center conductor of co-axial line.

Q9. The stub length L' will be

$$L' = \frac{\lambda}{2} - L$$

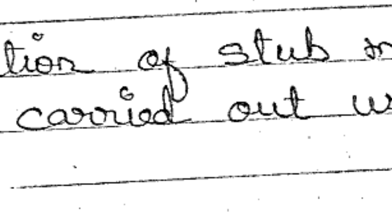
or,

$$L = \frac{\lambda}{2\pi} \tan^{-1} \frac{\sqrt{S}}{S-1}$$

Q10.→ Determination of SWR, sending end imp and load impedance.

→ The solution of stub matching problem may be easily carried out using smith chart.

Q11. It is a polar chart. It is used to determine SWR and sending end imp and load admittance. It is also used to measure impedance and admittance. It contains two circles
→ Const R circle and → Const X circle or β circle



Q14. i) Double stub matching does not required that the stub should be placed at definite point on the line like single stub matching.

ii) Double stub matching requires only the length of stub being changed while the position of the stub over the transmission line can be arbitrary.

Q17.

Q24. • It is used as one to one transformer.

• In connecting a load to a source in cases when the load and source cannot be made adjacent.

Q15. Given, $Z_0 = 50\Omega$

$Z_R = 90 + j60$

Q21.

Reflection coff, $K = \dfrac{Z_R - Z_0}{Z_R + Z_0}$

$$K = \frac{90 + j60 - 50}{90 + j60 + 50} = \frac{40 + j60}{140 + j60}$$

$$K = \frac{72.11 \angle 56.30}{152.31 \angle 23.19} = 0.473 \angle 33.11$$

$$K = 0.473 \angle 33.11$$

$$\therefore VSWR = \frac{1 + |K|}{1 - |K|} = \frac{1 + 0.473}{1 - 0.473} = \frac{1.473}{0.527}$$

$\therefore$ VSWR = 2.795

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r.

cases made

Q17. Given,

$Z_0 = 200\,\Omega$

$Z_R = 692 \angle -12^\circ$

or, $Z_R = 676.87 - j143.87$

$$\therefore K = \frac{Z_R - Z_0}{Z_R + Z_0} = \frac{676.87 - j143.87 - 200}{676.87 - j143.87 + 200}$$

$$K = \frac{476.87 - j143.87}{876.87 - j143.87}$$

$$K = \frac{498.09 \angle -16.78}{888.59 \angle -9.32}$$

$$K = 0.5605 \angle -7.46$$ <Ans>

Q21. Given, $Z_0 = 300\,\Omega$

$Z_R = 300 + j400$

Ref coeff $K = \frac{Z_R - Z_0}{Z_R + Z_0} = \frac{300 + j400 - 300}{300 + j400 + 300}$

$$K = \frac{j400}{600 + j400} = \frac{400 \angle 90}{721.1 \angle 33.69}$$

$$K = 0.5547 \angle 56.31$$

$$SWR = \frac{1 + |K|}{1 - |K|} = \frac{1 + 0.55}{1 - 0.55} = \frac{1.55}{0.45}$$

$$= \frac{1.473}{0.527}$$

SWR = 3.4

Q19. Given,

$$L = 9\,\mu H/m$$
$$C = 16\,pf/m$$
$$Z_0 = 1000\,\Omega = R$$

So, $Z = R + j\omega L = 1000 + j$

Q25. The dissipation line for which attenuation constant is zero i.e. $\alpha = 0$ is called the zero dissipation line.

if $\gamma = \alpha + j\beta$

$\alpha = 0$

i.e. $\gamma = j\beta$.

Q23. i) In smith chart the impedance is represented in circular line.

ii) Smith chart is based on two sets of orthognal-ck circles.

iii) It is the modified form of circle diagram for dissipationless transmission line.

iv) Its radius is unity.

v) The transformation utilized for formulating it is called ~~bin~~ bilinear transformation.

Q13. i) Because it radiates more power as compaired to short cKted stub.

ii) its effective length cannot be varied.

~~Unit-04~~

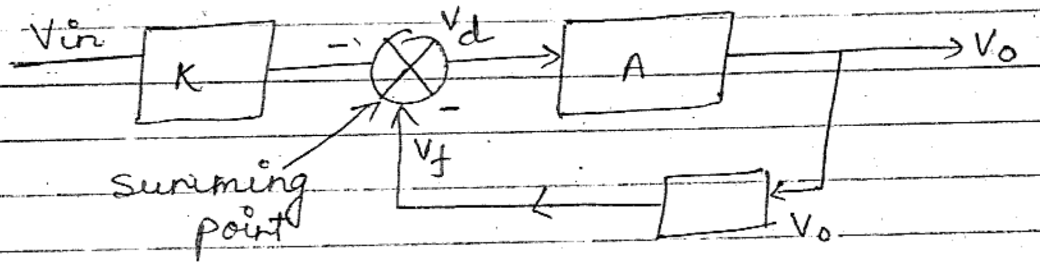
~~Part-A~~

Linear Integrated Circuit

Unit -2

Part -B

Q3. Closed loop block diagram of inverting amplifier



Let us obtain the closed loop transfer function V_o/V_{in} of the block diagram.

At the summing pt, we can write

$$-V_{in}K - V_f = V_d \quad — (1)$$

$$V_d A = V_o \quad — (2)$$

$$V_o \beta = V_f \quad — (3)$$

where, A = open loop gain

β = f/b ckt gain

K = ~~f/b c~~ attenuation factor

sub ① and ③ in ②

$$(-V_{in} K - V_f) A = V_o$$

i.e. $-V_{in} K A - V_o \beta A = V_o$

$$\therefore -V_{in} K A = V_o (1 + \beta A)$$

$$\frac{V_o}{V_{in}} = -\frac{AK}{1+\beta A} \quad \text{— ④}$$

Now let us consider the expression of obtained earlier and rearranging it similar to eq ④

$$A_{CL} = \frac{-A_{OL} R_f}{R_1 + R_f + R_1 A_{OL}} \quad \text{— ⑤}$$

divide numerator and denominator by $(R_1 + R_2)$

$$A_{CL} = \frac{-\dfrac{A_{OL} R_f}{R_1 + R_f}}{1 + \dfrac{R_1 A_{OL}}{(R_1 + R_f)}}$$

compairing eq ④ and ⑤ we can write

$A = A_{OL}$ = forward path gain

$\beta = \dfrac{R_1}{R_1 + R_f}$ = f/b path gain

$K = \dfrac{R_f}{R_1 + R_f}$ = voltage attenuation factor.

