UNIT-1 Lecture-5

Bias circuit, short circuit protection circuitry, the input stage, the second stage, the output stage



The reference bias current of the 741 circuit, I_{REF} , is generated in the branch at the extreme left of Fig, Q_{11} and Q_{12} and the resistance R_5 .

SHORT-CIRCUIT PROTECTION CIRCUITRY

•The 741 circuit includes large number of transistors that are normally off and conduct only when large output current is required.

•The large current can be achieved at the output terminals if the output terminal is short-circuited to one of the two supplies.

•This circuit protects the IC if an excess load current is drawn from it.

•The short-circuit protection network consists of R_6 , R_7 , Q_{15} , Q_{21} , Q_{24} , R_{11} and Q_{22} .

THE INPUT STAGE

- Input stage consists of transistors through Q_1 to Q_7 .
- The biasing is performed by transistors Q_8 , Q_9 and Q_{10} .
- Transistors Q_5 , Q_6 and Q_7 and resistors R_1 , R_2 and R_3 form the load circuit of the input stage.

- Every OP-AMP circuit uses a level shifter.
- The function of level shifter is to shift the dc level of the signal so that the signal at the OP-AMP output can swing positive and negative.
- In 741, level shifting is done in the first stage using the lateral pnp transistors Q_3 and Q_4 .

THE SECOND STAGE

• The second stage or intermediate stage is composed of Q_{16} , Q_{17} , Q_{13B} , and two resistors R_8 and R_9 .

•Transistor Q_{16} acts as an emitter follower.

•So it provides high input resistance to the second stage.

•This minimizes the loading on the input stage and avoids the loss of gain.

•Transistor Q_{17} acts as an common-emitter amplifier with a 100 Ω resistance in its emitter. •Its load is composed of the high output resistance of the pnp current source Q_{13B} in parallel with the input resistance with the output stage.

•The output of the second stage is taken at the collector of Q_{17} .

•Capacitor $C_{\rm C}$ is connected in the feedback path of the second stage to provide frequency compensation.

•Capacitor $C_{\rm C}$ is small in value.

•The chip are for Capacitor $C_{\rm C}$ is about 13 times that of a standard *npn* transistor.

THE OUTPUT STAGE

•741 uses class AB output stage.

•The purpose of the output stage is to provide the amplifier with low output resistance.

•Emitter follower circuit is the class A output stage.

•The drawback of the class A output stage is large power dissipated in the transistor.

•This power dissipation can be reduced by arranging the transistor to turn on only when an input signal is applied.

So in order to reduce the power dissipation two transistors are required.

•An npn to source the output current and a pnp transistor to sink the output current.

- •This kind of arrangement is called class B output stage.
- •Both the transistors will be cutoff when $v_{I} = 0$.
- •When $v_{\rm I}$ goes positive $Q_{\rm N}$ conducts while $Q_{\rm P}$ remains off.
 - When $v_{\rm I}$ goes negative transistors reverse roles.

•Class B output stage is efficient in power dissipation, but the output signal is distorted.

•Output signal is distorted when $|v_I|$ is less then about 0.5, neither of the transistors will conduct.

•This is called crossover distortion.

•Crossover distortion can be reduced by biasing the output stage transistors at low current.

•In this case, the output stage transistors will remain conducting when $v_{\rm I}$ is small.