DETAILS EXPLANATIONS

EE : Paper-2 (Paper-1) [Full Syllabus]

[PART : A]

1. When all the elements of a row of an array becomes zero that indicates symmertically located poles about jω-axis in this case Routh's array can be completed by replacing the zero elements with the coefficients of a equation obtained by differentating the auxiliary equation with respect to so the auxiliary equation is the equation obtain by using the elements of the row just above the row with zero elements.

2. A PMOSFET has several features different from of BJT. These are outlined below:

- BJT is a bipolar device where as PMOSFET is a unipolar device.

- A PMOSFET has lower switching losses but it's on resistance and conduction losses are more. A BJT has higher switching losses but lower conduction loss.

- A PMOSFET has high input impedance (MΩ) where as BJT input impedance is low (a few kΩ)

- P MOSFET is voltage controlled device where as BJT is current controlles device.

3. This rating of thyristor indicates the maximum rate as rise of current from anode to cathode without any harm to the device. When a thyristor is turned on, conduction starts at a place near the gate. This small area of conduction spreads to the whole area of junction. If the rate of rise of anode current $\left(\dfrac{di}{dt}\right)$ is large as compared to the spreading velocity of carries across the cathode junction, local hot spot will be formed near the gate connection on account of high current density. This couses the junction temp. to rise above the safe limit and as a consesuence, SCR may be damaged permantely.

4. *Latching Current :*

Latching current is the minimum forward current that flow through the thyristor to keep it in for ward conduction mode (i.e., No-state) at the time of triggering. If the forward current is less than latching current thyristor does not turnon i.e., $I_a < I_L$.

Holding Current :

Holding current is minimum forward current that flows through the thyristor to keep to in forward condution mode when forward current reduces below holding current turns-off.

The value of anode current below which it must fall for SCR to regain its blocking capacity i.e. to turn-off SCR.

$$I_L \simeq 2.5 \ I_H$$

5. Power of carrier

$$P_c = 500 \ W$$

Carrier frequency

$$f_c = 1 \ MHz$$

Modulation index

$$m_a = 0.6$$

Modulating frequency

$$f_m = 1 \ kHz$$

Bandwidth

$$B.W. = 2f_m$$
$$= 2 \times 1 \ kHz = 2 \ kHz$$

6. Modulation is the method by which some parameters (amplitude, frequency or phase) of a signal called carrier is varied in accordance with the meassage signal which is to be transmitted.

7. *Core :* It is a single solid dielectric material. The core material used for low and medium loss fibres is glass. Plastic core is also used for relatively higher loss fibres. Quart is also used for core material. The diameter of core varies from 8 to 200 μm.

8. *Disadvantages of Satellite Communication :*
    (i) It is not easy to access satellites, therefore if any problem rises in a satellite link it would become difficult to repair it.
    (ii) The cost of launching a satellite is very high.
    (iii) There is an excessive time delay between a transmitted and received signal.

9. Static errors can be grouped in three categories viz. gross errors, systematic errors and random or accidental errors. Systematic errors may further be categorised as instrumental errors, environmental errors and observational errors.

10. The damping used in a ballistic galvanometer must be necessarily electromagnetic because it can be determined from the instrument constants while air damping is indeterminate.

11. Dynamometer type instruments are usually not used for DC measurements as these instruments have higher cost, higher power consumption, low torque-weight ratio, nonuniform scale and other several drawbacks in comparison to PMMC instruments.

12.
$$\phi = \tan^{-1}\left(\frac{\sqrt{3}(w_1 - w_2)}{w_1 + w_2}\right)$$

(i) $w_1 = w_2 = w$
$$\phi = 0$$
$$\cos = 1 \text{ (Unity)}$$

(ii) $w_2 = 0$
$$\phi = \tan^{-1}\sqrt{3}$$
$$\phi = 60^\circ$$
$$\cos 60^\circ = 0.5$$

(iii) $w_1 = w$
$$w_2 = -w$$
$$\phi = \tan^{-1}\left(\frac{\pi}{2}\right)$$
$$\cos\left(\frac{\pi}{2}\right) = 0 \text{ (Zero)}$$

13. In 8085 microprocessor, zero flag is used to indicate the result of arithmetic or logic operation of ALU is zero or non-zero. If the result is non-zero, then Z-flag will be zero (reset) and if the result is zero, then Z-flag will be 1 (set). Here 'MOV D, B' is not an ALU operation hence zero flag is not affected.

14. While storing stack contents, the stack pointer always first decrement and then the memory location pointed by the stack pointer is filled up. After decrementing 1 from 0000 H, FFFFH is obtained, hence stack contents will be stored from the memory location FFFFH onwards on progressively decreasing memory location addresses.

15. Concept of relative stability in routh criteria is used to determine the number of closed loop poles to the right or left to a vertical line parallel to jω axis.

The number of closed loop poles to the right of vertical lines δ = –σ can be determined by shifting the vertically axis at δ = –σ. This is done by replacing δ by (z –σ) in charastics equation
$$\delta = -\sigma, \ z = 0, \ \delta = z - \sigma$$

and then routh's criteria is applied to find out the number of poles tto left or right of δ = σ.

16. Cut off rate/roll off rate : It is rate at which magnitude of transfer function reduces beyond the cut off frequency. Cut off rate indicates the ability of the system to distinguish between the desired signal and a noise.

Cut off frequency and bandwidth : is defined as the frequency at which magnitude of transfer function reduced to $\left(\dfrac{1}{\sqrt{2}}\right)$ times the initial magnitude at $\omega = 0$.

