FET AMPLIFIER

INTRODUCTION

Field Effect Transistor (FET) amplifiers provide an excellent voltage gain and high input impedence. Because of high input impedence and other characteristics of JFETs they are preferred over BJTs for certain types of applications.

There are 3 basic FET circuit configurations:

      i)Common Source

      ii)Common Drain

      iii)Common Gain

Similar to BJT CE,CC and CB circuits, only difference is in BJT large output collector current is controlled by small input base current whereas FET controls output current by means of small input voltage. In both the cases output current is controlled variable.

FET amplifier circuits use voltage controlled nature of the JFET. In Pinch off region, I_D depends only on V_{GS}.

Common Source (CS) Amplifier

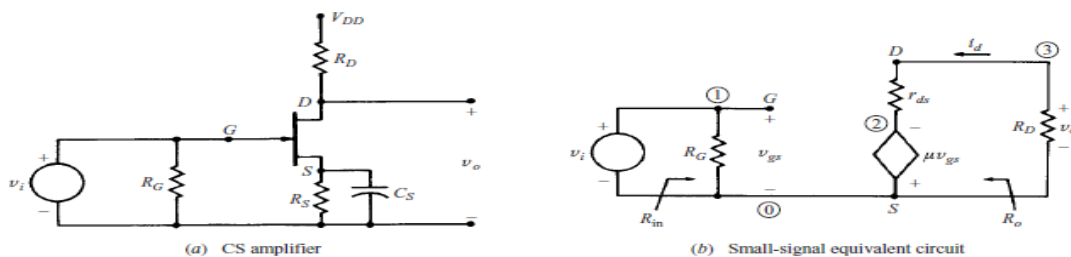(a) CS amplifier   (b) Small-signal equivalent circuit

Fig. 7.1 (a) CS Amplifier (b) Small-signal equivalent circuit

A simple Common Source amplifier is shown in Fig (a) and associated small signal equivalent circuit using voltage-source model of FET is shown in Fig (b)

Voltage Gain

Source resistance (R_S) is used to set the Q-Point but is bypassed by C_S for mid-frequency operation. From the small signal equivalent circuit, the output voltage

$$V_O = -R_D \mu V_{gs} (R_D + r_d)$$

Where $V_{gs} = V_i$, the input voltage,

Hence, the voltage gain,

$$A_V = V_O / V_i = -R_D \mu (R_D + r_d)$$

Input Impedence

From Fig (b) Input Impedence is

$$Z_{i =} R_G$$

For voltage divider bias as in CE Amplifiers of BJT

$$R_G = R_1 \parallel R_2$$

Output Impedance

Output impedance is the impedance measured at the output terminals with the input voltage $V_I = 0$

From the Fig. (b) when the input voltage $V_i = 0$, $V_{gs} = 0$ and hence

$$\mu V_{gs} = 0$$

The equivalent circuit for calculating output impedence is given in Fig..

Output impedence $Z_o = r_d \parallel R_D$

Normally r_d will be far greater than R_D . Hence $Z_o \approx R_D$