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JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR

I / II -MID TERM PAPER ANSWER SHEET

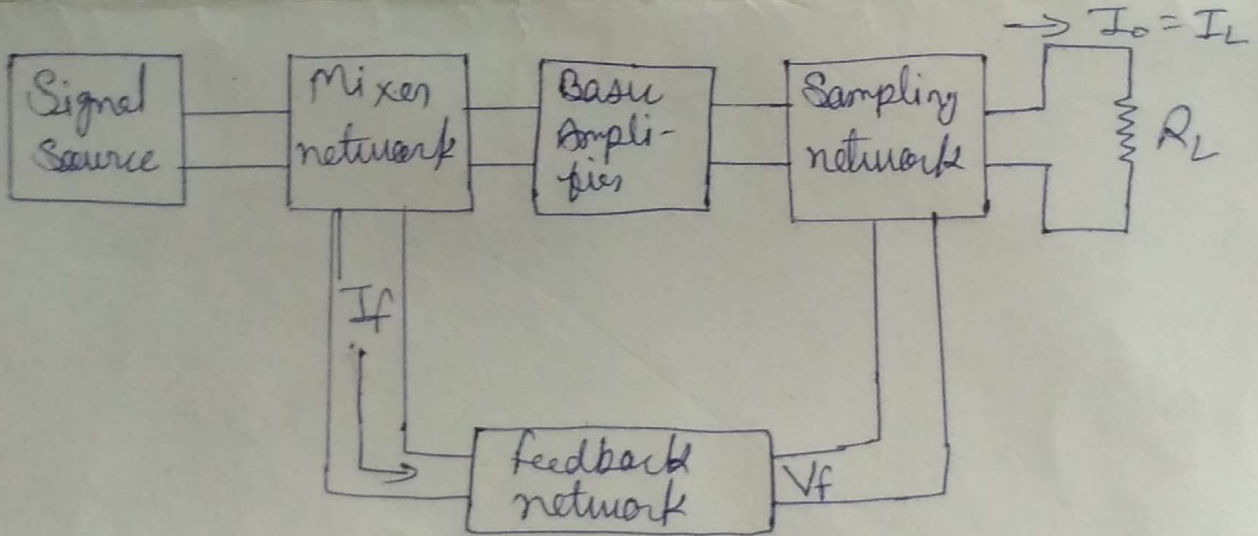
Semester: IV Branch : EE

Subject : Analog Electronics Submitted by : Vimarsh Joshi

Que 1.- Explain the feedback concept in detail with suitable diagram.

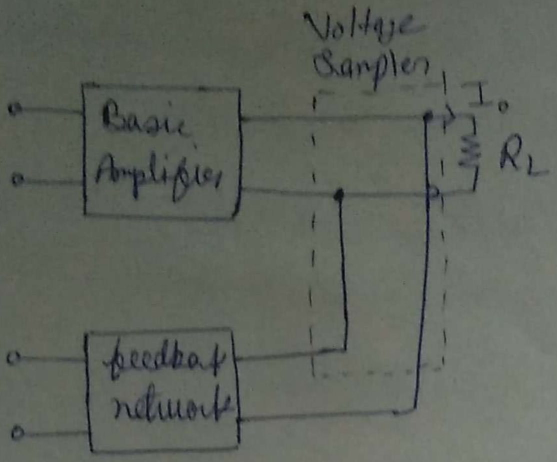
Ans.- Feedback Concept :-

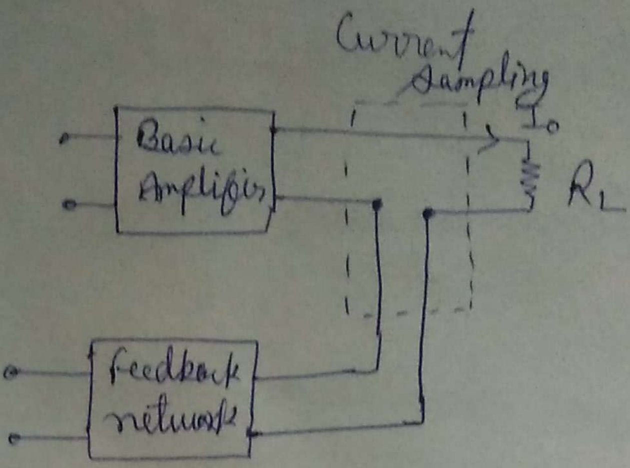
In a feedback process, a part of output is combined with the external input signal. fig 1.2 presents a generalised block diagram of a feedback amplifier. The output quantity is sampled by a suitable sampling network and fed to a feedback network and then combined with an external signal through a mixer network and fed to a basic amplifier



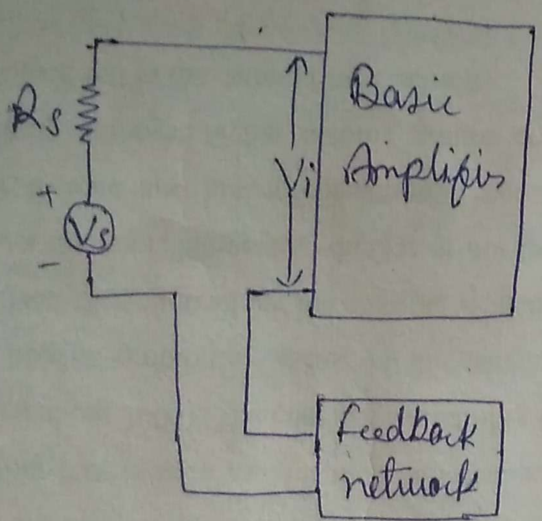
(a) Sampling Network :-

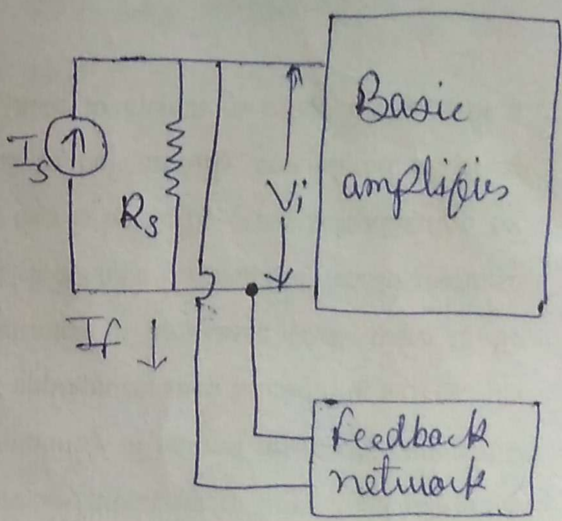
There are two types of sampling voltage or current. The output voltage is sampled by connecting the feedback network in shunt across the output known as voltage sampling and output sampled by connecting feedback network in series with output known as current sampling.





(b) Mixer Network :- Like sampling, there are two ways of mixing, series mixing and shunt mixing. following figure shows these series input and shunt input connection.





(c) Basic Amplifier :-

This can be any of the four basic amp^{rs} we have seen in the previous section.

(D) Feedback Network :-

This is a two port network, where input side is connected to the sampling network and output side is connected to the mixer network.

Que. 2. Explain the general characteristics of negative feedback amplifier in detail.

Ans. Characteristics of negative feedback amplifier are as follows -

① Desensitivity of transfer amplification :->

The gain with feedback is given by the formula -

$$\boxed{A_f = \frac{A}{1+A\beta}}$$

A_f is lessthan A by a factor $(1+A\beta)$, the factor $(1+A\beta)$ is called 'desensitivity' and is denoted by D.

If $A\beta \gg 1$, then $1+A\beta \cong A\beta$ and

$$A_f = \frac{A}{A\beta} = \frac{1}{\beta}$$

It is clear that A_f depends only on β not on gain without feedback A.

② Frequency Distortion :- We have seen that A_f depends on β. Hence if the feedback network is such that it does not have any freq. dependent component, then overall gain is not a function of frequency. Therefore a substantial reduction in frequency is obtained.

③ Non linear Distortion :-

If a large amplitude signal is applied to an amplifier, then it results in distortion in the output signal. Such distortion produces second - harmonic component which is undiserable. Let magnitude of second-harmonic component be B_2. Now let us apply negative feedback to the amplifier. There will reduction in the amplitude of B_2. let it be B_{2f} with feedback.

Now

$$\boxed{B_{2f} = \frac{B_2}{1+B_2\beta}}$$

④ Noise :-

Noise is defined as undesireable signals picked up and amplified by the amplifier. let N be the amplitude of noise in an amplifier without feedback It can be shown that with feedback applied to the ampr the noise will be reduced to N_f, where

$$\boxed{N_f = \frac{N}{1+A\beta}}$$

⑤ Increased Bandwidth :-

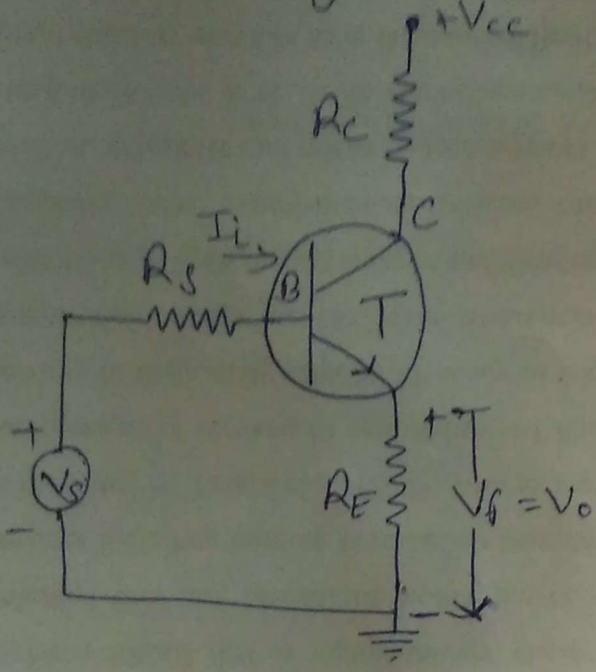
We know that amplifier gain falls off at low and high frequencies. At low frequency, the series capacitance can not be considered as short circuited, so the gain falls off. At higher frequency, the shunt capacitance can not be considered open circuited hence gain falls off. The bandwidth of the amplifier will be $(f_2 - f_1)$. when feedback is applied, the gain of ampr is decreased.

$$\boxed{A_{high} = \frac{A_{mid}}{1+j(f/f_2)}} \qquad \boxed{A_{low} = \frac{A_{mid}}{1-j(f_1/f)}}$$

Que. 3. Explain the analysis of voltage series feedback amplifier with suitable diagram.

