UNIT III – AMPLIFIERS

1. Mention the disadvantages of FET compared to BJT.

1. FET is a voltage controlled device
2. Less sensitivity to changes in applied voltage

2. Define pinch off voltage of a FET

The substrate is of p-type material on to which an n-type channel is epitaxially grown. A p-type gate is then diffused into the n-type channel.

3. What is MOSFET? Name its types.

- MOSFET is a metal oxide semiconductor field effect transistor
- Its types are depletion and enhancement type

4. Compare JFET with BJT.

Parameter	BJT	JFET
1. Control element	Current controlled device	Voltage controlled device
2. Configurations	CE, CB and CC	CC,CG, CD

5. Mention the operating modes of MOSFET.

The two operating modes are

1) Depletion Mode
2) Enhancement Mode

6. Why FET is called as "Voltage operated device"?

- The voltage applied between gate and source (VGS) controls the drain current ID
- Therefore, FET is a voltage controlled device

7. Define : Amplification factor in JFET

$$\text{Amplification factor} = \left.\frac{V_{DS}}{V_{QS}}\right|_{I_D \text{ Constant}}$$

8. Give any two differences between E-MOSFET and D-MOSFET.

	E-MOSFET	D-MOSFET
1. Channel	Exists Permanently	Channel is physically absent
2. Operation	Can be operated in depletion mode as well as enhance mode	Can only be operated in enhance mode

UNIT-II - AMPLIFIERS.

1. Describe the methods of determination of h-parameters from its static input and output characteristics (8).

$V_1 = h_{11} I_1 + h_{12} V_2$

$I_2 = h_{21} I + h_{22} V_2$ Assume $R_s = 0$.

Equivalent circuit diagram for input & output Impedance.

* Current Gain $A_i = -\frac{I_2}{I_1} = \frac{-h_{21}}{1+h_{22}R_L}$ = forward current gain.

* Input impedance $Z_i = h_{11} - \frac{h_{12}h_{21}R_L}{1+h_{22}R_L}$ = Input impedance.

* Voltage gain, $V_2 = -I_2 R_L$ $A_V = \frac{-h_{21}R_L}{h_{11}+\Delta h R_L}$ = voltage gain.

* Output impedance ($V_1 = 0$) $Z_0 = \frac{V_2}{I_2} = \frac{R_s + h_{11}}{R_s h_{22} + \Delta h}$ = O/p impedance

2) Draw and explain the h-parameter equivalent circuit of a transistor in CC configuration. Derive the expression for Input impedance, output impedance, voltage gain & current gain. (8).

Hybrid equivalent circuit for CC configuration

$V_1 = V_{bc}$ $I_1 = I_b$ $h_{11} = h_{ic}$ $h_{12} = h_{rc}$

$V_2 = V_{ec}$ $I_2 = I_e$ $h_{21} = h_{fc}$ $h_{22} = h_{oc}$

* diagram for CC configuration

* Current gain, $A_i = \frac{h_{fc}}{1+h_{oc}R_L}$

* Input impedance, $Z_i = h_{ic} - \frac{h_{rc}h_{rc}R_L}{1+h_{oc}R_L}$

* Voltage gain $A_V = \frac{h_{fc}R_L}{h_{ic}+\Delta h R_L}$; O/p impedance $Z_0 = \frac{R_s + h_{ic}}{R_s h_{oc} + \Delta h}$.

3. Explain the switching characteristics of a transistor with neat sketch (10)

Transistor parameters : Input impedance $h_{ib} = \frac{\Delta V_{EB}}{\Delta I_E}\Big|_{V_{CB}\text{ constant}}$

Output admittance, $h_{ob} = \frac{\Delta I_c}{\Delta V_{CB}}\Big|_{I_E\text{ - constant.}}$

forward current gain, $h_{fb} = \frac{\Delta I_c}{\Delta I_E}\Big|_{V_{CB}\text{ - constant.}}$

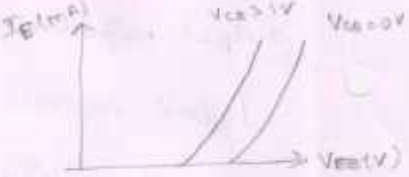
Reverse voltage gain, $h_{rb} = \frac{\Delta V_{EB}}{\Delta V_{CB}}\Big|_{I_E\text{ - constant.}}$

* Input characteristics diagram of CE, CB, CC configuration.
* output characteristics " " " "

4. Describe the static inputs and outputs characteristics of CB configuration of a transistor with neat circuit diagram (16)

Also called as grounded base configuration

* I/p terminal → emitter
* o/p terminal → collector
* Common terminal → Base
* diagram - circuit
* Input characteristics : V_{EB} Vs I_E.