Bandwidth (B.W.) $= \omega_c - 0 = \omega_c$

$$= \omega_n \sqrt{(1-2\xi^2) + \sqrt{(1-2\xi^2)^2 + 1}}$$

17. *Physical Variable Representation :*

In this representation of state model the physical variable such as voltage, current, velocity, displacement etc. are used to as the state variable. The advantage of this representation is that the state variable can be measured directly with the help of measuring instrunments.

18. When a pulses of light of appropriate wavelength and of sufficient intensity, is allowed to strike the gate to cathod junction, the electron-hole pairs are generated in innerp-layer they width of depection region in innner P-layer gets reduced, hence avalance break over may occur which may turn-on SCR. Light triggering SCR has the advantage of electrical isolation between power circuit and control circuits. The SCR employing light triggering are called LASCR (Light activated SCR) used in HVDC transmission system.

19. *Zener Breakdown :*

If electric field is very high the holes and the electron in covalent bond is so high as electron may break the covalent bond so large number of charge carrier are generated. This type of breakdown is called zener breakdwon or direct rupturing of covalent bond.

It depends on voltage and doping level, both layer must be highly doped. Small voltage resuired for breakdown, it is electrostatic breakdown.

Avalanche breakdown :

Mean cumalative process of collision it occurs due to thermal effect or temperature. It occurs more common in lightly doped semiconductor junctions.

20. The diodes which have low reverse recovery time, of about 5 µs or less, are classified as fast vecovery diodes. These are use in chopper, commutation circuits, SMPS, induction heating etc. their current rating vary from about 1A to several thousand ampere and voltage rating from 50 V to about 3 kV for voltage rating below about 400 V, the expitaxial process is used for diode fabrication and have fast recovery time as low as 50 ns.

[PART : B]

21. In a cycloconverter, AC power at one frequncy is converted directly to a lower frequency in a single conversion stage.

Cycloconverter function by mean of phase commutation, without auxilary forced commutation circuits. The power circuit is more compact, eleminating circuit losses associated with force commutation. It is extremely attractive for large power low speed drives.

22. Two trangistor model is obtained by bisecting the two middle layers, in two seperate halves as shown in figure. Junction $J_1 - J_2$ and $J_2 - J_3$ can be constitute pnp and npn transistor separately.

When devices is conducting then:
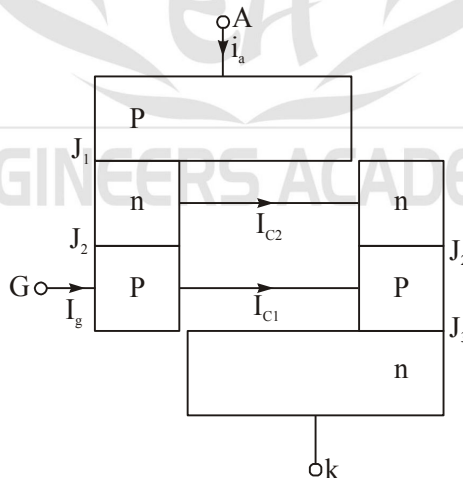
$$I_{C1} = \alpha_1 I_{E1} + I_{CBO1} \qquad ...(1)$$
$$I_{C1} = \alpha_1 I_A + I_{CBO1}$$

and $I_{C2} = \alpha_2 I_{E2} + I_{CBO2}$ ...(2)
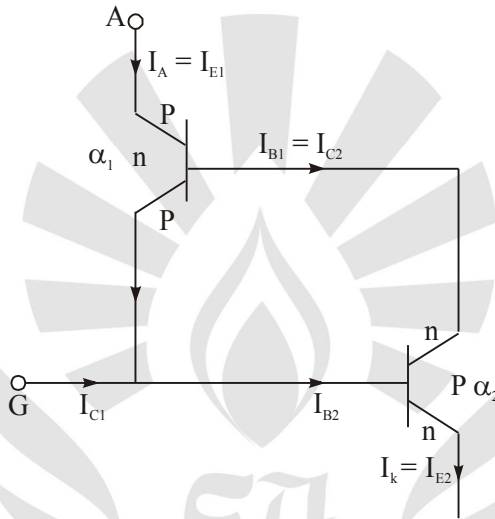
$I_{C2} = \alpha_2 I_k + I_{CBO2}$

$I_A = I_{C1} + I_{C2} = \alpha_1 I_A + I_{CBO1} + \alpha_2 I_k + I_{CBO2}$

When gate current is applied than

$I_k = I_A + I_g$

$I_A = \alpha_1 I_A + I_{COB1} + \alpha_2(I_A + I_g) + I_{COB2}$

$I_A = \dfrac{\alpha_2 I_g + I_{CBO1} + I_{CBO2}}{1 - (\alpha_1 + \alpha_2)}$

In I_E increase then current gain α increase due to this $I_A\uparrow$. This effect is commulative effect, so, the anode current rises to full load current. The two transistor modes required the continuous base current for the transistor therefore the base to zero but in case of SCR, the I_g is reduce to zero, once the SCR is in conduction mode.

23. Maximum and minimum amplitudes of AM modulated wave are

$V_{max} = 750$ mV and $V_{min} = 250$ mV

Modulation index,

$$m_a = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{750 \times 10^{-3} - 250 \times 10^{-3}}{750 \times 10^{-3} + 250 \times 10^{-3}}$$

modulation index

$$m_a = \frac{500}{1000} = 0.5$$

The percentage modulation

$$= 0.5 \times 100 = 50\%$$

24. *Frequency Modulation :*
- The frequency deviation is proportional to the amplitude of modulating signal.
- For FM signal, the maximum frequency deviation takes place when modulating signal is at positive and negative peaks.
- The modulation index is inversely proportional to the modulating frequency.