Ans. – Voltage-Series feedback topology :-

Circuit diagram –



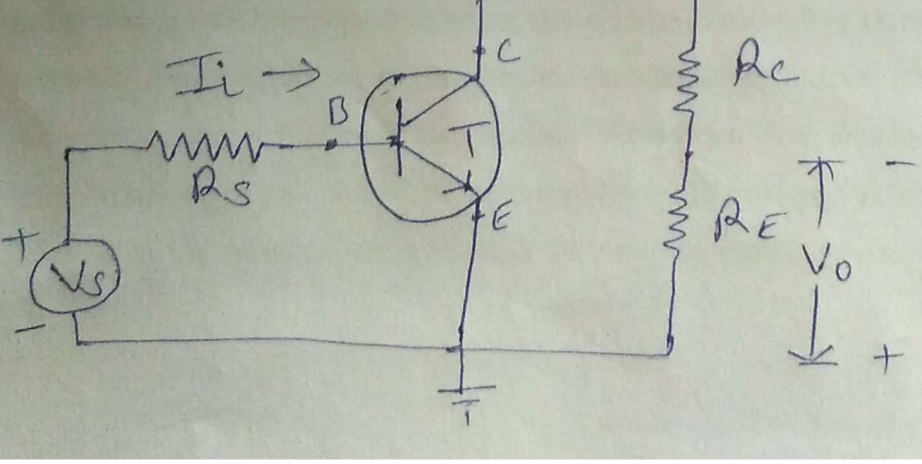
Step-1 → Type of topology used is voltage-series topology.

Step-2 → Input and output ckt. without feedback

Input = Vo (Short circuited)

Output = Ii = 0 (open circuited)

Modified diagram →



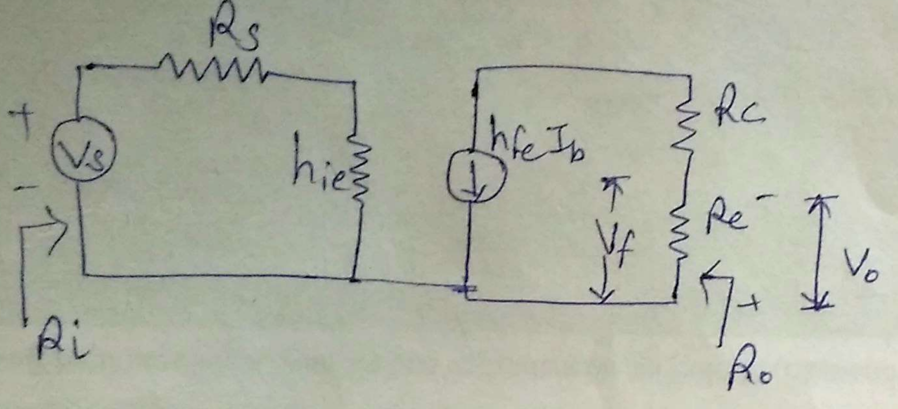
Step-3 → It requis that the source to be thevenin source, but source is already a thevenin source.

Step 4 and 5 → Calculate β -

$$\beta = \frac{\text{Feedback Signal}}{\text{Output Signal}} = \frac{V_f}{V_o} = 1.$$

∵ Both voltage present across R_e.

Step-6 Draw h-parameter Circuit -



Step 7 - Calculate D, A_{vf}, R_{if}, R_{of} and R'_{of}

$$A_v = \frac{V_o}{V_s} = \frac{h_{fe} I_b R_e}{(R_s + h_{ie}) I_b}$$

$$\boxed{A_v = \frac{h_{fe} R_e}{R_s + h_{ie}}}$$

$$D = 1 + A_v \beta$$

$$D = 1 + \frac{h_{fe} R_e}{R_s + h_{ie}} \qquad [\because \beta = 1]$$

$$\boxed{D = \frac{R_s + h_{ie} + h_{fe} R_e}{R_s + h_{ie}}}$$

$$A_{vf} = \frac{A_v}{1 + A_v \beta}$$

$$A_{vf} = \frac{\frac{h_{fe} R_e}{R_s + h_{ie}}}{1 + \frac{h_{fe} R_e}{R_s + h_{ie}}}$$

$$\Rightarrow \boxed{A_{vf} = \frac{h_{fe} R_e}{R_s + h_{ie} + h_{fe} R_e}}$$

$$R_i = R_s + h_{ie}$$

$$R_{if} = R_i \cdot D$$

$$= (R_s + h_{ie}) \times \frac{R_s + h_{ie} + h_{fe} R_e}{(R_s + h_{ie})}$$

$$\boxed{R_{if} = R_s + h_{ie} + h_{fe} R_e}$$

$$\boxed{\begin{array}{l} R_o = \infty \\ \hline R_{of} = \infty \end{array}} \quad \& \quad \boxed{R'_{of} = \frac{R_e(R_s + h_{ie})}{R_s + h_{fe} R_e + h_{ie}}}$$

Que. 4. Explain the defination of oscillator and also explain the Hartley Oscillators in detail.

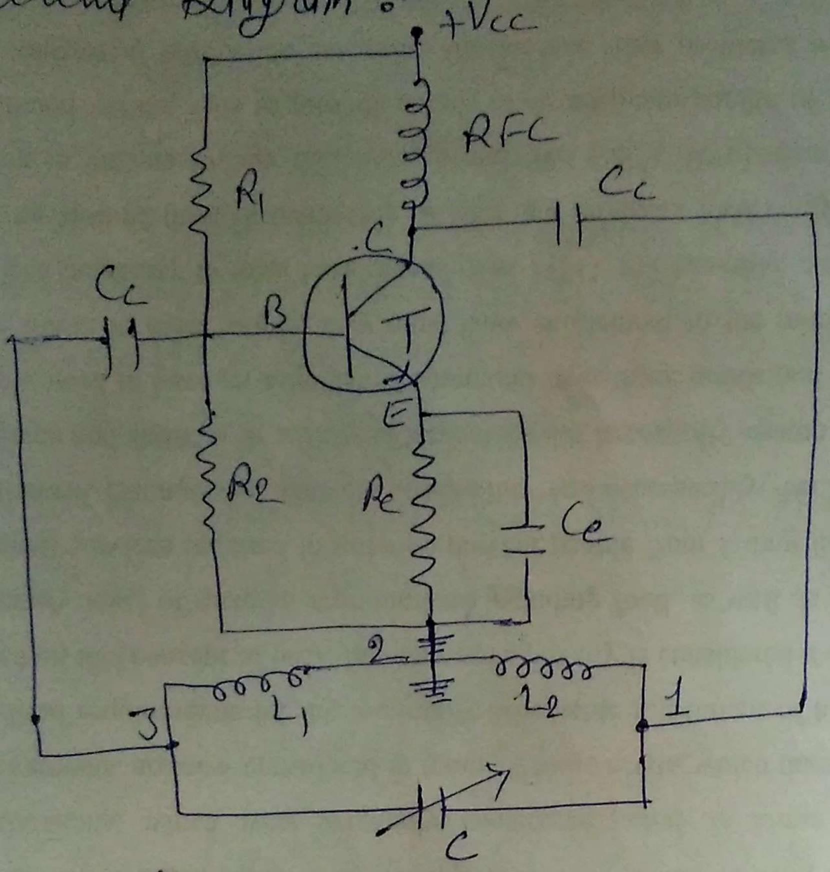
Ans.- Defination of Oscillators :-

An Oscillator is basically a waveform generator, which generate an output waveform which oscillates with constant amplitude and constant desired frequency.

In short, an oscillator is an amplifier which use a positive feedback without any external input signal.

Hartley Oscillator :-

Circuit Diagram :-



Construction :→

(1) R_1, R_2 and R_e resistors are used for biasing purpose.

(2) Coupling Capacitor C_c used to block dc signal & C_e is bypass capacitor.

(3) RFC (Radio Frequency choke) used to
a) prevent radio freq. current from reaching dc supply
b) Prevent dc supply from short ckt the output voltage.

(4) In tank circuit we use two inductors and a variable capacitor.

Working :- Inductor store energy in the form of magnetic field while capacitor store energy in the form of electric field.

When the supply voltage is on a current is set up in tank circuit as a result the starting voltage for oscillation required is provided. This current produce ac voltage across L_1 & L_2.

A transistor shift a phase by 180° and the remaining 180° is provided by tank circuit. Then the total phase shift is of 0° or 360°.

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

The general eqn of LC oscillator is -

$$h_{ie}(Z_1 + Z_2 + Z_3) + Z_1 Z_2 (h_{fe} + 1) + Z_1 Z_3 = 0$$

$$Z_1 = j\omega L_1 ,\ Z_2 = j\omega L_2 ,\ Z_3 = \frac{1}{j\omega C} = \frac{-j}{\omega C}$$

$$h_{ie}\left(j\omega L_1 + j\omega L_2 - \frac{j}{\omega C}\right) - \omega^2 L_1 L_2 (1 + h_{fe}) + \frac{L_1}{C} = 0$$

keep img. part equal to zero -

$$h_{ie}\, j\omega \left(L_1 + L_2 + \frac{1}{\omega^2 C}\right) = 0$$

$$L_1 + L_2 = \frac{1}{\omega^2 C}$$

$$\omega = \frac{1}{\sqrt{(L_1 + L_2)C}}$$

$$\Rightarrow \boxed{f = \frac{1}{2\pi\sqrt{(L_1 + L_2)C}}}$$

To determine Condition of oscillation real part Should be zero.