$$A_{CL} = -\frac{A_{OL}K}{1+A_{OL}\beta}$$

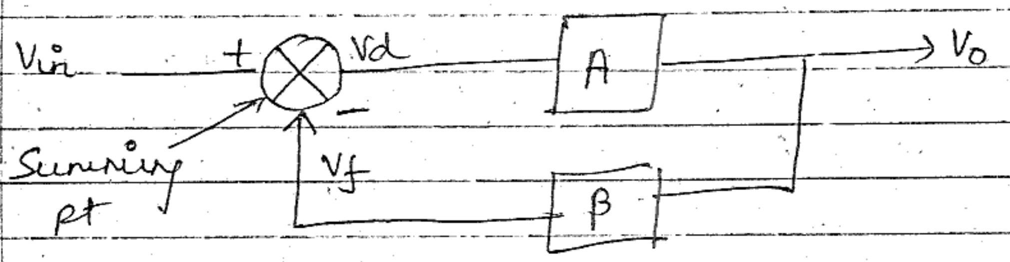
Ideally $A_{OL}\beta >> 1$ hence $1 + A_{OL}\beta \approx A_{OL}\beta$

hence we get

$$A_{CL} = \frac{-K}{\beta}$$

$$= \frac{-R_f}{R_1+R_f} \frac{(R_1+R_f)}{R_f} = \frac{-R_f}{R_1}$$

Closed loop block diagram of non-inverting amplifier -



Let us obtain the ratio V_o/V_{in} in terms of forward path gain A and f/b path gain β.

At the summing pt we can write

$$V_{in} - V_f = V_d \quad \text{— (1)}$$

$$V_d A = V_o \quad \text{— (2)}$$

$$V_o \beta = V_f \quad \text{— (3)}$$

$\approx A_{OL}\beta$

$\frac{R_f}{R_1}$

Inverting

V_o

terms of gain β.

where

A = open loop gain

β = f/b path gain

~~subtracting~~ substituting ① and ③ in ② we get

$$(V_{in} - V_f)\,A = V_o$$

$$\therefore (V_{in} - V_o\beta)\,A = V_o$$

$$V_{in}A - V_oA\beta = V_o$$

$$V_o(1 + A\beta) = AV_{in}$$

$$\therefore \frac{V_o}{V_{in}} = \frac{A}{1 + A\beta} \quad \text{—} ④$$

Now consider the expression of A_{CL} obtain-ed and rearranging it similar to eq ④

$$A_{CL} = \frac{A_{OL}(R_1 + R_f)}{R_1 + R_f + R_1 A_{OL}}$$

dividing numerator and denominator by $(R_1 + R_f)$

$$\therefore A_{CL} = \frac{\dfrac{A_{OL}(R_1 + R_f)}{R_1 + R_f}}{1 + \dfrac{A_{OL}R_1}{R_1 + R_f}}$$

$$A_{CL} = \frac{A_{OL}}{1 + A_{OL}\left(\frac{R_1}{R_1 + R_f}\right)} \quad \text{— (5)}$$

comparing the eq (4) and (5) we get,

$A = A_{OL}$ = forward path gain

$\beta = \frac{R_1}{R_1 + R_f}$ - f/b path gain

$$\therefore A_{CL} = \frac{A_{OL}}{1 + A_{OL}\beta}$$

Ideally $A_{OL}\beta \gg 1$ hence $1 + A_{OL}\beta \approx A_{OL}\beta$

$$A_{CL} = \frac{1}{\beta} = \frac{R_1 + R_f}{R_1} = 1 + \frac{R_f}{R_1}$$

$$A_{CL} = \frac{1}{\beta} \quad \text{(ideal)}$$

92.

CONTROL SYSTEM

Unit -2

get,

LONG

Q2. The input is unit impulse
i.e. $r(t) = \delta(t)$

$$\therefore R(s) = L[\delta(t)] = 1$$

Given,

$$G(s) = \frac{C(s)}{R(s)} = \frac{9}{s^2+4s+9}$$

$\beta \approx A_{OL}\beta$

As $R(s) = 1$

R_f

R_1

$$\therefore C(s) = R(s)\cdot\frac{9}{s^2+4s+9}$$

$$= \frac{9}{s^2+4s+9}$$

$$C(s) = \frac{9}{s^2+4s+4+9-4}$$

$$= \frac{9}{(s+2)^2+(\sqrt{5})^2}$$

$$c(s) = \frac{9}{\sqrt{5}}\left[\frac{\sqrt{5}}{(s+2)^2+(\sqrt{5})^2}\right]$$

Taking inverse laplace transfer function

$$c(t) = \frac{9}{\sqrt{5}} e^{-2t} \sin\sqrt{5}\, t$$

$$\left\{\because L^{-1}\left[\frac{\omega}{(s+a)^2+\omega^2}\right] = e^{-at}\sin\omega t\right\}$$

Unit - 05

Q1. Freq response of lag compensator –

Consider the general form of lag compensator,

$$G_c(s) = \frac{(s+1/T)}{(s+1/\beta T)} = \frac{(sT+1)/T}{(s\beta T+1)/\beta T} = \beta\frac{(1+sT)}{(1+s\beta T)}$$

sinusoidal transfer function of lag compensator is obtained by letting $s=j\omega$ in the above equation

$$\therefore G_c(j\omega) = \frac{\beta(1+j\omega T)}{(1+j\omega\beta T)} \quad \text{—} (1)$$

When $\omega = 0$, $G_c(j\omega) = \beta$ — (2)

From eq (2) we can say that the lag compensator provides a dc gain of β (here $\beta > 1$). If the dc gain of the compensator is not desirable then it can be eliminated by a suitable attenuation.