Phase Modulation :
- The phase deviation is proportional to the amplitude of modulating signal.
- For PM signal the maximum frequency deviation takes place near zero crossings of the modulating signal.
- The modulating index does not depend on modulating frequency.

25. *Advantages of superheterodyne Receiver :*
- It has uniform bandwidth because the intermediate frequency is fixed.
- The selectivity of superheterodyne receiver is decided mainly by IF amplifier. It has better selectivity because the IF amplifier is narrow band.
- Design of superheterodyne receiver is much simpler since they operate only at intermediate frequency.

26. The disc rotates continuously in the series magnetic field under load conditions and so there is a dynamically induced emf in the disc which induces eddy currents. Due to interaction of eddy currents with the field of series magnet a braking torque proportional to the square of the energizing current is developed. The braking torque so developed is called the selfbraking torque.

The self-braking torque assumes increasing importance with the increase in load current and thus at high values of load current the registration tends to be low.

27. Increase of secondary burden (in volt-amperes) obviously necessitates an increase of secondary terminal voltage for given value of secondary current, This again means an increase in the induced secondary emf and consequently in the core flux and flux density. Thus both I_e and I_m are increased and the ratio error is made more negative and the phase angle error more positive-norrnally this will mean increase in the errors.

28. Most of the CRO applications involve measurement or display of a quantity which varies with respect to time. This requires that the CRT spot moves across the screen with a constant velocity. For this a voltage which varies linearly with time has to be applied to

one of deflection plates. This voltage is used to sweep the electron beam across the screen, so it is called a sweep voltage. Because of its shape, it is also sometimes called a sawtooth or ramp voltage. The time base generator is required to provide this sweep, sawtooth or ramp voltage.

29.
$$\phi = \tan^{-1}\left(\frac{\sqrt{3}(w_1 - w_2)}{w_1 + w_2}\right)$$

(i) $w_1 = 1000 \text{ W}$

$w_2 = 500 \text{ W}$

$$\phi = \tan^{-1}\left(\frac{\sqrt{3}(1000 - 500)}{1000 + 500}\right)$$

$\phi = 30°$

$\cos 30° = 0.866 \text{ (lag)}$

(ii) $w_1 = 1000 \text{ W}$

$w_2 = -500 \text{ W}$

$$\phi = \tan^{-1}\left(\frac{\sqrt{3}(1000 + 500)}{1000 - 500}\right)$$

$$\phi = \tan^{-1} 3\sqrt{3}$$

$\cos\phi = 0.189 \text{(lag)}$

30. As the characteristic impeance of an equivalent π or T section does not match with each other hence a T section should not be simply joined to a P section. As the input impedance of the half section is the characteristic impedance of the π section, hence matching can be obtained if a half section is connected in between a T and π section.
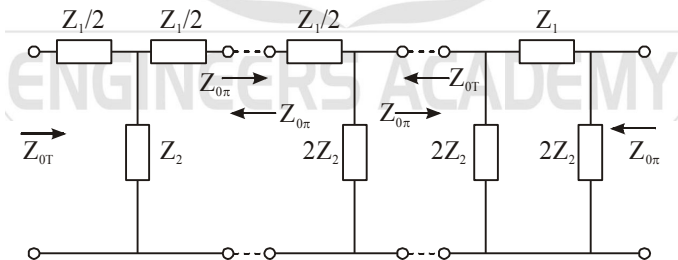
When an m-derived section is segregated into half section, the impedance at the point of obsection is dependent upon the value of m. It has been for tanately found that with m = 0.6 The impedance at the bisection remains nearly equal to R_o and is constant in the entire pass band. Figure shows the prottype half section for matching T and π sections.

31. Given: $T(s) = \dfrac{10}{s}$

$$Q_o = \frac{10}{s(Js^2 + fs + k)}$$

Steady state value

$$Q_o(\infty) = \lim_{s \to 0} s.\frac{10}{s(Js^2 + fs + k)} = \frac{10}{k} \text{ (output)}$$

Input $T(\infty) = 10$ (Ten units step)

$$\text{Error} = \lim_{t \to \infty} [\text{input} - \text{output}] = 0.5$$

$$= 10 - \frac{10}{K} = 0.5$$

$\Rightarrow \qquad K = \dfrac{10}{9.5} = 1.05$

$M_P = 6\% = 0.06$ given

$$= e^{-\frac{\pi\xi}{\sqrt{1-\xi^2}}} \times 100$$

$$0.06 = e^{-\frac{\pi\xi}{\sqrt{1-\xi^2}}}$$

$\therefore \qquad \xi = 0.667$

$t_p = 1$ sec (given) or

$$t_p = \frac{\pi}{\omega_n\sqrt{1-\xi^2}}$$

$\Rightarrow \qquad 1 = \dfrac{\pi}{\omega_n\sqrt{1-(0.667)^2}}$

$\therefore \qquad \omega_n = 4.21$ rad/sec

Characteristic equation $Js^2 + fs + k = 0$

$\Rightarrow \qquad s^2 + \dfrac{f}{J}s + \dfrac{k}{J} = 0$

Compare with $s^2 + 2\xi\omega_n s + \omega_n^2 = 0$

$$\omega_n^2 = \frac{k}{J} \Rightarrow J = \frac{k}{\omega_n^2}$$

$$= \frac{10}{9.5 \times \omega_n^2} = \frac{10}{9.5 \times (4.21)^2}$$

$J = 0.06$

$$2\xi\omega_n = \frac{f}{J} \Rightarrow f = 2\xi\omega_n J$$
$$= 2 \times 0.667 \times 4.21 \times 0.06$$
$$f = 0.34$$
$$k = 1.05$$
$$J = 0.06$$