$$\Rightarrow -\omega^2 L_1 L_2 (1+h_{fe}) + \frac{L_1}{C} = 0$$

$$\omega^2 L_2 (1+h_{fe}) = \frac{1}{C}$$

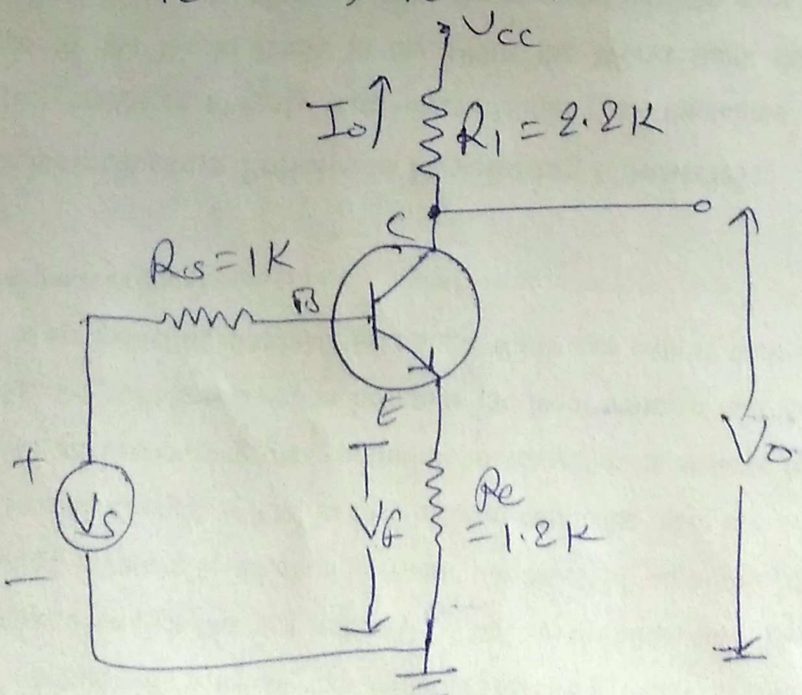
$$\omega^2 = \frac{1}{(1+h_{fe}) L_2 C}$$

$$\frac{1}{(L_1+L_2)C} = \frac{1}{(h_{fe}+1) L_2 C}$$

$$(1+h_{fe}) L_2 = L_1 + L_2$$

$$\Rightarrow \boxed{h_{fe} = \frac{L_1}{L_2}}$$

Que. 5. Calculate D, G_{mf}, A_{vf}, R_{if}, R_{of}, R'_{of} for the circuit shown below. The transistor parameters are $h_{ie} = 1.1K$, $h_{fe} = 50$, $h_{oe} = h_{re} = 0$.



$$G_M = \frac{-h_{fe}}{R_s + h_{ie} + R_e}$$

$$G_M = \frac{-50}{1\times10^3 + 1.1\times10^3 + 1.2\times10^3} = 0.05$$

$$\beta = -R_e$$

$$\beta = -1.2\times10^3$$

(i) $D = 1 + \beta G_M = 1 + 1.2\times10^3 \times 0.015 = 19.18$

(ii) $G_{Mf} = \frac{G_M}{D} = \frac{0.015}{19.18} = 0.782\times10^{-3}$

(iii) $A_{vf} = G_{Mf} R_L$

$$= 0.782\times10^{-3} \times 2.2\times10^3 = 1.72$$

(iv) $R_{if} = R_i D = (R_s + h_{ie} + R_e) D$

$$= (1\times10^3 + 1.1\times10^3 + 1.2\times10^3) \times 19.18$$

$$= 632.94 K\Omega$$

(v) $R_o = \infty$ and $R_{of} = R_o\, D = \infty$

(vi) $R'_{of} = R_{of} \parallel R_L$

$$\boxed{R'_{of} = 2.2 K\Omega}$$

This question paper contains (5) no. of printed page.

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I-Mid Term Examination Session 2017-2018

B.Tech II Year IV Semester

Branch: EE	**Subject: CA-II**
Time: 02:00-3:30	**Subject Code: 4EE2A**
Date: 06 -03-18	**Max. Marks: 20**

Note: Attempt any four questions out of five questions.

Attempt any four questions out of following five questions

Q.1 Explain series connection of two port network with suitable diagram.

ANS:

4.8.2 Series-Series Connection

The parameters of two 2-port networks connected in series-series connection can be expressed in the terms of Z-parameters consider the figure 4.9.

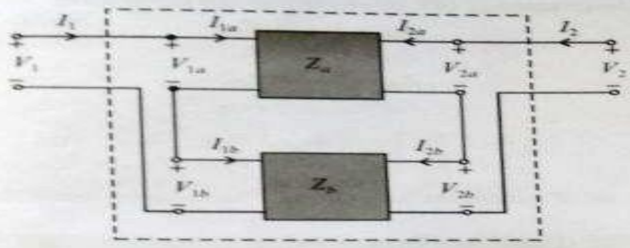


Figure 4.9 Series-series connection of two 2-port networks

Using Z-parameters, we can write the set of equations for networks Z_a

$$V_{1a} = Z_{11a} I_{1a} + Z_{12a} I_{2a}$$
$$V_{2a} = Z_{21a} I_{1a} + Z_{22a} I_{2a}$$

for network Z_b

$$V_{1b} = Z_{11b} I_{1b} + Z_{12b} I_{2b}$$
$$V_{2b} = Z_{21b} I_{1b} + Z_{22b} I_{2b}$$

and for overall network

$$\left.\begin{aligned} V_1 &= Z_{11} I_1 + Z_{12} I_2 \\ V_2 &= Z_{21} I_1 + Z_{22} I_2 \end{aligned}\right\} \quad .....(4.89)$$

from figure 4.9, we have

$$I_1 = I_{1a} = I_{1b},\ I_2 = I_{2a} = I_{2b}$$

and

$$V_1 = V_{1a} + V_{1b},\ V_2 = V_{2a} + V_{2b}$$

Thus,

$$\begin{aligned} V_1 &= V_{1a} + V_{1b} \\ &= Z_{11a} I_{1a} + Z_{12a} I_{2a} + Z_{11b} I_{1b} + Z_{12b} I_{2b} \\ &= Z_{11a} I_1 + Z_{11b} I_1 + Z_{12b} I_2 + Z_{12b} I_2 \\ &= (Z_{11a} + Z_{11b}) I_1 + (Z_{12a} + Z_{12b}) I_2 \end{aligned} \quad .....(4.90)$$

and

$$\begin{aligned} V_2 &= V_{2a} + V_{2b} \\ &= Z_{21a} I_{1a} + Z_{22a} I_{2a} + Z_{21b} I_{1b} + Z_{22b} I_{2b} \\ &= (Z_{21a} + Z_{21b}) I_1 + (Z_{22a} + Z_{22b}) I_2 \end{aligned} \quad .....(4.91)$$

By comparing equation (4.89), (4.90) and (4.91), we have

$$Z_{11} = Z_{11a} + Z_{11b}$$
$$Z_{12} = Z_{12a} + Z_{12b}$$
$$Z_{21} = Z_{21a} + Z_{21b}$$
$$Z_{22} = Z_{22a} + Z_{22b}$$

Hence

$$\begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} Z_{11a} + Z_{11b} & Z_{12a} + Z_{12b} \\ Z_{21a} + Z_{21b} & Z_{22a} + Z_{22b} \end{bmatrix} \quad .....(4.92)$$

Therefore, the Z-parameters of individual series-series connected two 2-port networks are added.

Q.2 check whether the given polynomial are Hurwitz or not?

(a) $P(s) = s^4+s^3+5s^2+3s+4$

ANS;

ANS-2

a>.

$P(s) = s^4 + s^3 + 2s^2 + 3s + 2$

$E(s) = s^4 + 2s^2 + 2$

$O(s) = s^3 + 3s$

Now CFE

$$s^3+3s\ \big)\ s^4 + 2s^2 + 2\ \big(\ s \quad (+ve)$$
$$s^4 + 3s^2$$
$$-s^2+2\ \big)\ s^3 + 2s\ \big(\ -s \quad (+ve)$$
$$s^3 \mp 2s$$
$$4s\ \big)\ -s^2 + 2\ \big(\ -\frac{s}{4} \quad (+ve)$$
$$\mp s^2$$
$$2\ \big)\ 4s\ \big(\ 2s \quad (+ve)$$
$$4s$$
$$\times$$

For Hurwitz

all quatents terms are +ve.

(b) $P(s) = s^4+3s^2+2$

Solution: Since $P(s)$ contains only even polynomials, let us take its derivative $P'(s) = 4s^3 + 6s$. Now continued fraction expansion

$$4s^3+6s\ \big)\ s^4+3s^2+2\ \big(\ \frac{s}{4}$$
$$s^4+\frac{6}{4}s^2$$
$$\frac{3}{2}s^2+2\ \big)\ 4s^3+6s\ \big(\ \frac{3}{8}s$$
$$4s^3+\frac{16}{3}s$$
$$\frac{2}{3}s\ \big)\ \frac{3}{2}s^2+2\ \big(\ \frac{9}{2}s$$
$$\frac{3}{2}s$$
$$2\ \big)\ \frac{2}{3}s\ \big(\ \frac{s}{3}$$
$$\frac{2}{3}s$$
$$\times$$

ANS: Since all quotients in the continued fraction expansion are positive, $P(s)$ is Hurwitz.

Q.3 checks whether following function are PRF function.

$$Y(s) = \frac{s^2+6s+10}{S+10}$$

ANS:

Since all the quotient terms of $y(s)$ are real, therefore for real s, $y(s)$is real. Also the poles and zeros lie on the left half of the s-plane. Now let us see the positive realness of the given in $j\omega$-domain.

$$Re[y(j\omega)] = Re\left[\frac{(j\omega)^2+2(j\omega)+20}{(j\omega)+10}\right] \times \frac{-j\omega+10}{-j\omega+10}$$

$$= Re\left[\frac{j\omega^3+2\omega^2-20j\omega-10\omega^2+20j\omega+200}{\omega^2+100}\right]$$

$$= \frac{-8\omega^2+200}{\omega^2+100}$$

Since for all values of ω, $Re[y(j\omega)] \ngeq 0$, that means given funciton is not a positive real function.

Q.4 design Cauer-1 and Cauer-2 form for given transfer function.

$$Z_{LC}(s) = \frac{s(s^2+4)(s^2+6)}{(s^2+1)(s^2+5)}$$

Q.5 Write short notes on following:

(a) Z-parameter

ANS: Z parameters

We will get the following set of two equations by considering the variables V_1& V_2 as dependent and I_1 & I_2 as independent. The coefficients of independent variables, I_1 and I_2 are called as Z parameters.

V1=Z11I1+Z12I2V1=Z11I1+Z12I2

V2=Z21I1+Z22I2V2=Z21I1+Z22I2

The Z parameters are

Z11=V1I1,whenI2=0Z11=V1I1,whenI2=0

Z12=V1I2,whenI1=0Z12=V1I2,whenI1=0

Z21=V2I1,whenI2=0Z21=V2I1,whenI2=0

Z22=V2I2,whenI1=0Z22=V2I2,whenI1=0

Z parameters are called as impedance parameters because these are simply the ratios of voltages and currents. Units of Z parameters are Ohm (Ω).