→ $V_{CB} = 0$, EB → forward bias

→ I_E ↑, ↑ V_{EB}.

→ width ↓, V_{CB} ↑

→ V_{EB} - constant

Output characteristics : V_{CB} Vs I_c.

→ I_E → constant

→ V_{CB} ↑, I_c is noted

→ I_c independent of V_{CB}.

→ $V_{CB} = 0$, I_c flows.

5. Derive the expression for current gain, Input impedance and voltage gain of CE transistor amplifier (16)

* Circuit diagram of CE configuration

Input characteristics : → V_{BE} Vs I_B | V_{CE} → constant

↑ I_B ↑ V_{BE}, $V_{CE} = 0$, forward bias

Output characteristics : V_{CE} Vs I_C | I_B = constant.

→ V_{CE} ↑.

→ Saturation region

→ Cut off region below $I_B = 0$.

→ Active region.

* I/p impedance : $h_{ie} = \frac{\Delta V_{BE}}{\Delta I_B}$ | V_{CE} - constant

* O/p admittance , $h_{oe} = \frac{\Delta I_C}{\Delta V_{CE}}$ | I_B - constant

* forward current gain , $h_{fe} = \frac{\Delta I_C}{\Delta I_B}$ | V_{CE} constant

* Revone voltage gain $h_{re} = \frac{\Delta V_{BE}}{\Delta V_{CC}}$ | I_B - constant.

6. Draw the circuit for determining the transistor common emitter h-parameter equivalent circuit & write the input impedance, o/p impedance and voltage gain (16)

* $\frac{1}{h_{oe}}$ is in parallel with R_L. $\frac{1}{h_{oe}} >> R_L$, $I_e = h_{fe} I_b$.

* Circuit diagram for CE hybrid model.

* Current gain : $A_i = -h_{fe}$

* Voltage gain : $A_V = -\frac{h_{fe} R_L}{h_{ie}}$

* Input impedance : $R_i = h_{ie} + h_{re} A_i R_L$ $= V_b / I_b$

* O/p impedance : $\frac{V_c}{I_c}$, $V_s = 0$.

7. Explain the midband analysis of single stage CE, CB, and CC amplifier (16)

Single stage amplifier – only one amplifying device.

CE – Q point is determined by V_{cc}, R_B and R_c.

$$I_B = \frac{V_{cc}}{R_B} \; ; \; I_c = \beta I_B \; ; \; V_{CE} = V_{cc} - I_c R_c$$

Characteristics of CE amplifier : large A_I, A_V, A_P

CC – Remain active region. $V_o = I_E R_E = \beta I_B R_E$

characteristics of CC amplifier : High ct gain.
Large i/p impedance
Small o/p "

CB – Emitter → forward bias.
Reverse bias by V_{cc}. $V_o = V_{cc} - I_c R_c$.

Characteristics : High voltage gain.
Small i/p impedance
Large o/p ".

8. Explain the analysis of low frequency response of RC coupled amplifiers (16)

Low freq range – C is omitted., reactance is large.

Current gain : $A_{I1} = I_o/I_b$ $A_{I1} = \dfrac{A_{Im}}{\sqrt{1+(f_L/f)^2}}$

Phase angle $\Phi = 180^\circ + \tan^{-1}\left(\dfrac{1}{2\pi f C_c (R_o + R_L)}\right)$ $f = 0.707 |A_{Im}|$

Voltage gain : $A_{V1} = \dfrac{V_o}{V_i}$ $V_i = I_b h_{ie}$. $A_{V1} = \dfrac{|A_{Vm}|}{\sqrt{1+(f_L/f)^2}}$

$$\Phi = 180 + \tan^{-1}\left(\frac{1}{2\pi f C_c (R_c + R_L)}\right)$$

$\therefore f_L = \dfrac{1}{2\pi C_c (R_c + R_L)}$ both voltage & Current gain the lower 3dB freq are same.