32. In this representation output and its derivatives are taken as state variables. The advantage of this representation is that the controllability and obsorability of the system can be determined directly. *Example :*

$$\frac{d^3y}{dt^3} + a_1\frac{d^2y}{dt^2} + a_2\frac{dy}{dt} + a_3y = x \qquad ...(1)$$

$$\text{Let,} \quad x_1 = y \qquad\qquad ...(2)$$

$$x_2 = \frac{dy}{dt} = \dot{x}_1 = \frac{dx_1}{dt} \qquad ...(3)$$

$$x_3 = \frac{d^2y}{dt^2} = \dot{x}_2 = \frac{dx_1}{dt} \qquad ...(4)$$

$$u = x \qquad\qquad ...(5)$$

Modifying equation (3) we have,

$$\frac{dx_1}{dt} = 0.x_1 + 1.x_2 + 0.x_3 + 0.u \qquad ...(6)$$

Similarly from equation (4)

$$\frac{dx_2}{dt} = 0.x_1 + 0.x_2 + 1.x_3 + 0.u \qquad ...(7)$$

Similarly from equation (1), (3), (4) & (5) we have

$$\frac{dx_3}{dt} = -a_3x_1 - a_2x_2 - a_1x_3 + u \qquad ...(8)$$

From equation (6), (7) & (8) we have

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -a_3 & -a_2 & -a_1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}u$$

$$\dot{x} = AX + BU$$

State equation phase variable representation

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -a_3 & -a_2 & -a_1 \end{bmatrix}; \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

output $y = x_1$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + 0.u$$

Output equation

$\qquad y = CX + DU$

where $C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$

$\qquad D = 0$

The co-efficient of differential equation representing the system. Gives the last row of system. Matrix in phase variable representation from the differential equation representing the system.

[PART : C]

33. Let internal impedance of source

$\qquad Z_s = R_s + j\omega L_s$

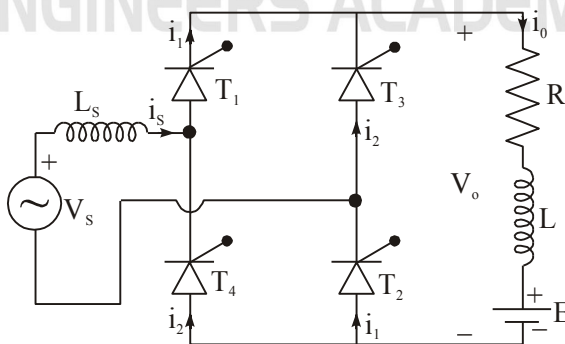Let $R_s \simeq 0$

Supply current $i_s = i_1 - i_2$

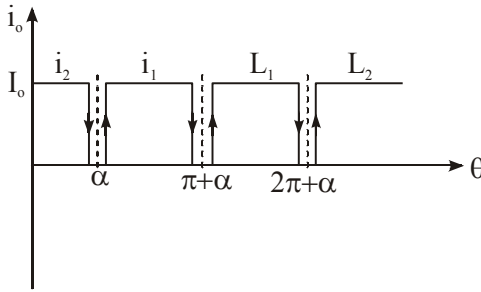If $T_1 T_2 \rightarrow$ ON $i_s = I_o$ and $V_o = V_s$

If $T_3 T_4 \rightarrow$ ON $i_s = -I_o$ and $V_o = -V_s$
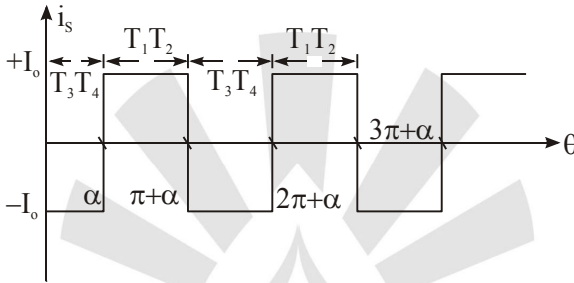
Where load current $i_o \simeq I_o$ (assume constant)

So supply current wave from can be represented as shown in figure (b).

(a) Connection Diagram

(b) Wave Form

(c) Wave Form

At $\theta = \alpha$, $\pi + \alpha$, $2\pi + \alpha$,... supply current i_s changes suddenly from $-I_o$ to $+I_o$ and $+I_o$ to $-I_o$ when the load current is transferred suddenly from T_3T_4 to T_1T_2 and from T_1T_2 to T_3T_4. It is possible only if L_s $\simeq 0$ however due to L_s, i_s can't be changed suddenly i.e. load current can't be transferred suddenly from T_1T_2 to T_3T_4 at $\theta = \pi + \alpha$. Let current through $T_1T_2 = i_1$ and current through $T_3T_4 = i_2$

$$i_1 + i_2 = I_0$$

For $\theta < \pi + \alpha$; $i_1 = I_o$ and $i_2 = 0$ as given in figure (c)