We can calculate two Z parameters, Z_{11} and Z_{21}, by doing open circuit of port2. Similarly, we can calculate the other two Z parameters, Z_{12} and Z_{22} by doing open circuit of port1. Hence, the Z parameters are also called as open-circuit impedance parameters.

(b) H-parameter

ANS: h-parameters

We will get the following set of two equations by considering the variables V_1& I_2 as dependent and I_1 & V_2 as independent. The coefficients of independent variables, I_1 and V_2, are called as h-parameters.

$$V1=h11I1+h12V2V1=h11I1+h12V2$$

$$I2=h21I1+h22V2I2=h21I1+h22V2$$

The h-parameters are

$$h11=V1I1,whenV2=0h11=V1I1,whenV2=0$$

$$h12=V1V2,whenI1=0h12=V1V2,whenI1=0$$

$$h21=I2I1,whenV2=0h21=I2I1,whenV2=0$$

$$h22=I2V2,whenI1=0h22=I2V2,whenI1=0$$

h-parameters are called as hybrid parameters. The parameters, h_{12} and h_{21}, do not have any units, since those are dimension-less. The units of parameters, h_{11} and h_{22}, are Ohm and Mho respectively.

We can calculate two parameters, h_{11} and h_{21} by doing short circuit of port2. Similarly, we can calculate the other two parameters, h_{12} and h_{22} by doing open circuit of port1.

The h-parameters or hybrid parameters are useful in transistor modelling circuits (networks).

(s) Pole and Zero concepts

ANS;

For a given general network function $F(s)$, it can be expressed as the ratio of two polynomials as written below:

$$F(s) = \frac{P(s)}{Q(s)} = \frac{a_0 s^n + a_1 s^{n-1} + \ldots + a_{n-1} s + a_n}{b_0 s^m + b_1 s^{m-1} + \ldots + b_{m-1} s + b_m} \quad \ldots(2.15)$$

where the coefficients a_0 to a_n and b_0 to b_m are real and positive for a network containing passive elements only and no controlled sources. In this equation n denotes the degree of numerator polynomials and m denotes the degree of denominator polynomials. Therefore, the numerator and the denominator polynomials can be expressed in terms of their factors. For $P(s) = 0$, the numerator has n roots, say $z_1, z_2, \ldots, z_n$. Similarly for the equation $Q(s) = 0$, the denominator has m roots, say $p_1, p_2, \ldots, p_n$. Hence the network function can be written as:

$$F(s) = \frac{P(s)}{Q(s)} = \frac{a_0(s - z_1)(s - z_2)\ldots(s - z_n)}{b_0(s - p_1)(s - p_2)\ldots(s - p_m)} \quad \ldots(2.16)$$

where $a_0/b_0 = H$ is a constant which is known as scale factor and $z_1, z_2, \ldots, z_n$, $p_1, p_2, \ldots, p_n$ are the complex frequencies. The values of s, for which $F(s)$ has zero value, are called as the zeros of $F(s)$ and the values of s, for which $F(s)$ has infinite value, are called as the poles of $F(s)$. A finite zero or a finite pole has a finite value. The zeros are denoted by 0 and the poles are denoted by × on s-plane. The network function is completely defined by its poles and zeros. If the poles or zeros are not repeated, then the function is said to be having simple poles or simple zeros. If the poles or zeros are repeated, then the function is said to be having multiple poles or multiple zeros. Total number of zeros equals total number of poles. If $n > m$, then $(n-m)$ zeros are at $s = \infty$ and for $m > n$, then $(m-n)$ poles are at $s = \infty$. This can be explained easily by taking an example, so let the network function

$$F(s) = \frac{s(s+5)}{(s+1)(s+2+j3)(s+2-j3)} \quad \ldots(2.17)$$

Here, the network function has two zeros at $s = 0$ and $s = -5$. Also the network function has three finite poles at $s = -2-j3$, $s = -2+j3$ and $s = -1$. These zeros and poles can be shown at the s-plane as shown in figure 2.6. Hence there is included a zero at $s=\infty$ in order to make the number of zeros equal to number of poles.

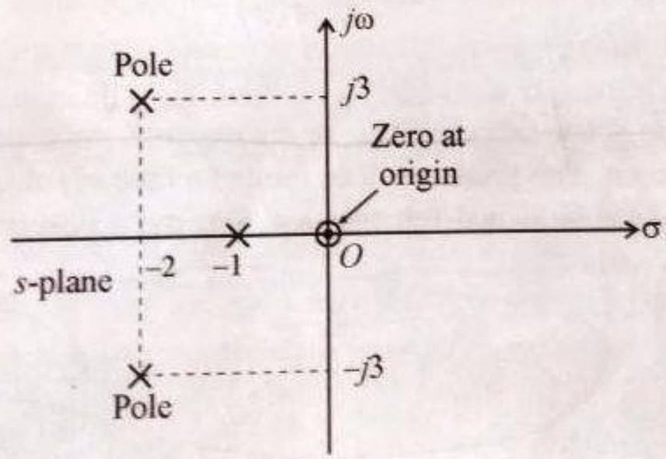


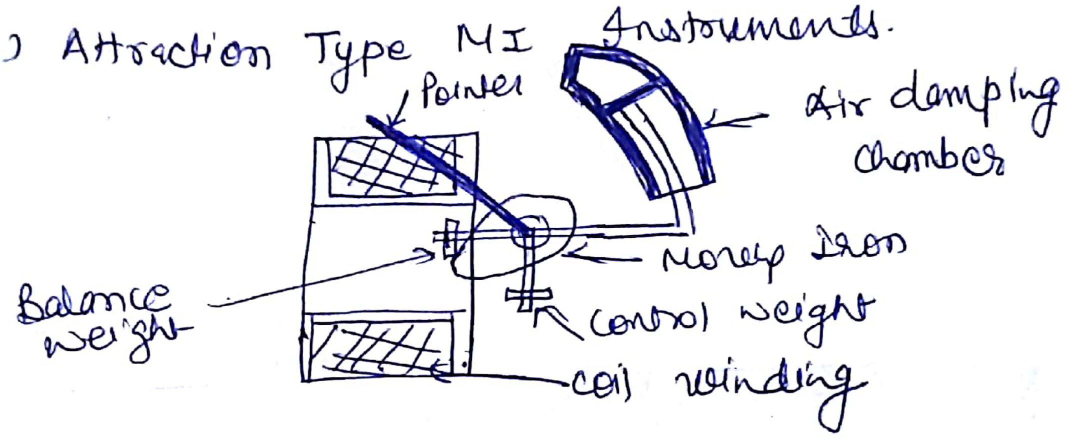
Figure 2.6 Plot of zeros and poles of a given network function $F(s)$

Semester: IV Branch : EE

Subject : EM Submitted by : Axli Gupta

Ans 1. There are two types of MI instruments
(a) Attraction Type MI Inst.
(b) Repulsion type MI Instr.

(a) Attraction Type MI Instruments.



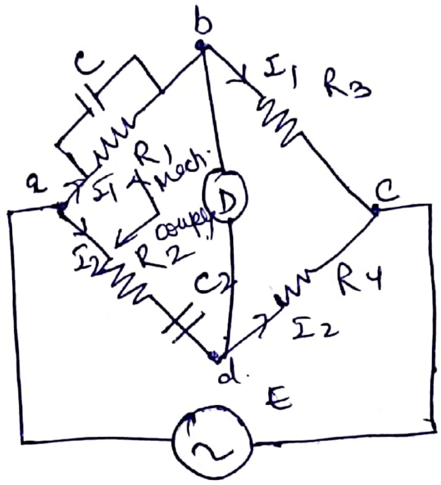
The flat coil is used having a narrow slot. It also has a MI mounted. When current flows through the coil, a magnetic field is produced and the moving iron moves. Spring control is used. The air friction damping is provided with the light Al piston which moves in a chamber. When current flows through the coil, a mag. field is produced and moving iron moves from the weaker field to stronger field.

(b) Repulsion type - It is also of two types -
(i) Radial Vane type - In this type, there are two vanes which are radial strips of iron. The strips are placed within the coil. The fixed vane is attached to coil & movable is to spind

(2)

(iii) Coaxial vane type - In this fixed and moving vans are sections of co-axial cylinders. when the current flows through the coil, the two vanes are magnetised. The repulsion tends to seperate the irons the resulting torque rotates the moving system.

Ans 2. Weins bridge is used for determination of frequency in terms of values of various bridge elements.



At balance condition

$$\left(\frac{R_1}{1+j\omega C_1 R_1}\right) R_4 = \left(R_2 - \frac{j}{\omega C_2}\right) R_3$$

or $$\frac{R_4}{R_3} = \frac{R_2}{R_1} + \frac{C_1}{C_2} + j\left(\omega C_1 R_2 - \frac{1}{\omega C_2 R_1}\right)$$

Equating real and imaginary part

$$\frac{R_4}{R_3} = \frac{R_2}{R_1} + \frac{C_1}{C_2}$$

and $$\omega C_1 R_2 - \frac{1}{\omega C_2 R_1} = 0$$

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$\Rightarrow \omega = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$

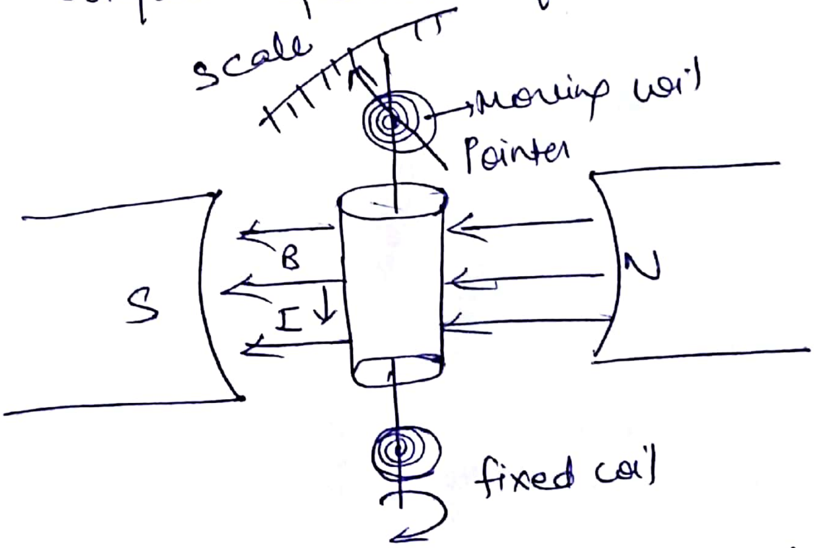
and $2\pi f = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$

$\Rightarrow f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$ Hz

In most wein's bridge $R_1 = R_2$ & $C_1 = C_2$

So $\boxed{f = \frac{1}{2\pi RC}}$

Ans 3. Torque equation of PMMC –



Assume there are N turns of wires, coil length L and width W.