Let us assume that the gain β is eliminated by a suitable attenuation n/w. Now, $G_c(j\omega)$ is given by

$$G_c(j\omega) = \frac{1+j\omega T}{1+j\omega\beta T} = \frac{\sqrt{1+(\omega T)^2}\ \angle \tan^{-1}\omega T}{\sqrt{1+(\omega\beta T)^2}\ \angle \tan^{-1}\omega\beta T} \quad \text{—③}$$

The sinusoidal transfer function shown in eq ③ has two corner frequencies and they are denoted as ω_{c1} and ω_{c2}.

$$\text{Here, } \omega_{c1} = \frac{1}{\beta T} \text{ and } \omega_{c2} = \frac{1}{T}$$

since, $\beta T > T$, $\omega_{c1} < \omega_{c2}$

$$\text{Let, } A = |G_c(j\omega)| \text{ in db} = 20\log\frac{\sqrt{1+(\omega T)^2}}{\sqrt{1+(\omega\beta T)^2}} \quad \text{—④}$$

At very low frequencies i.e. upto ω_{c1}, $\omega T \ll 1$ and $\omega\beta T \ll 1$.

$$\therefore A \approx 20\log 1 = 0$$

In the freq range from ωc_1 to ωc_2, $\omega T \ll 1$ and $\omega\beta T \gg 1$

$$\therefore A \approx 20\log\frac{1}{\sqrt{(\omega\beta T)^2}} = 20\log\frac{1}{\omega\beta T}$$

At very high frequencies i.e after ω_{C2}, $\omega T \gg 1$ and $\omega\beta T \gg 1$.

$$\therefore A \approx 20 \log \frac{\sqrt{(\omega T)^2}}{\sqrt{(\omega\beta T)^2}} = 20 \log \frac{1}{\beta}$$

The approx. magnitude plot of lag compensator is in fig below. The mag. plot of Bode plot of $G_c(j\omega)$ is a straight line through 0 db to ω_{C1}, then it has a slope of -20 db/dec upto ωC_2 and after ω_{C2} it is a straight line with a const gain of $20 \log\left(\frac{1}{\beta}\right)$.

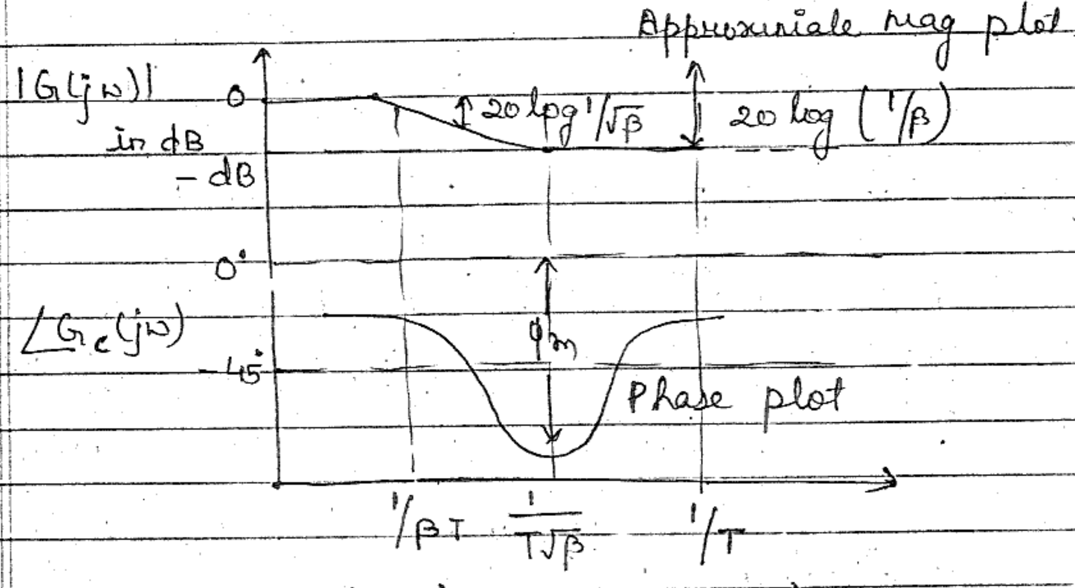


Fig- Bode plot of lag compensator

Let $\phi = \angle G_c(j\omega)$

$$\therefore \phi = \tan^{-1} \omega T - \tan^{-1} \omega\beta T$$

As $\omega \to 0$, $\phi \to 0$
As $\omega \to \infty$, $\phi \to 0$

As ω is varied from 0 to ∞, the phase angle decreases from 0 to a -ve max value of ϕ_m at $\omega = \omega_m$, then increases from this max to 0. The phase plot of lag compensator is shown above. It can be shown that that freq at which max phase lag occurs is the geometric mean of two corner freq.

Freq of max phase lag, $\omega_m = \sqrt{\omega_{c_1} \omega_{c_2}}$

$$= \sqrt{\frac{1}{\beta T} \cdot \frac{1}{T}} = \frac{1}{T\sqrt{\beta}}$$

From the bode plot of lag compensator, we observe that lag compensator has a dc gain of unity while it offers a high freq gain of $\left(\frac{1}{\beta}\right)$. It means that the high freq noise is attenuated in passing through the n/w and so the signal to noise ratio is improved. A typical choice of $\beta = 10$.

Q2. Freq response of lead compensator –

Consider the general form of lead compensator

$$G_c(s) = \frac{s + 1/T}{s + \frac{1}{\alpha T}} = \frac{(1+sT)/T}{(1+s\alpha T)/\alpha T} = \alpha \frac{(1+sT)}{(1+\alpha sT)} \longrightarrow (1)$$

The sinusoidal transfer function of lead compensator is obtained by letting $s = j\omega$ in eq ①.

$$\therefore G_c(j\omega) = \alpha \frac{(1+j\omega T)}{(1+j\alpha\omega T)} \quad — ②$$

When $\omega = 0$, $G_c(j\omega) = \alpha \quad — ③$

From eq ③ we can say that the lead compen. provides an attenuation of α (Here $\alpha < 1$). If the attenuation of the compensator is not desirable then it can be eliminated by suitable amplifier.

Let us assume that the attenuation α is eliminated by a suitable amplifier network. Now, $G_c(j\omega)$ is given by,

$$G_c(j\omega) = \frac{1+j\omega T}{1+j\omega\alpha T} = \frac{\sqrt{1+(\omega T)^2} \angle \tan^{-1}\omega T}{\sqrt{1+(\omega\alpha T)^2} \angle \tan^{-1}\omega\alpha T} \quad — ④$$

Sinusoidal transfer function shown in ④ has two corner freq ω_{c_1} and ω_{c_2}.