For $\theta > \pi + \alpha$; $i_1 = I_o$ and $i_2 = I_o$

At $\theta = \pi + \alpha$, i_1 can't be reduce to zero suddenly and i_2 can't rise from zero to I_o suddenly due L_s. Due to L_s at $\theta = \pi + \alpha$, i_1 decreases and i_2 increases at finite rate.
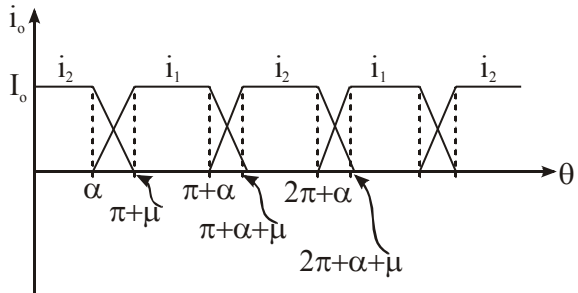

Figure : (d) During overlap Angle 'μ'

From $\theta = \pi + \alpha$ to $\theta = \alpha + \mu$, i_1 decrease and i_2 increase so all the four thyristor $T_1 T_2$ and $T_3 T_4$ conduct so output voltage $V_o = 0$.

Supply current $i_s = i_1 - i_2$

During overlop angle 'μ' say from $\theta = \alpha$ to $\theta = \alpha + \mu$ all the four thyristor are conducting during overlopping (using kVL)
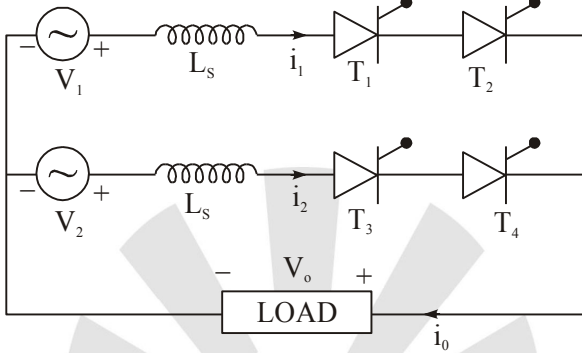

Figure : (e) Equivalent Circuit of figure (a)

$$-V_1 + L_s \frac{di_1}{dt} - L_s \frac{di_2}{dt} + V_2 = 0$$

$$\Rightarrow \qquad L_s \frac{d(i_1 - i_2)}{dt} = V_1 - V_2$$

$$= V_s - (-V_s) = 2V_s$$

$$\Rightarrow \qquad \frac{di_1}{dt} - \frac{di_2}{dt} = \frac{2V_m \sin \omega t}{L_s} \qquad \dots(1)$$

As $\qquad i_1 + i_2 = I_o$

So, $\qquad \dfrac{di_1}{dt} + \dfrac{di_2}{dt} = 0 \qquad \dots(2)$

Using equation (1) and (2)

$$\frac{2 di_1}{dt} = \frac{2V_m \sin \omega t}{L_s}$$

$$\Rightarrow \quad \int di_1 = \frac{V_m}{L_s} \int \sin \omega t \, dt$$

As $\qquad \omega t = \theta \Rightarrow t = \dfrac{\theta}{\omega} \Rightarrow dt = \dfrac{d\theta}{\omega}$

So $\quad \displaystyle\int_o^{I_o} di_1 = \frac{V_m}{\omega L_s} \int_\alpha^{\alpha + \mu} \sin\theta \, d\theta$

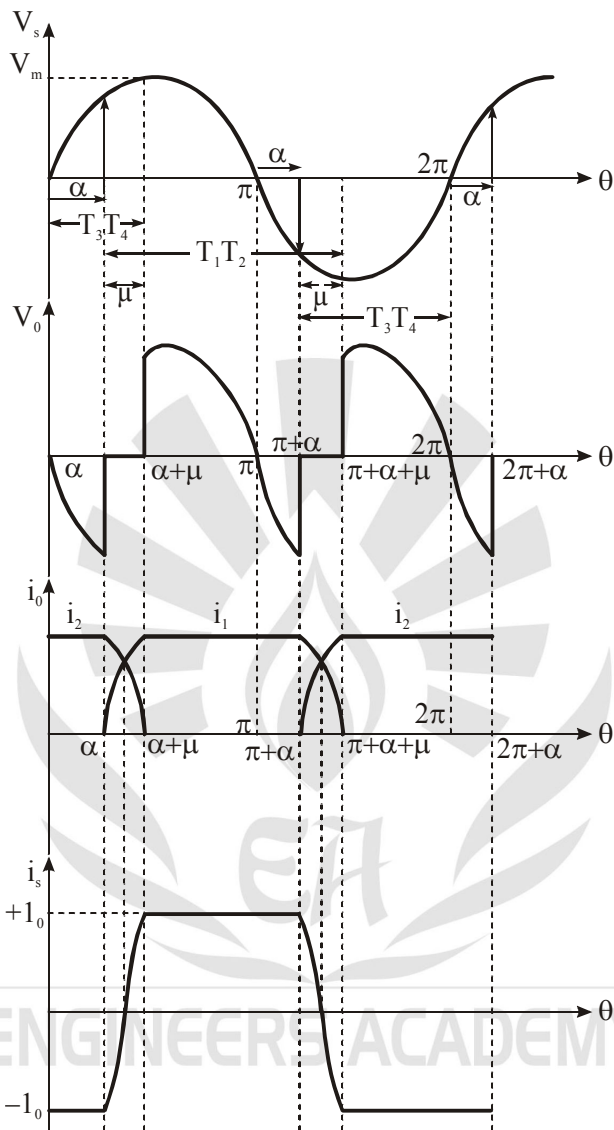$$\Rightarrow \qquad I_o = \frac{V_m}{\omega L_s}[\cos\alpha - \cos(\alpha + \mu)]$$