The force F ⊥er to both current & mag. field

$F = NBIL$ —— (1)

The deflecting torque Td is equal to multiplication of force with distance to pt. of suspension

for one side of cylinder

T_d = force × distance

$$= NBIL \times \frac{W}{2}$$

for other side

$$T_{d2} = NBIL \times \frac{W}{2}$$

$$T_d = T_{d1} + T_{d2} = NBILW$$
$$= NBIA \quad \text{—— (2)}$$

where A = Area of coil

This torque will cause the coil to rotate untill an equilliburium position is reached at an angle (θ) with original position

$$T_c = K\theta \quad \text{—— (3)}$$

K = spring const.
θ = Angle of deflection

At steady state position

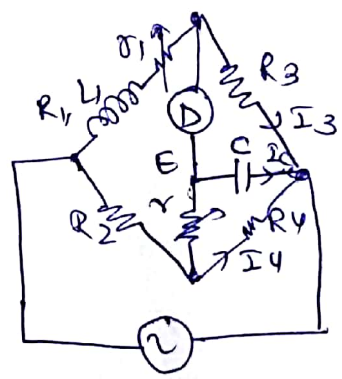
$$T_d = T_c$$

$$NBIA = K\theta$$

$$\theta = \frac{NBA}{K} \cdot I = C \cdot I$$

$$\boxed{\theta \propto I}$$

Ans 4.



L_1 = unknown self Inductance
r_1 = resistance connected in series with L_1

C = fixed standard capacitor

At balance

$I_1 = I_3$, & $I_2 = I_C + I_4$

At balance, for loop BCEB

$$I_1 R_3 = I_C \times \frac{1}{j\omega C}$$

$$\therefore I_C = I_1 j\omega C R_3 \quad \text{--- (1)}$$

for loop ABEDA

$$I_1 (R_1 + r_1 + j\omega L_1) = I_2 R_2 + I_C r \quad \text{--- (2)}$$

for loop CEDC

$$I_C \left(r + \frac{1}{j\omega C} \right) = I_4 R_4$$

or $$I_C \left(r + \frac{1}{j\omega C} \right) = (I_2 - I_C) R_4 \quad \text{--- (3)}$$

from (1), (2) & (3)

$$I_1 (R_1 + r_1 + j\omega L_1) = I_2 R_2 + I_1 j\omega C R_3 . r$$

or $$I_1 (R_1 + r_1 + j\omega L_1 - j\omega C R_3 r) = I_2 R_2 \quad \text{--- (4)}$$

& $$I_1 j\omega C R_3 \left(r + \frac{1}{j\omega C} \right) = (I_2 - I_1 j\omega C R_3) R_4$$

or $$I_1 (j\omega C R_3 r + j\omega C R_3 R_4 + R_3) = I_2 R_4 \quad \text{--- (5)}$$

from (4) & (5)

$$\Rightarrow \frac{I_1}{R_2} (r_1 + R_1 + j\omega L_1 - j\omega C R_3 r) = \frac{I_1}{R_4} (j\omega C R_3 r + j\omega C R_3 R_4 + R_3)$$

equating real & imaginary part

$$r_1 + R_1 = \frac{R_2}{R_4} R_3$$

$$\text{or } R_1 = \frac{R_2 R_3}{R_4} - r_1 \quad \text{—— (6)}$$

$$\& \quad j\omega(L_1 - CR_3 r) = \frac{R_2}{R_4} j\omega CR_3(r + R_4)$$

$$\boxed{L_1 = \frac{CR_3}{R_4}\left[r(R_4 + R_2) + R_2 R_4\right]}$$

Ans 5 $\quad T_c = 240 \times 10^{-6}$ Nm

$T_d = NBIA$

$= 3I$ Nm

At steady state condition

$T_c = T_d$

$3I = 240 \times 10^{-6}$

$I = 80 \times 10^{-6}$ A

Let resistance R

so voltage $= 80 \times 10^{-6} R$

volts/division $= \frac{80 \times 10^{-6}}{200} R$

$R = 2.5 \times 10^{6}\ \Omega$ Ans

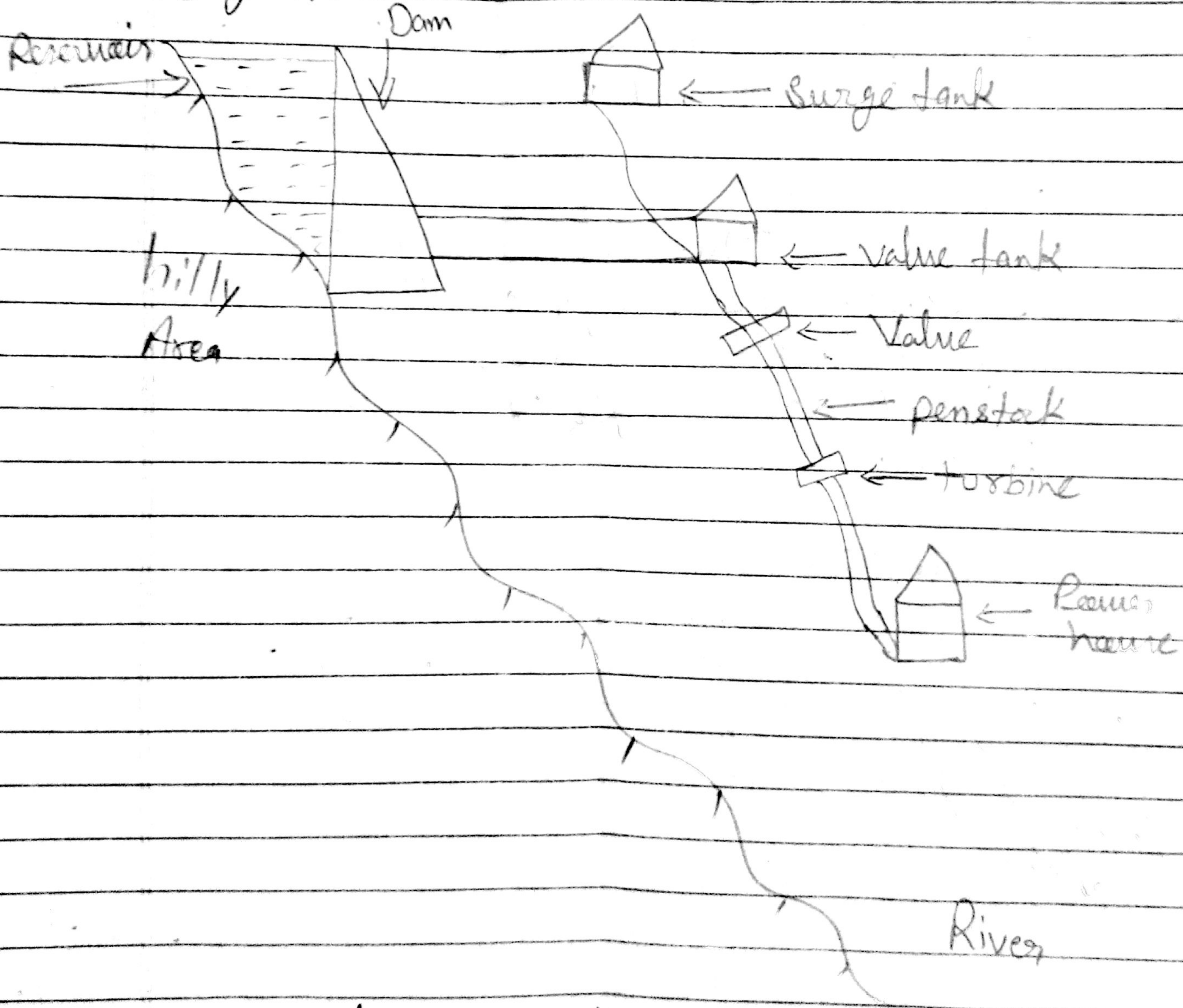
Aman Chopra [Dept of GE]

Que. 1. Explain hydro power plant with neat and clean diagram.

Ans. Hydro Power Plant :-

Hydro power plant consist of a surge tank, penstock and hydraulic turbine for generation of electric energy. The hilly areas are choosen for such plant.

Diagram :->



The plant is stabilized at the availability of water is large. There may be designed as the under the earth or outside the earth.

The parts of power plant are described as follows :-

(i) Surge tank ⇒

When the water having the higher level at a time with high pressure. The water body should maintain the same pressure at a constant velocity. to prevent the water hammer's to the penstock and turbine the surge tank is used. The level of water so pressure is also changed, So water surge tank is required to the handle the water hammer and unstable pressure.

(ii) Valve tank :->

This is placed at the near by surge tank. for the supply of the water to the penstock and the turbine same time the two different valve stock are used for penstock and turbine.