Here, $\omega_{c_1} = \frac{1}{T}$ and $\omega_{c_2} = \frac{1}{\alpha T}$.

$\because T > \alpha T$, $\omega_{c_1} < \omega_{c_2}$

$$\text{Let } A = |G_c(j\omega)| \text{ in db} = 20 \log \frac{\sqrt{[1+(\omega T)^2]}}{\sqrt{1+(\omega\alpha T)^2}} \quad — ⑤$$

At very low frequencies i.e. upto ω_{c1}, $\omega T << 1$ and $\omega \alpha T << 1$.

$$\therefore A = 20 \log 1 = 0$$

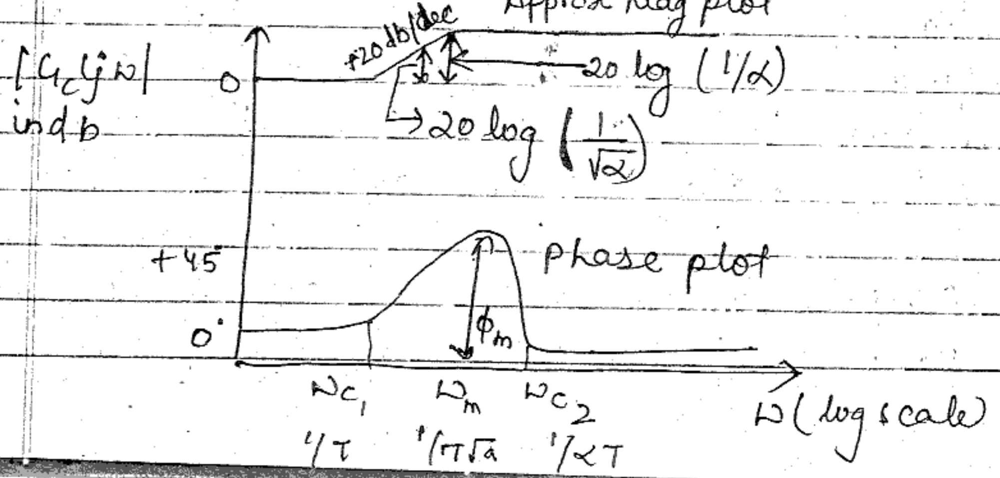
In the frequency range from ω_{c1} to ω_{c2}, $\omega T >> 1$ and $\omega \alpha T << 1$.

$$\therefore A \approx 20 \log \sqrt{(\omega T)^2} = 20 \log (\omega T)$$

At very high frequencis i.e. after ω_{c2}, $\omega T >> 1$ and $\omega \alpha T >> 1$.

$$\therefore A = 20 \log \frac{\sqrt{(\omega T)^2}}{\sqrt{(\omega \alpha T)^2}} = 20 \log \frac{1}{\alpha}$$

The approx. magnitude plot of lead compensator is shown in fig. The magnitude plot of Bode plot of $G_c(j\omega)$ is a straight line through 0 db upto ω_{c1}, then it has a slope of +20 db/decade upto ω_{c2} and after ω_{c2}, it is a straight line with constant gain of $20 \log \left(\frac{1}{\alpha}\right)$.



Let $\phi = \angle G_c(j\omega)$

$\therefore \phi = \tan^{-1} \omega T - \tan^{-1} \omega \alpha T$

As $\omega \to 0$, $\phi \to 0$

As $\omega \to \infty$, $\phi \to 0$

As ω is varied from 0 to ∞, the phase angle increases from 0 to a max value of ϕ_m at $\omega = \omega_m$, then decreases from this max value to 0.

It can be shown that the freq at which max phase lead occurs is the geometric mean of the two corner frequencies

Freq of max phase lead, $\omega_m = \sqrt{\omega_{c_1} \cdot \omega_{c_2}}$

$$\omega_m = \sqrt{\frac{1}{T} \cdot \frac{1}{\alpha T}} = \frac{1}{T\sqrt{\alpha}}$$

The choice of α is governed by the inherent noise in control system. From the Bode plot of the lead n/w, we observe that the high freq noise s/g are amplified by a factor $\frac{1}{\alpha}$, while the low freq control signal undergo unit amplification. Thus the $\frac{S}{N}$ ratio at the o/p of the lead compensator is poorer than its i/p. To prevent $\frac{S}{N}$ ratio at the o/p from deteriorating excessively, it is recommended that the value of α should not be less than 0.07. A typical choice of $\alpha = 0.6$.

Electronics Circuits - II

Unit - 1

Part - A

Q1. -ve f/b - When part of o/p s/g and i/p signal are in out of phase the f/b is called -ve f/b.

+ve f/b - When i/p s/g and part of o/p s/g are in phase, the f/b is called positive f/b.

Q2. The feedback n/w provides reduced portion of the output as f/b s/l to the i/p mixer n/w.
It is given as

$$V_f = \beta V_o$$

In this β is a feedback factor or f/b ratio. It is used in f/b ckts represents f/b factor which always lies b/w 0 and 1.

Q3. The reciprocal of the sensitivity is called desensitivity. Denoted by D.
It is given as

$$D = 1 + \beta A$$

Sensitivity is given as $\frac{1}{1+\beta A}$.

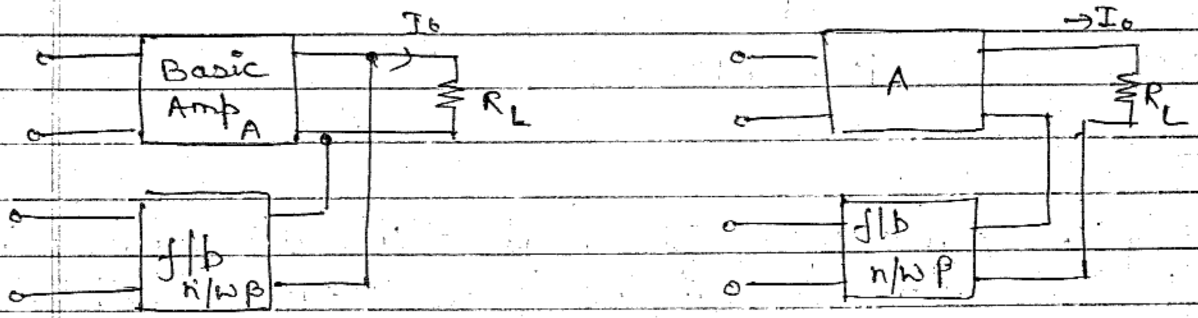
Q4.