Figure : Typical current and Voltage waveform will L_s.

and $\qquad \cos(\alpha+\mu) = \cos \alpha - \dfrac{\omega L_s}{V_m} I_o \qquad ...(3)$

The average output voltage (periodicity $= \pi$)

$$V_o = \frac{1}{\pi} \int_{\alpha}^{\alpha+\pi} V_o d\theta = \frac{1}{\pi} \int_{\alpha+\mu}^{\alpha+\pi} V_m \sin\theta \, d\theta$$
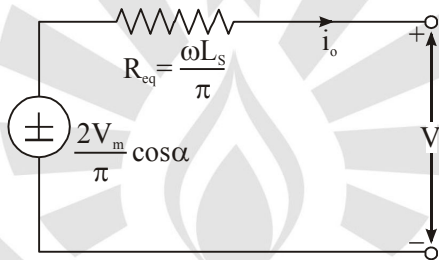
$$\Rightarrow \quad V_o = \frac{V_m}{\pi}[\cos(\alpha + \mu) - \cos(\alpha + \pi)]$$

$$= \frac{V_m}{\pi}[\cos\alpha + \cos(\alpha + \mu)] \qquad ...(4)$$

from equation (3) put $\cos(\alpha + \mu)$ in equation (4)

$$\text{Then} \quad V_o = \frac{V_m}{\pi}\left[\cos\alpha + \left\{\cos\alpha - \frac{\omega L_s I_o}{V_m}\right\}\right]$$

$$\Rightarrow \quad V_o = \frac{2V_m}{\pi}\cos\alpha - \frac{\omega L_s}{\pi}I_o \qquad ...(5)$$

So due to L_s there is drop in the output voltage, depending upon I_o the equivalent circuit of equation (5) can be represent voltage at NO load i.e. $I_o = 0$

$$V_{o(nl)} = \frac{2V_m}{\pi}\cos\alpha \text{ and at load}$$
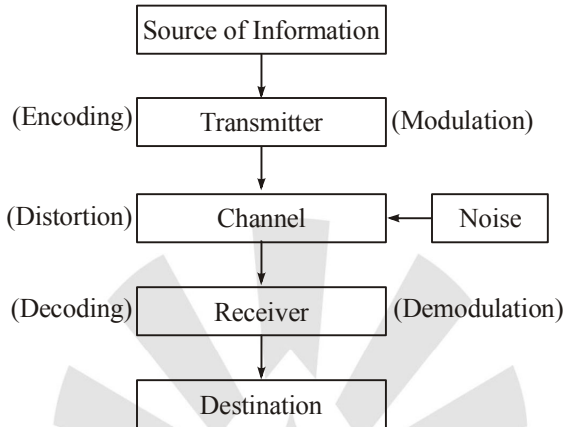
$$V_o = \frac{2V_m}{\pi}\cos\alpha - R_{eq}I_o$$

Voltage regulation

$$\text{V.R.} = \frac{V_{o(nl)} - V_o}{V_o} \times 100$$

$$= \frac{(\omega L_s/\pi)I_o}{V_o} \times 100 \simeq \frac{(\omega L_s I_o/\pi)}{V_{o(nl)}} \times 100$$

$$\text{V.R.} = \frac{\dfrac{\omega L_s}{\pi}I_o}{\dfrac{2V_m}{\pi}\cos\alpha} \times 100$$