(iii) Penstock :->

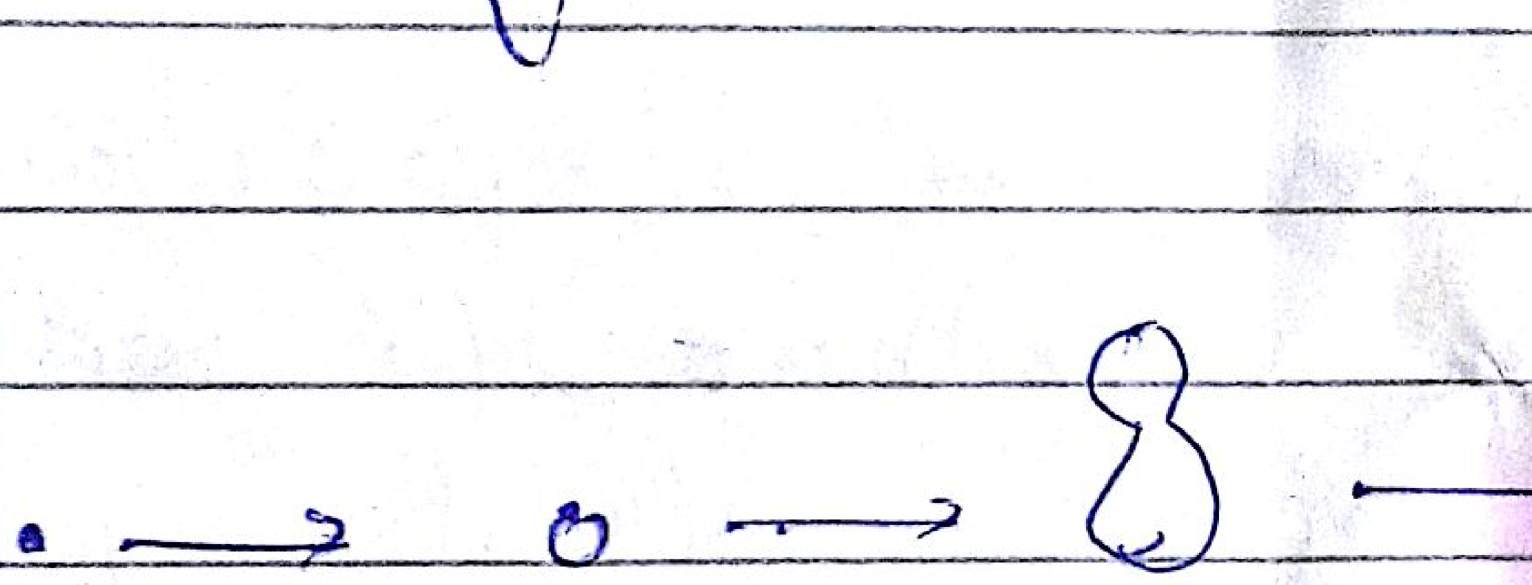
Penstock are used to pass the water from surge tank and valve tank. These are made of normally steel or concrete. The water is passed to turbine through penstock.

(iv) Hydralic turbine :->

The hydro power plant the kinetic energy is converted into electric energy by generator.

(V) Power House :->

The electricity is passed to power



U^{225}

Fig: Nuclear Fusion.

Reaction:-

$${}_{92}U^{232} + {}^{1}_{0}n \longrightarrow {}^{139}_{56}Ba +$$

$${}^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{106}_{42}Mo$$

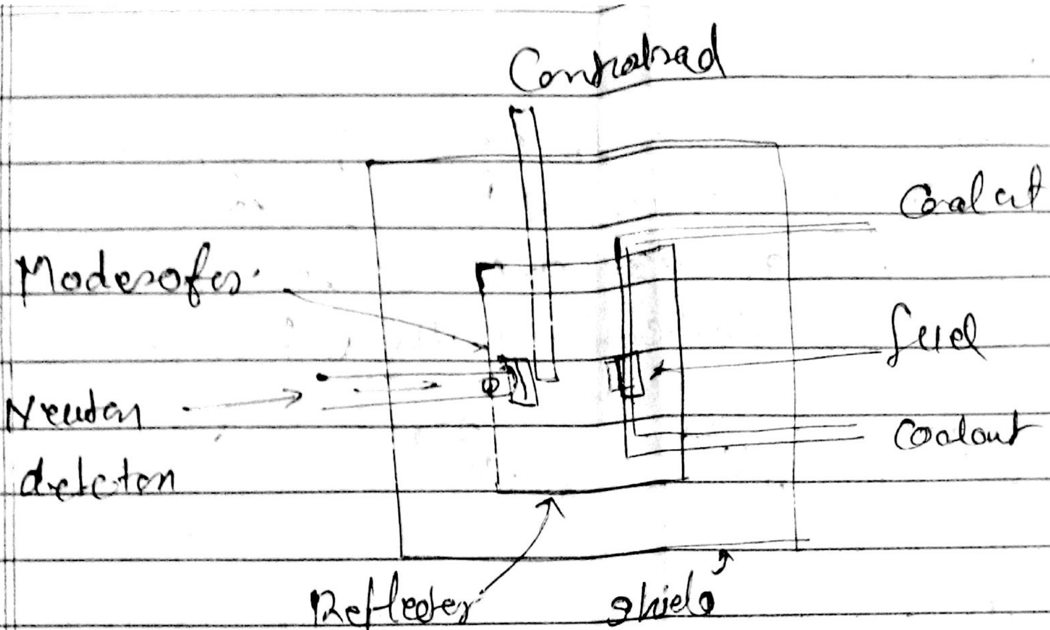
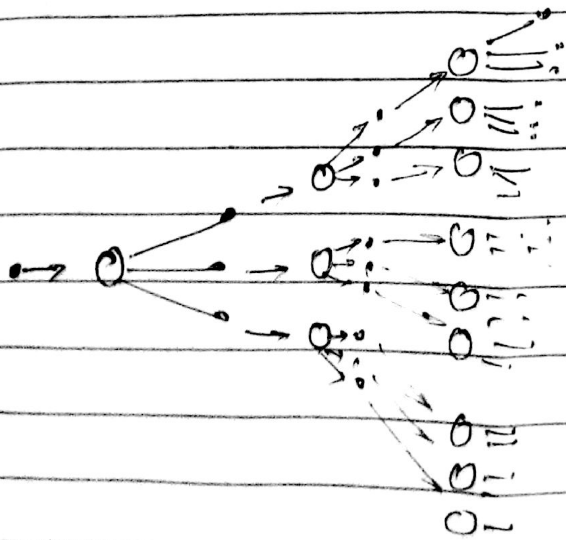


Fig: Nuclear Reactor:

Nuclear fission

The process of propagation of reaction by multiplication in there of each fission, is called chain reaction. Nuclear power plant have controlled types of chain reaction to generate energy.

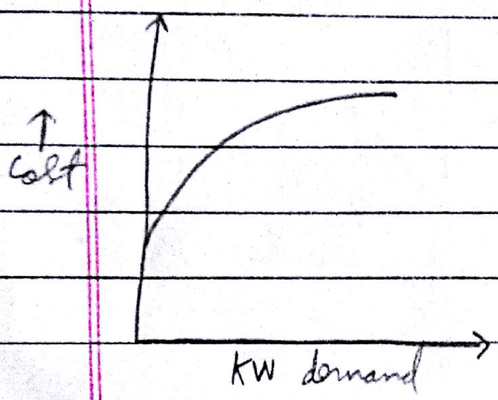
(i) Control nuclear fission:
(ii) Un-control nuclear fission.

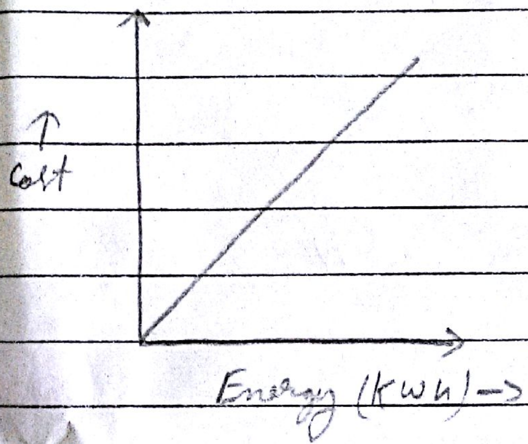


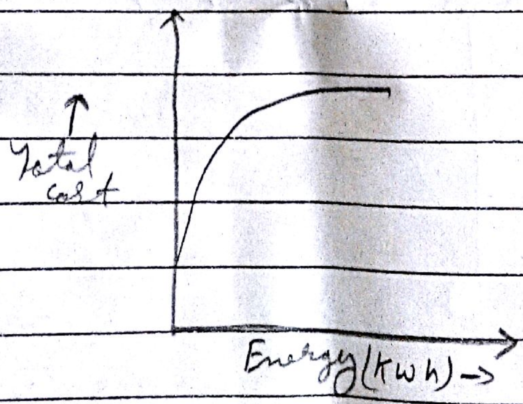
Q Explain two part tariff & three part tariff :-

Sol. ⇒ Two part tariff :-

In this tariff, the total charges are based on max." demand & energy consumed.





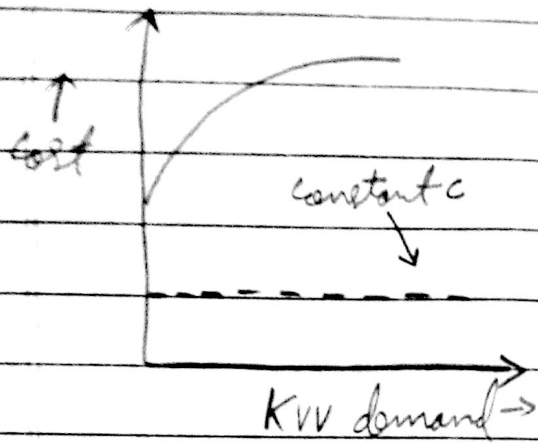


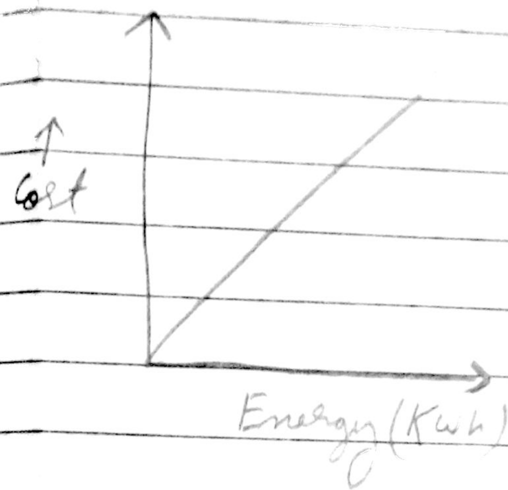
⇒ It is expressed as,

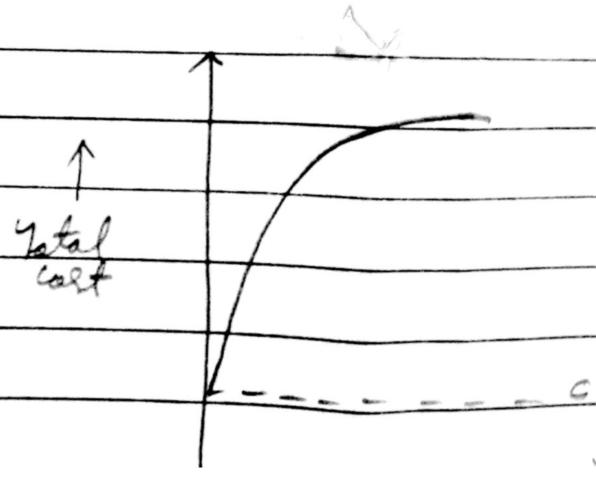
$$y = Dx + Ez$$

A separate meter is req." to record the max." demand. This tariff is used for industrial or heavy loads.