Q5.

Q4. There are two ways to sample the o/p a/c to the sampling parameter, either voltage or current.

The o/p voltage is sampled by connecting f/b n/w in shunt across the o/p. This type of connection is referred to as voltage, or ~~nore~~ node sampling.

The o/p current is sampled by connecting the f/b n/w in series with the o/p. This type of connection is referred to as current, or loop, sampling.



a) Voltage or node sampling

b) Current or loop sampling

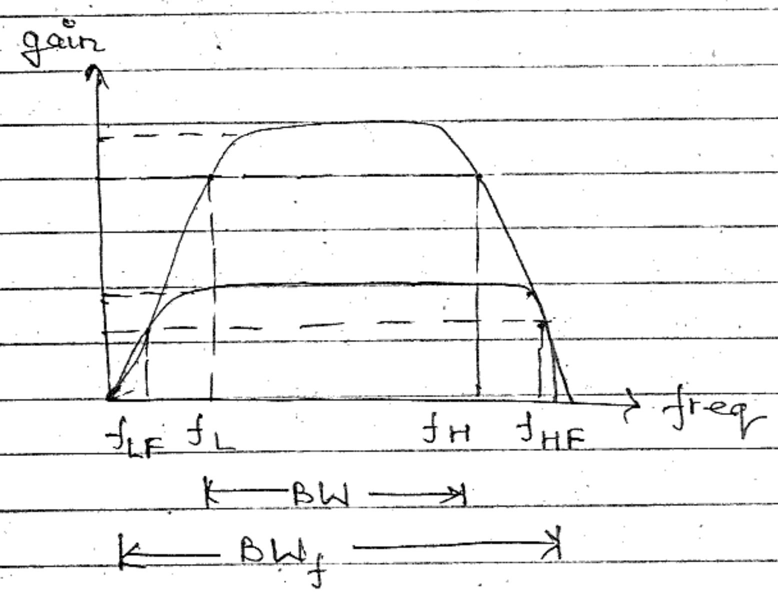
Q5.→ Normally high i/p resistance of a voltage amplifier can be made higher but in +ve f/b it doesn't happens.

→ In case of -ve f/b low output resistance of a voltage amplifier can be lowered.

→ The proper use of -ve f/b improves freq response of amplifier.

→ There is a significant improvement in the linearity of operation of f/b amplifier compare with that of the amp without f/b. Q8.

Q6.



Q11.

Q12.

Q7. Effect of -ve f/b on gain - In this case gain decreases by the factor $(1+A\beta)$ by which the band width increases. The gain-bW product of an amplifier does not altered.

Effect on distortion - The frequency distortion reduces and noise distortion also reduces in the amplifier due to the -ve f/b. Q13.

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compare

gain
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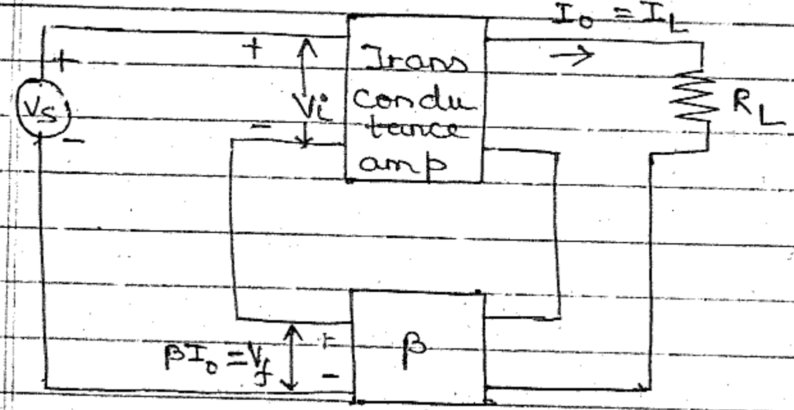
stortion
ces in

Q8. The fractional change in amplification with f/b divided by the fractional change without f/b is called sensitivity of the transfer gain.

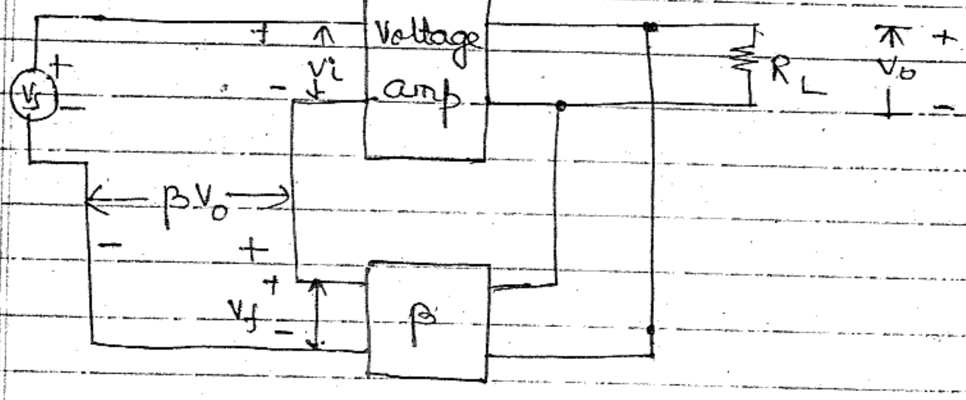
$$\text{Sensitivity} = \frac{1}{(1+\beta A)}$$

Q11.
- Voltage amplifier with voltage series f/b
- Transconductance amplifier with current series f/b
- Current amplifier with current shunt f/b.
- Transresistance amp with voltage shunt f/b

Q12.



Q13.



Q14 $A_{vf} = \frac{A_v}{1+A_v\beta} = \frac{600}{1+600\times0.01} = 85.71$

Q15 → In case of voltage series and current series the input impedance increases and o/p impedances decreases in voltage series and increase in current series.