$$= \frac{\omega L_s I_o}{2V_m \cos\alpha} \times 100$$

34. *A Communication Model :*

The figure represents block diagram of an electrical communication system. We briefly discuss about all the elements shown in figure. Communication system with it's block diagram.

```
            ┌──────────────────────────┐
            │  Source of Information    │
            └──────────────────────────┘
                        │
                        ▼
(Encoding)  ┌──────────────────────────┐ (Modulation)
            │       Transmitter         │
            └──────────────────────────┘
                        │
                        ▼
(Distortion)┌──────────────────────────┐      ┌──────────┐
            │         Channel           │◄─────│  Noise   │
            └──────────────────────────┘      └──────────┘
                        │
                        ▼
(Decoding)  ┌──────────────────────────┐ (Demodulation)
            │        Receiver           │
            └──────────────────────────┘
                        │
                        ▼
            ┌──────────────────────────┐
            │       Destination         │
            └──────────────────────────┘
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Communication System

(i) *Source of Information :*

It sends information. Source of information may be in the form of sound (human voice, music etc.), picture or some other data which is to be sent. Basically it is a physical message which must be converted to an electric signal by an input transducer.

(ii) *Transmitter :*

It process the signal for efficient transmission. A physical signal does not have sufficient power such that it can be transferred directly over long distances. Signal must be modified in order to transmit them efficiently. This process is called modulation.

The main functions of transmitter includes modulation, encoding and analog to digital conversion.

(iii) *Channel :*

Channel is a medium through which signal travels from transmitter to receiver. It may be wire, optical fibre or wireless media. Since the signal travels along channel, the possibility of distortion due to noise is maximum in the channel. Noise is an unwanted signal which is random in nature.

(iv) *Receiver :*

It receives the information which comes from transmitter through a channel. Receiver does the reverse process of transmitter in order to get the original signal back. The main functions of a receiver includes demodulation (reverse of of modulation), decoding (reverse of encoding) and digital to analog conversion.

35. A simple satellite communication system is shown in figure. The satellite receives the signal from the transmitting earth station, frequency converts, amplifies and retransmits the signal towards the receiving earth station.

(Transponder)
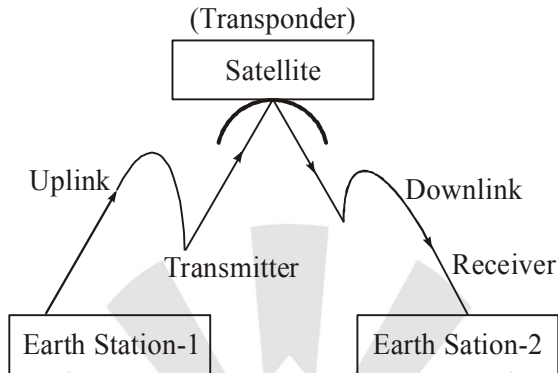
Figure : A Satellite Communication System

(i) *Uplink Model (Earth Statioin Transmitter)*

An earth station transmitter consist of an IF modulator, an IF to RF, MW converter, a high power amplifier (HPA) and a band pass filter (BPF). The IF modulator converts the input baseband signal to FM, the up-converter translates the IF to an appropriate RF carrier frequency. The high power amplifier provides adequate output power to propagate the signal to the satellite transponder.
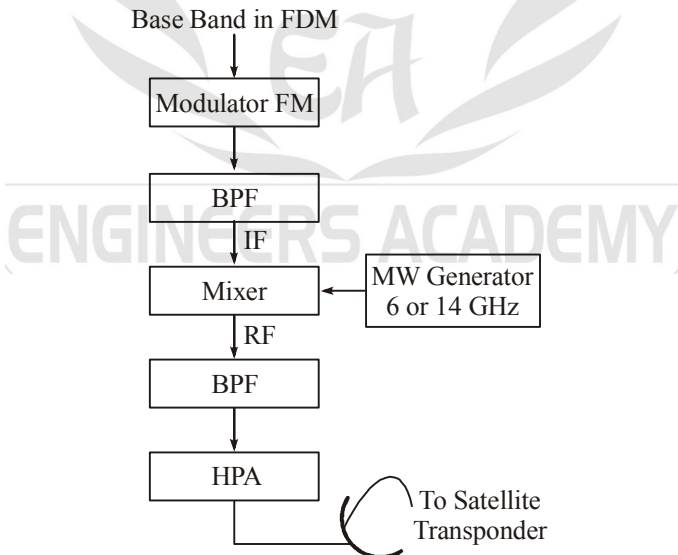
Figure : Earth Station Transmitter (Uplink)

(ii) *Transponder :*

The transponder as shown in figure consists of a receiving antenna which operates at uplink frequency, a band-pass filter (BPF), an input low noise amplifier (LNA), a frequency mixer, an output low power amplifier (TWT) and a transmitting antenna which operates at downlink frequency. The frequency translator is basically an RF to RF repeater. The frequency of the oscillator is equal to the frequency shift required, so it is equal to the difference of uplink and downlink frequency. Usually there are many transmitting and receiving earth station, in such conditions there are more than one transponder in a satellite.
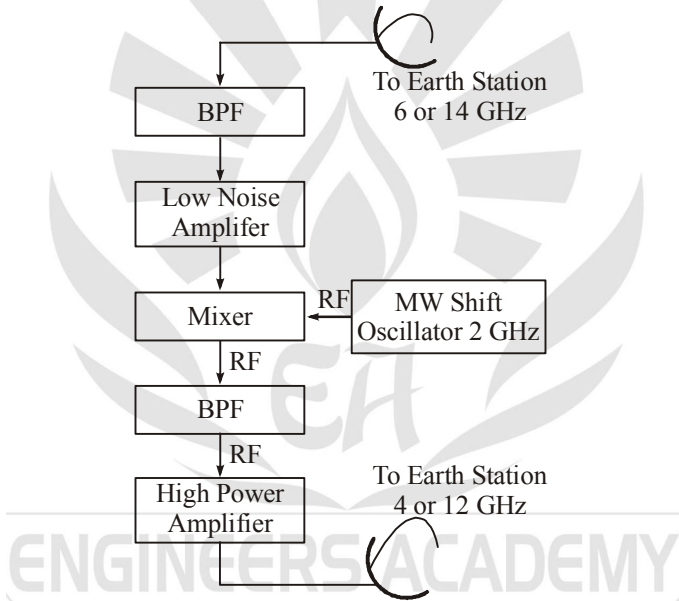
Figure : Satellite Transponder

(iii) *Downlink Model (Earth Station Receiver) :*

A simplified block diagram of a satellite earth receiving station is shown in figure. It receives the signal from satellite transponder antenna and feeds it to a low noise microwave amplifier. The output of this is fed to a down-converter, which converts RF to IF. This IF signal is then demodulated in order to extract original signal.