Acc. to this tariff the consumer pays some amount in addition to charges for max. demand and energy consumed.







Question: Explain Selection and location of power plants.

Answer: List down the factors to be considered for selection of site for thermal power plant:

1. Availability of Coal: A thermal plant of 400m. Capacity requires nearly 6000 tons of Coal every day.
- power plant should be located near Coal mines.

2. Ash Disposal facilities: Ash comes out in hot condition and handling is difficult
- The ash can be disposed into sea or river

3. Water availability: water consumption is more as feed water into boiler condenser and for ash disposal. Hence plant should be located near water source.

4. Transport facility: the plant should be far away from residential area to avoid nusiance from smoke. Fly ash and noise

5. Nature of land: land (soil) should have good bearing capacity to withstand dead Load of plant

7. Distance from load centre: Most of the time the electric power generated in a hydro electric power to be economical on transmission the routs and the distances should be carefully considered since the cost of construction of transmission lines and their maintenance will depend upon the route selected.

8. Access to site: it is always a desirable factor to have a good access to the site of the plant. this factor is very

Q. Give the Comparative of study of thermal, Hydro, Nuclear power plant.

Ans.

Thermal power plant	Nuclear power plant	Hydro power plant.
(1) Thermal power plant Convert heat or Coal Energy into Electrical energy.	(1) they Convert lay heavy metal elements like uranium (235) into electrical or heat energy	(1) hydro power plant Convert steam energy or (water vapour into Electrical energy.
(2) The main Sources of thermal power plant is Coal in bulk	(2) Sources req? to generate electricity is heavy metals like uranium, thorium etc.	(2) Reqn Sources to produce electricity is water or steam
(3) In thermal power plant Coal and ash Storage is required for generation	(3) In Nuclear p. p. Nuclear Reactor is used to Convertor	(3) hydro power plant has Condenser or Cooling ~~plant~~ fans

(4) Thermal power plant produce energy 5-6 gels them supply to nearly substations

(4) Nuclear power plant is main source to produce electricity but in the, the workers works very protected covers because a single radiation attack or body to damaged part

(4) hydro p.p is good in generation bech. the Reservoir is menor in india to produce electricity

(5) Its source is less day-by-day after some years its production is stop due to non-availaility of Coal in earth surface

(5) Sources of Nuclear p.p. also less on earth. so it is also stop in future

(5) Source of Hydro p.p. is not end because the Reservious is bulk in India.

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JNIT

JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR

4 I/II -MID TERM PAPER ANSWER SHEET

Semester: IV Branch : Electrical

Subject : Electrical Machine -II Submitted by : Anena Sharma

Q5. Calculate the highest Speed at which (a) 50Hz (b) 60Hz alternator can be operated?

Ans - $\uparrow N_s = \frac{120f}{P\downarrow}$

highest Speed means lowest Number of Pole.

Let the minimum number of Pole is $P = 2$

$$N_s = \frac{120f}{P}$$

(a) $N_s = \frac{\cancel{120}^{6} \times 50}{\cancel{2}} = 3000$ R.P.M

(b) $N_s = \frac{\cancel{120}^{60} \times 60}{\cancel{2}} = 3600$ R.P.M

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Q1. Explain the Double field revolving theory of Single phase Induction Motor?

Ans - The double revolving field theory of single phase induction motors basically states that a stationary pulsating magnetic field can be resolved into two rotating magnetic fields, each of equal magnitude but rotating in opposite directions.

equation for an alternating magnetic field whose axis is fixed in space is given by -

$$b(\alpha) = B_{max} \sin \omega t \cos \alpha \quad \ldots \quad (1)$$

where, B_{max} is the maximum Value of the Sinusoidally distributed air-gap flux.

$$\sin A \cos B = \frac{1}{2} \sin(A-B) + \frac{1}{2} \sin(A+B)$$

$$b(\alpha) = \frac{1}{2} B_{max} \sin(\omega t - \alpha) + \frac{1}{2} B_{max} \sin(\omega t + \alpha).$$

$\frac{1}{2} B_{max} \sin(\omega t - \alpha)$ = equation of a revolving field moving in positive 'α' direction.

$\frac{1}{2} B_{max} \sin(\omega t + \alpha)$ = equation of a revolving field moving in negative 'α' direction.

since,

$\frac{1}{2} B_{max} \sin(\omega t - \alpha)$ is the forward field

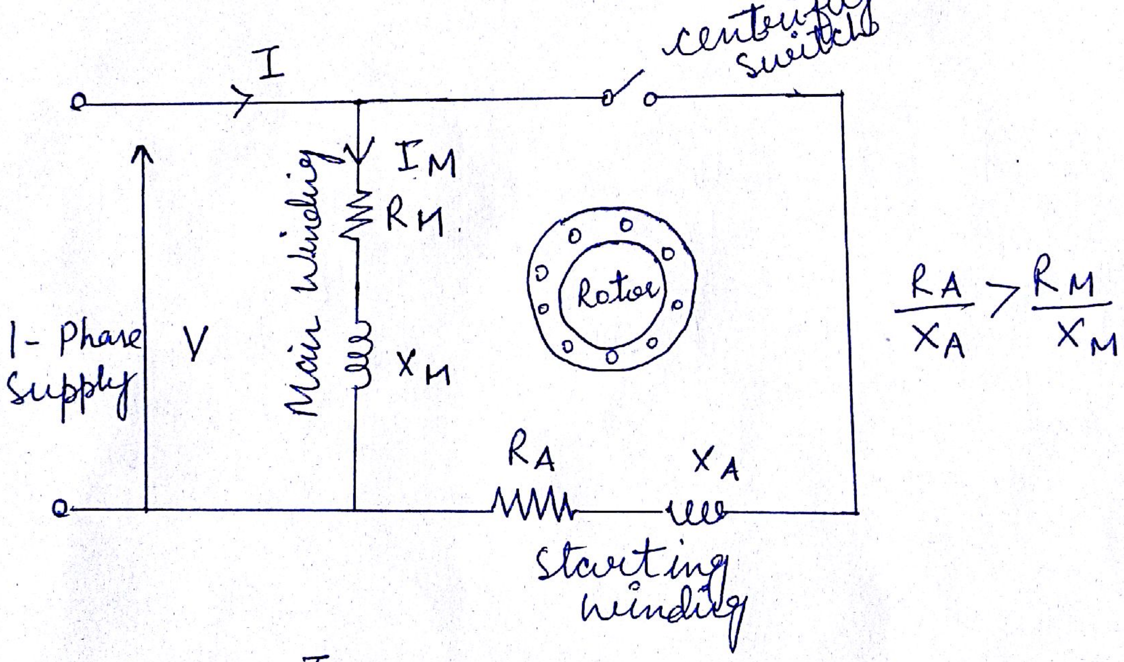
$\frac{1}{2} B_{max} \sin(\omega t + \alpha)$ is the Backward field.

Q2. Explain the Starting Method of Single phase I.M?

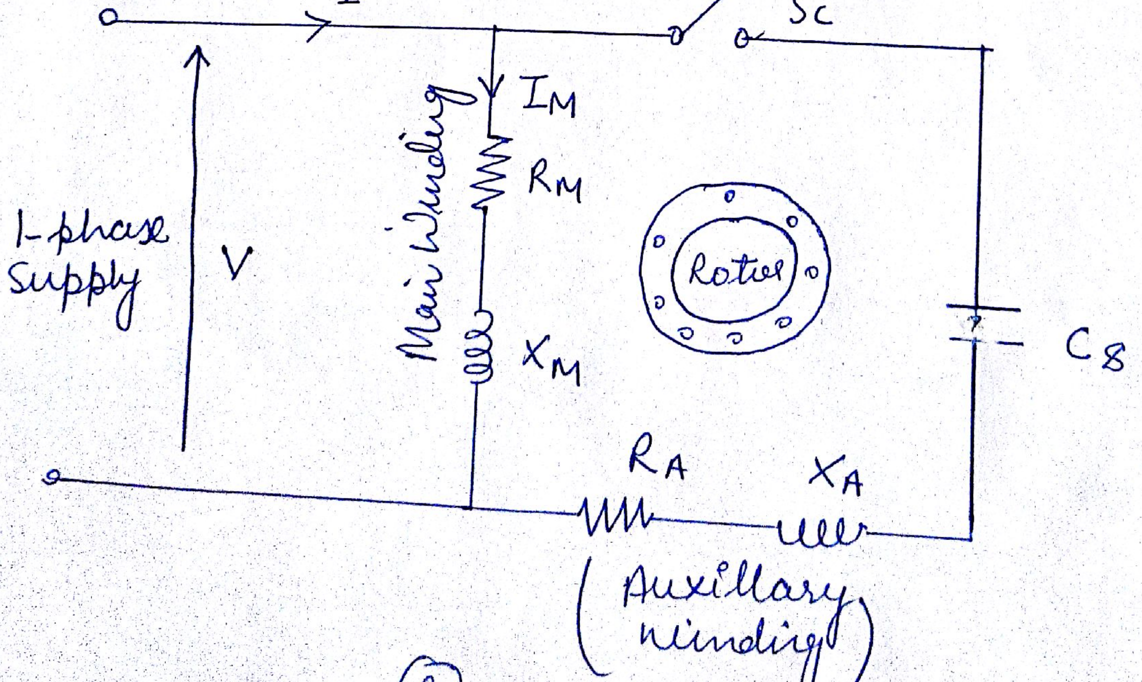
Ans - Single-phase Induction motors are usually classified according to the auxillary means used to start the motor.