→ In case of current shunt and voltage shunt the i/p impedance decreases and o/p impedance increases in current shunt and decreases in voltage shunt.

Q18 There are three types of f/b connection

1) Sampling n/w
2) F/b n/w
3) Mixer n/w

Q20. The open loop gain can be defined as the gain without feedback.

Q25 $A_{vf} = \frac{A_v}{1+A_v\beta} = \frac{200}{1+2\times0.05}$

$= \frac{200}{1.1} = 181.81$

Q23.

Q24.

Q17.

Q21

Q23.

Positive f/b amp	Negative f/b amp
• Input signal and part of the output which is fed back to the i/p are in phase, the f/b is called +ve f/b.	• When the i/p signal and part of the o/p which is f/b fed back to i/p are not in phase i.e. out of phase, the f/b is called -ve f/b.
• ~~An~~ Oscillators works on this principle.	• Amplifiers works on this principle.

Q24. In emitter follower circuit the voltage series feedback has been used.

Q17. Gain of closed loop i.e. gain with feedback is given by

$$A_V = \frac{A_v}{1 + A_v \beta}$$

where,

A_v = open loop gain i.e. gain without feedback

β = f/b factor

Q21. -ve f/b is employed in high gain amplifier because

- It improves frequency response of amplifier
- Normally high i/p resistance of a voltage amp can be made higher.

- Normally low o/p resistance of a voltage amplifier can be lowered.

ltage

Unit - 2

Part - A

Q1. Q factor of the crystal is very high, typically 20,000. Value of Q upto 10^6 also can be achieved.

Q2. Classification of oscillators - 2-8
→ Based on the output waveform
→ Based on the circuit components
→ Based on the range of operating frequencies
→ Based on whether f/b is used or not.

Q3. and Q5. The Barkhausen Criterion states that :-
i) The total phase shift around a loop as the signal proceeds from i/p through ampli, f/b n/w back to i/p again, completing a loop, is precisely 0° or 360°, or of course an integral multiple of 2π radians.
ii) The mag. of the product of the open loop gain of the amp (A) and the f/b factor β is unity i.e. $|A\beta| = 1$.

Q6. The piezoelectric effect means under the influence of the mechanical pressure, the voltage gets generated across the opposite faces of the crystal. If the mechanical force is applied in such a way to force the crystal to vibrate, the a.c. voltage gets generated across it. Conversely, if the crystal is subjected to a.c. voltage, it vibrates causing mechanical distortion in the crystal shape.

Q7.

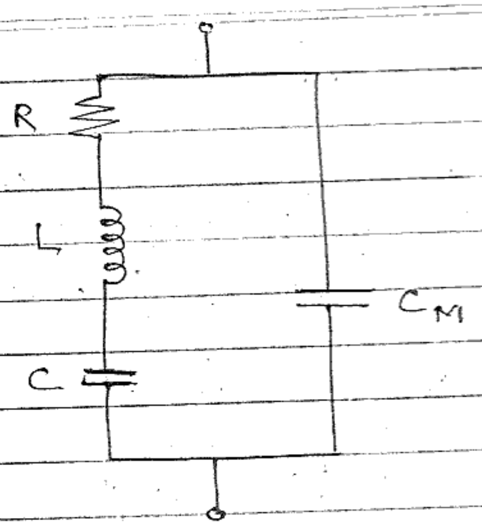


Fig. Equivalent ckt of a crystal

Q8. It is similar to the modification in colpitts oscillator, the Hartley oscillator ckt can be modified to get Miller crystal oscillator, In Hartley osc. ckt, two ~~rea~~ inductors and one capacitor is required in the tank ckt. One inductor ~~in it~~ is replaced by the crystal which acts as an inductor for the frequencies slightly greater than the series resonant frequency.

Q9. The freq for RC phase shift oscillator is

$$f = \frac{1}{2\pi RC\sqrt{4K+6}}$$

This is the freq at which $\angle A\beta = 0°$.
At the same freq $|A\beta| = 1$.

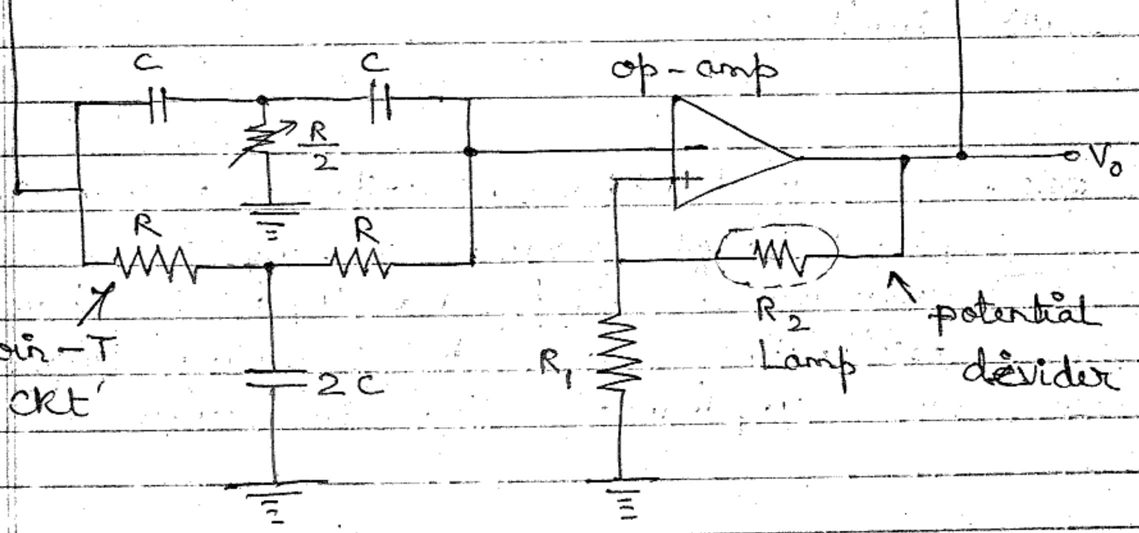
Q10. An oscillator is a ckt which biasically act as a generator, generating the o/p signal which oscillates with constant amplitude and constant desired frequency.

It works on the principle of +ve f/b.

Q11.