From Satellite
Transponder
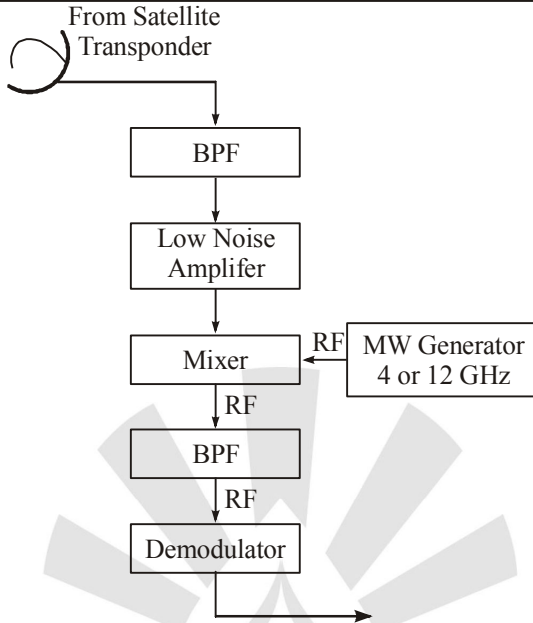
Figure : Earth Station Receiver (Downlink)

36. Let $\qquad u = R^2 = 100^2 = 10{,}000$

Percentage error in u

$$= \frac{2\delta R}{R} = 2 \times 5 = 10\%$$

Let $\qquad v = \omega^2 L^2 = (2\pi \times 50)^2 \times 2^2$
$$= 394784$$

Percentage error in $v = \dfrac{2\delta L}{L} = 2 \times 10 = 20\%$

Let $\qquad x = u + v = R^2 + \omega^2 L^2$
$$= (100)^2 + (2\pi \times 50)^2 \times 2^2$$
$$= 404784$$

Percentage error in x

$$= \frac{u}{x} \cdot \frac{\delta u}{u} + \frac{v}{x} \cdot \frac{\delta v}{v} = \left[\frac{10000}{404784} \times 10 + \frac{394784}{404784} \times 20\right]$$

$$= 0.24 + 19.5 = 19.74\%$$

Now $\qquad Z = x^{1/2}$

So, $\qquad \dfrac{\delta Z}{Z} = \pm\dfrac{1}{2}\dfrac{\delta x}{x} = \pm\dfrac{1}{2} \times 19.74$

$$= 9.87\%$$

37. Every instruction of program has to operate on a data. The method of specifying the data to be operated with an instruction is called addressing.

8085 has the following addressing modes :

(i) *Immediate addressing Mode :*

In an immediate addressing mode, 8 or 16 bit data can be specified as a part of the instruction.

Example : MVI B, 20 H

(ii) *Register Addressing Mode :*

The register addressing mode specialties the source operand, destination operand or both to be contained in an 8085 register.

Example : MOVE B, A

(iii) Direct Addressing Mode :

The direct addressing mode specify 16-bit address of the operand with in the instruction itself. Since, this address is a part of the instruction, the second and third byte of the instruction contain this 16-bit address.

Example : LDA2050 H

(iv) Indirect Addressing Mode :

In indirect addressing mode, the memory address where two operands are located is specified by the contents of a register pair.

Example : LDAX B

(v) Implicit Addressing Mode :

In implicit addressing mode, op-code specifies the address of the operands.

Example : CMA, RAL

38. Open loop transfer function of a system caube determine from magnitude plot by using following steps.

- Initial part of magnitude plot (I.e., at low frequency) determine the number of poles and zeros at origin as well as the gain parameter k.

- If initial slope of magnitude plot is $-20x$ r dB dec. r = Number of O/L pole.

- If nitial slope of magnitude plot is $+20$ xr dB/dec r = Number of O/L zero at origin.

- If initial slope is zero dB/dec, then there is neither a pole nor a zero at origin. The distance of ploat from ω axis 20 log k.

- The intersection of initial slope with $\omega = 1$ axis is at $20 \log k$.
- The expression for initial part of the magnitude plot is given by

  (a) $|GH|_{dB} = 20 \log \dfrac{k}{\omega r}$

      r = Number of O/L pole at origin

  (b) $|GH|_{dB} = 20 \log k\omega r$

      r = Number of O/L zero at origin

  (c) $|GH|_{dB} = 20 \log k$

  where there is neither zeronor pole.

- If slop of magnitude plot changes by $-20 \times r$ no of O/L pole at corner frequency. then there must be r no of O/L pole at that corner frequency.

- If slope of magnitude plot changes by $+20 \times r$ db/dec. at a corner frequency. Then there must be r no of O/L zero at that corner frequency.

39. Breakaway and breakin points at which two locil/branches coming towards each other, meet and get diverted in opposite direction. If there are two consecutive open loop loples on real axis and there exist a root locus between them then there is always a break away point between them. If there are two consecutive open loop zeros on real axis and root locus exists between them there has to be a break in point between them. A break away points exist if and only if root locus exist between two adjoining open loop poles. Break in point exists if and only if root locus exist between two adjoining open loop zeros. Most of the time break away and break in point lie on real axis but some times they may lie on complex plane also.
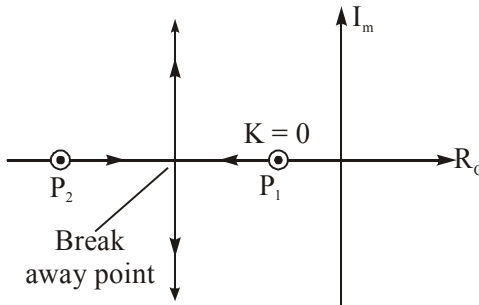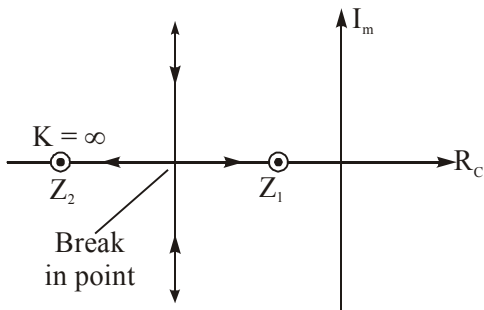
Figure: Position of break away and Break in Plaint in Root locus break away or break in point can be determine by patting,

$$\frac{dk}{ds} = 0$$

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