1. Split phase Motor
2. capacitor Start Motor
3. capacitor Start Capacitor run motor
4. Permanent Split Capacitor motor
5. Shaded pole motor

(1)



(2)



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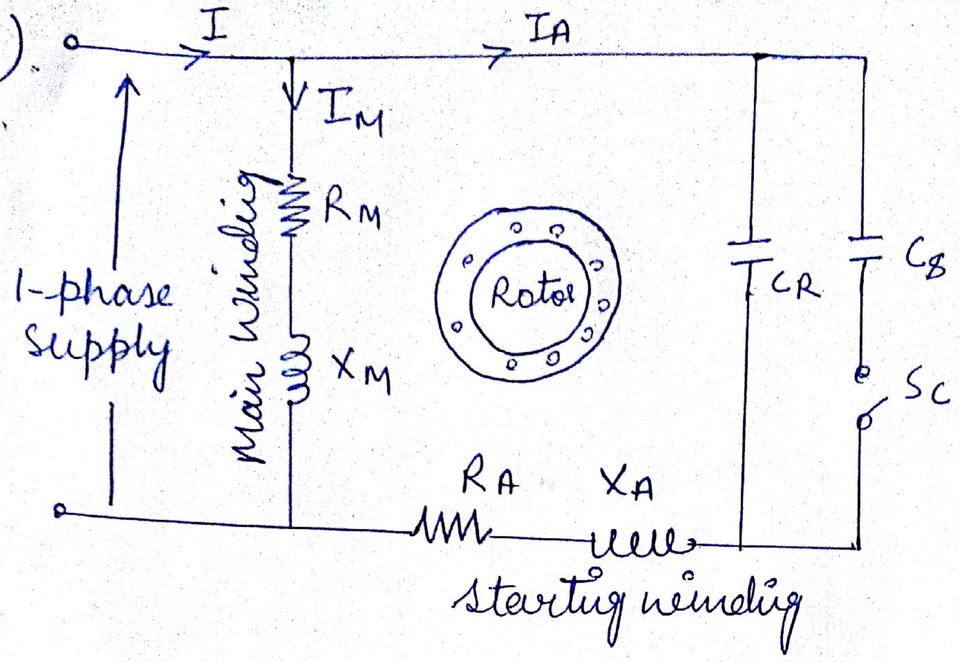
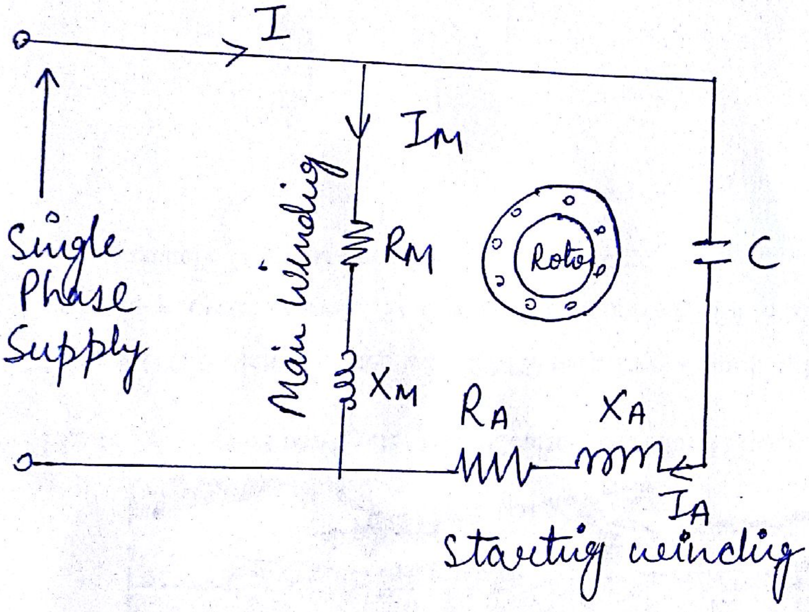


(iv)



Q3. why synchronous motor is not Self-Starting ? Also, explain the why Inductor motor is inherently start ?

Ans synchronous motors are doubly excited machine. one is 3-phase Supply given to Stator and other is DC excitation given to rotor of the motor.

Induction motor is inherently ~~start~~ not starting. A Single phase induction motor consists of a Single phase winding mounted on the stator and a cage winding on the rotor. when a Single phase supply is connected to the stator winding a pulsating magnetic field is produced. By pulsating field we mean that the field builds up in one direction, falls to zero and then builds up

in the opposite direction. under these condition, the rotor does not rotate due to inertia.
Single phase induction motor is inherently not self-starting and it requires some special starting means.

Q4. Explain reluctance motor and stepper motor?

Ans - A Reluctance motor is a type of electric motor that induces non-permanent magnetic poles on the ferromagnetic rotor.

- The rotor does not have any winding.
Torque is generated through the phenomenon of magnetic reluctance.
Reluctance motors can deliver very high power density at low cost, making them ideal for many application

Stepper motor -

- The stepper motor has a rotor movement in discrete steps. The angular rotation is determined by the number of pulses fed into the control circuit.
Each input pulse initiates the drive Circuit which produces one step of angular movement.
The device may be considered as a digital to analogue converter.
The drive circuit has inbuilt logic which causes appropriate winding to be energized and deenergized by solid state switches in required sequential manner.

JNIT

JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR
I / II -MID TERM PAPER ANSWER SHEET

Semester: IV **Branch :** EE
Subject : Ad. Eng. Maths-II **Submitted by :** Ms Daljeet Kaur

1. $E = 1 + \frac{1}{2}\delta^2 + \delta\sqrt{1+\delta^2/4}$

We know that $\delta = E^{1/2} - E^{-1/2}$

$\delta = E^{1/2} - \frac{1}{E^{1/2}}$

$\delta = \frac{E-1}{E^{1/2}} \Rightarrow E - \delta E^{1/2} - 1 = 0$

$\Rightarrow E^{1/2} = \frac{1}{2}(\delta + \sqrt{\delta^2+4})$ (neglecting -ve sign)

Squaring both sides

$E = \frac{1}{4}(\delta + \sqrt{\delta^2+4})^2 \Rightarrow E = \frac{1}{4}[\delta^2 + \delta^2 + 4 + 2\delta\sqrt{\delta^2+4}]$

$\Rightarrow E = 1 + \frac{\delta^2}{2} + \delta\sqrt{1+\delta^2/4}$

2.

											Total
Rank in A	5	2	9	8	1	10	3	4	4	7	
Rank in B	10	5	1	3	8	6	2	7	9	4	
$d = d_A - d_B$	-5	-3	8	5	-7	4	1	-3	-3	3	0
d^2	25	9	64	25	49	16	1	9	9	9	216

Rank correlation coefficient $\rho = 1 - \frac{6\sum d^2}{n(n^2-1)}$

$\rho = 1 - \frac{6 \times 216}{10 \times 99} = -0.3091$

3. $\bar{x} = \frac{\sum x}{n} = \frac{12}{18} = 0.667$ $\bar{y} = \frac{\sum y}{n} = \frac{18}{18} = 1$

$\sigma_x^2 = \frac{\sum x^2}{n} - (\bar{x})^2 = \frac{60}{18} - (0.667)^2 = 2.8884$

$\sigma_y^2 = \frac{\sum y^2}{n} - (\bar{y})^2 = \frac{96}{18} - 1 = 4.3333$

$Cov(x,y) = \frac{\sum xy}{n} - \bar{x}\bar{y} = \frac{48}{18} - (0.667)(1) = 1.9997$

Line of regression of y on x is

$y - \bar{y} = \frac{Cov(x,y)}{\sigma_x^2}(x - \bar{x})$

$\Rightarrow y - 1 = \frac{1.9997}{2.8884}(x - 0.667)$

$\Rightarrow y = 0.692x + 0.538$

Line of regression of x on y is

$$x-\bar{x} = \frac{Cov(x,y)}{\sigma_y^2}(y-\bar{y})$$

$$\Rightarrow (x-0.667) = \frac{1.9997}{4.333}(y-1)$$

$$\Rightarrow x = 0.4618y + 0.2055$$

Coefficient of correlation $r^2 = 0.4615 \times 0.692 = 0.3194$

$$r = 0.565 \cong 0.57$$

4. $$x = \frac{1}{20}(17-y+2z) \quad \text{———— (1)}$$

$$y = \frac{1}{20}(-18-3x+z) \quad \text{———— (2)}$$

$$z = \frac{1}{20}(25-2x+3y) \quad \text{———— (3)}$$

Taking Initial approximation as $x^{(1)} = y^{(1)} = z^{(1)} = 0$ and substituting in eq^n (1)

$$x^{(2)} = \frac{17}{20} = 0.85$$

Now, substituting $x^{(2)} = 0.85$ and $z^{(1)} = 0$ in eq^n (2)

$$y^{(2)} = \frac{1}{20}(-18-3x^{(2)}+z^{(1)})$$

$$= \frac{1}{20}(-18-3\times 0.85+0)$$

$$y^{(2)} = -1.0275$$

Putting $x = x^{(2)} = 0.85$ & $y^{(2)} = -1.0275$ in eq^n (3)

$$z^{(2)} = \frac{1}{20}\left[25-2x^{(2)}+3y^{(2)}\right]$$

$$= \frac{1}{20}\left[25-2\times 0.85+3\times(-1.0275)\right]$$

$$z^{(2)} = 1.0109$$

Second Iterations

$$x^{(3)} = \frac{1}{20}\left[17-y^{(2)}+2z^{(2)}\right] = \frac{1}{20}\left[17-(-1.0275)+2\times 1.0109\right]$$

$$x^{(3)} = 1.0025$$

$$y^{(3)} = \frac{1}{20}\left[-18-3x^{(3)}+z^{(2)}\right] = \frac{1}{20}\left[-18-3\times 1.0025+1.0109\right]$$

$$y^{(3)} = -0.998$$

$$z^{(3)} = \frac{1}{20}\left[25-2x^{(3)}+3y^{(3)}\right] = \frac{1}{20}\left[25-2\times 1.0025+3(-0.998)\right]$$

$$z^{(3)} = 0.9998$$

Third Iteration

$$x^{(4)} = \frac{1}{20}\left[17 - y^{(3)} + 2z^{(3)}\right] = 1$$

$$y^{(4)} = \frac{1}{20}\left[-18 - 3x^{(4)} + z^{(3)}\right] = -1$$

$$z^{(4)} = \frac{1}{20}\left[25 - 2x^{(4)} + 3y^{(4)}\right] = 1$$

The value in second, third iterations are almost same.
Therefore the solution of given system of equations are

$x = 1,\ y = -1,\ z = 1.$

5. Let the line to be fitted be $y = a + bx$ ——— (1)

By principle of least squares, the normal equations are

$$\left.\begin{aligned} \Sigma y &= na + b\Sigma x \\ \Sigma xy &= a\Sigma x + b\Sigma x^2 \end{aligned}\right\} \quad \text{——— (2)}$$

						Total
x	1	2	3	4	5	$\Sigma x = 15$
y	5	7	9	10	11	$\Sigma y = 42$
x^2	1	4	9	16	25	$\Sigma x^2 = 55$
xy	5	14	27	40	55	$\Sigma xy = 141$

Substituting these values in the normal equations, we get

$$42 = 5a + 15b$$
$$141 = 15a + 55b$$

Solving these two equations, we get

$a = 3.9$ & $b = 1.5$

Hence the best fitted straight line is

$$y = 3.9 + 1.5x.$$