Amplifier	Oscillator
• It is a device which is used to amplify the signal to desired level.	• It is a device which acts as a generator, generating o/p s/l which oscillates with const amp and desired freq.
• It works on the principle of −ve f/b.	• It works on the principle of +ve f/b.

Q13. Ckt diagram of Twin-T RC oscillator –



Q14. i) The freq is stable and accurate but in case of colpitt osc. the freq is not stable.

ii) It is the good frequency stability.

iii) The stray ~~or~~ capacitances have no effect on C_3 which decides the freq.

iv) Keeping C_3 variable, freq can be varied in desired range.

Q15. The positive feedback is used in oscillator because whenever the part of the o/p that is fed back to the amplifier as its input, is in phase with the original i/p signal applied to the amplifier.

Q16. The crystal oscillator has a 2-64 higher degree of frequency stability because of

i) the temp stability

ii) Long term stability

iii) Short " "

Q22. A/c to Barkhausen criterion, when total phase shift around a loop is 0° or 360° ensuring +ve f/b and $|A\beta| = 1$ then the oscillations are with constant frequency and amplitude called sustained oscillations.

Q19. i) RC oscillators [Wien Bridge Oscillators]

ii) Twin - T oscillator

They L F oscillators

Q20. i) L C oscillators

ii)

They are H F oscillators

Q21. When total phase shift around a loop is 0° or 360° but $|A\beta| < 1$ then the oscillations are called damped oscillation i.e. such oscillation amplitude decreases exponentially and the oscillations finally cease.

Q24. Freq. of oscillation for Hartley

$$f = \frac{1}{2\pi\sqrt{C L_{eq}}}$$

where, $L_{eq} = L_1 + L_2$

Freq of oscillation for colpitt

$$f = \frac{1}{2\pi\sqrt{L C_{eq}}}$$

where,

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

Q18.

RC oscillator	LC oscillator
• The oscillators using components resistor and capacitor are called RC oscillator.	• The oscillators using the component inductor and capacitor are called LC oscillator.
• They are used at low freq range of 20 HZ to 100-200 kHz.	• They are used at high freq range more than 200 - 300 kHz upto GHz.

Q23.

Q25. Given,

$$L_1 = 0.2 \text{ mH}$$
$$L_2 = 0.3 \text{ mH}$$
$$C = 0.003 \mu F$$

$$L_{eq} = L_1 + L_2 = 0.2 + 0.3 = 0.6 \text{ mH}$$

$$C = 0.003 \mu f = 0.003 \times 10^{-10} F$$

$$\therefore f = \frac{1}{2\pi \sqrt{L_{eq} C}}$$

$$f = \frac{1}{2\pi \sqrt{0.6 \times 10^{-3} \times 0.003 \times 10^{-10}}}$$

$$= \frac{1}{2\pi \sqrt{0.0006 \times}}$$

Q23. It is difficult to have a variable frequency operation in a RC phase shift oscillator because if R and C will be changed then the values of R and C of all three sections must be changed simultaneously to satisfy the oscillating conditions. But it is not possible so, the phase shift oscillator is considered as a fixed freq oscillator.

Unit - 3

Part - A

Q5.
→
→
→
Q6.
Q7.
I)
II)
III)
i)
ii)

Q1. To amplify the selective range of frequencies, the resistive load, R_c is replaced by a tuned circuit.

The tuned ckt is capable of amplifying a signal over a narrow band of frequencies centered at f_r. The amplifiers with such a tuned ckt as a load are Known as tuned amplifier.

Q2. In order to obtain a high overall gain, several identical stages of tuned amplifiers can be used in cascade. The overall gain is the product of the voltage gains of the individual stages. All amplifier stages are assumed to be identical and to be tuned to the same freq. ω_0. This is called synchronous tuning and amplifier is called synchronously tuned amplifier.

Q4. Unloaded Q is the ratio of stored energy to dissipated energy in a reactor or ~~reas~~ resonator.

The loaded Q, or Q_L, of a resonator is determined by how tightly the resonator is coupled to its terminations.

Q5. There are three types of coil losses

→ Copper loss - total loss of coil is called copper loss. $\propto \frac{1}{f}$.

→ Hysteresis loss - It is independent of freq. It is proportional to area enclosed by the hyterisis loop.

→ Eddy current - It is due to the current flowing within the copper or core cased by inductor. It heated the copper or core $\propto f$.

Q6. The Q is the ratio of reactance to resistance. The Q factor also can be defined as the measure of efficiency with which inductor can store the energy.

Q7. Ad -

I) They amplify defined frequencies.
II) Signal to noise ratio at o/p is good.
III) They are well suited for radio transmitters and receivers.

Dis ad-

i) If the band of freq is increased, design becomes complex.
ii) They are not suitable to amplify audio frequencies.

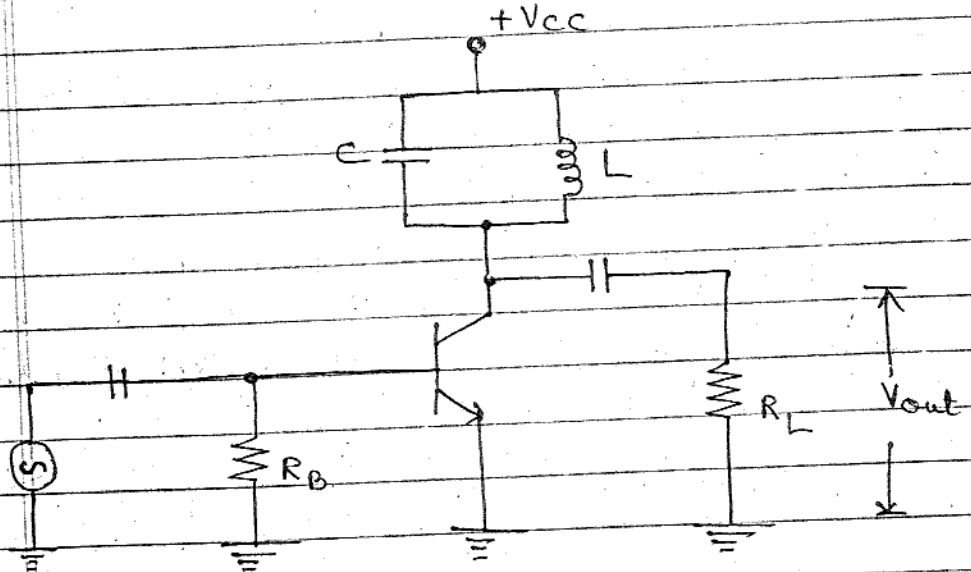
Q9. → Single tuned
→ Double tuned
→ Stragger tuned
→ Synchrorously tuned

Q1 I_i

Q10. * The effect of cascading single tuned amplifiers on bandwidth is that it reduces the BW.

Q20.

Q11.



Tuned class-C amp

Q13. Types of neutralization
→ Hazeltine neutralization
→ Neutrodyne "
→ Neutralization using coil
→ Rice neutralization

tuned
reduces

Q14.

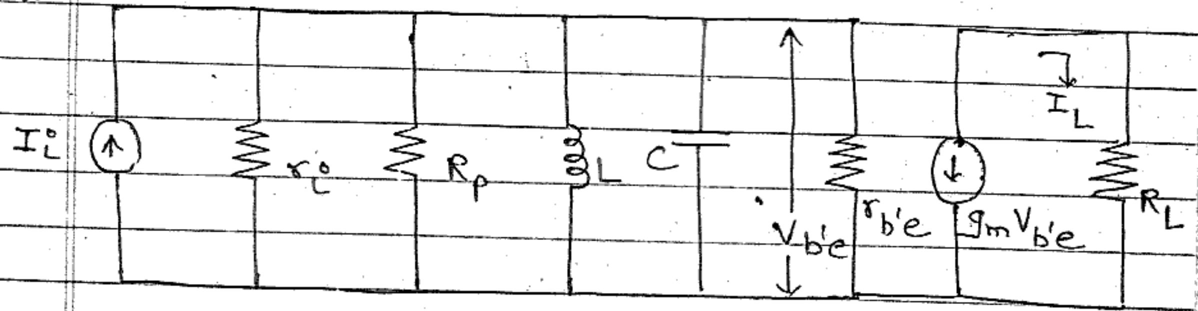


Fig – Equi·ckt of single tuned amp

Q20.

Transmission Line And Wave guides

Unit - 02

Part - B

Q2. Given,

$R = 10\ \Omega/Km$

$L = 3.8\ mH/Km$

$G = 1 \times 10^{-6}\ \mho/Km$

$C = 0.0085\ \mu F/Km$

$f = 1KHz$

$\omega = 2\pi f$

i/p impedance

$$Z = R + j\omega L$$

$$= 10 + j \times 2 \times \pi \times 1000 \times 3.8 \times 10^{-3}$$

$$Z = 10 + j23.86$$

$$Z = 25.87 \angle 67.26\ \Omega$$

$l = 100\ Km$ $\qquad Z_i = 200\ \Omega$

$$Y = G + j\omega C$$

$$= 10^{-6} + j \times 2 \times \pi \times 1000 \times 0.0085 \times 10^{-6}$$

$$= 10^{-6} + j53.38 \times 10^{-6}$$

$$= 53.38 \times 10^{-6} \angle 88.92$$

$$\therefore Z_0 = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{25.87 \angle 67.26}{53.38 \times 10^{-6} \angle 88.92}}$$

$$= \sqrt{\frac{25.87}{53.38 \times 10^{-6}}} \angle \frac{67.26 - 88.92}{2}$$

$$Z_0 = 0.696 \times 10^3 \angle -11.33$$

$$= 696.15 \angle -11.33$$

$$Z_S = Z_0 = 682.5 - j137\ \Omega$$

$$\gamma = \sqrt{ZY}$$

$$= \sqrt{25.87 \angle 67.26 \times 53.38 \times 10^{-6} \angle 88.92}$$

$$= 0.037 \angle 78.09$$

$\times 10^{-3}$

$$\gamma = 0.0076 + j\,0.0362 \text{ per Km}$$

By formula,

Sending end current

$$I_S = \left| \frac{V_i}{Z_i + Z_S} \right|$$

10^{-6}

$$I_S = \left| \frac{1}{200 + 682.5 - j137} \right|$$

$$= \frac{1}{\sqrt{882.5 + (137)^2}} = \cancel{\sqrt{\quad}}\ \cancel{1}$$

8.92

$$= \frac{1}{\sqrt{797575.25}} = \frac{1}{893.07}$$

$$I_S = 1.12 \times 10^{-3} = 1.12 \text{ mA}$$

Reflection co-efficient $= \frac{V_R}{V_S}$

$V_s = |I_s Z_s|$ Q1. and Q21.

$= 1.12 \times 10^{-3} \times \sqrt{(682.5)^2 + (137)^2}$

$= 1.12 \times 10^{-3} \times 696.1$

$= 0.779\ V$ Q2 and Q11

$V_R = V_s e^{-\gamma l}$ $(\because \gamma = \alpha + j\beta)$

$= V_s e^{-(\alpha + j\beta) l}$

$= V_s e^{-\alpha l} \cdot e^{-j\beta l}$

$= 0.779 \times e^{-0.0076 \times 100} e^{-j0.0362 \times 100}$ Q5

$= 0.364 e^{-j3.62}$

$= 0.364 \angle -3.62$ radian

magnitude of $V_R = 0.364\ V$

and $\beta = -3.62$ Q

Co-efficient $= \frac{V_R}{V_s} = \frac{0.364}{0.779}$

$= 0.467$ (Ans)

Unit - 04

Part - A

Q1. and Q21. The symmetrical triggering uses only one trigger i/p to the i/p of any one transistor.

Q2 and Q11 In bistable mv, trigger is required to change the state. The time required to change the state is called transition time. The speed-up capacitors are used to reduce the transition time without affecting the stable states. These capacitor allows fast rise and fall times and avoids the distortion in o/p.

Q5 The bistable mv has two stable states. The mv can exist indefinitely in either of the two stable states. It requires an external trigger pulse to change from one stable state to another. The ckt remains in one stable state unless an external trigger pulse is applied.

Q4. App of schmitt trigger

i) Squaring ckt
ii) Amplitude Comparator
iii) Reference level detector
iv) As a flip-flop in digital ckts

Q9. The basic difference is that in practical ckt, single supply voltage V_{cc} is used, instead of three supply voltages.

Q3.i)

I set

AHKUR