SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: 23BMB101-Electron Devices and Circuits

I Year : II Semester

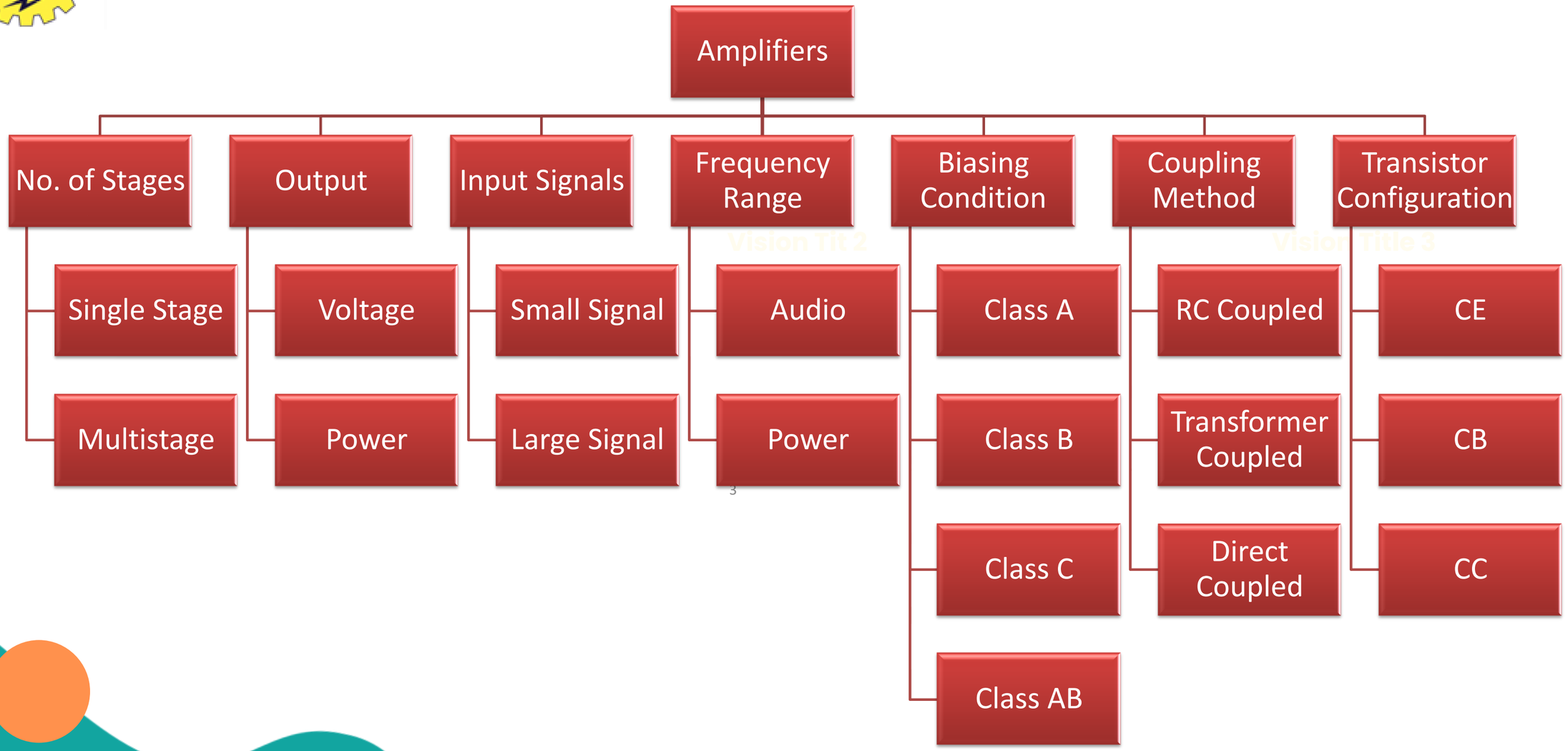
Unit IV –Power Amplifiers & Switching Circuits

Topic : Transformer Coupled Class A Amplifier

INTRODUCTION

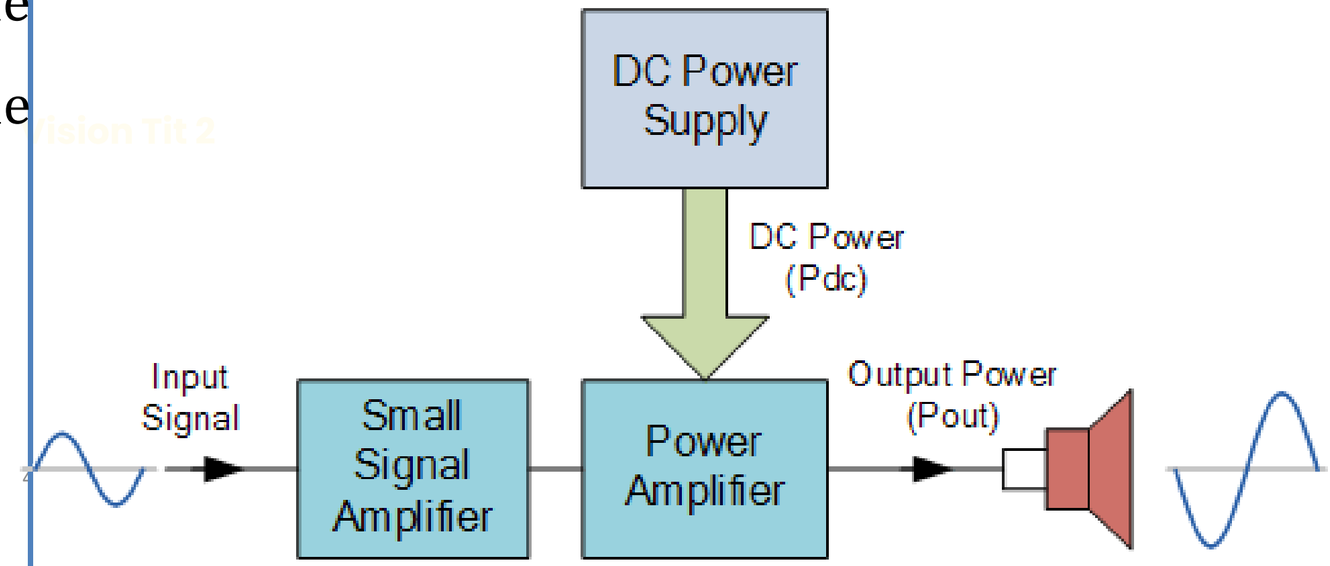
- Common Emitter (CE) amplifiers are designed to produce a large output voltage swing from a relatively small input signal voltage of only a few millivolt's and are used mainly as "small signal amplifiers".
- Sometimes an amplifier is required to drive large resistive loads such as a loudspeaker or to drive a motor in a robot and for these types of applications where high switching currents are needed Power Amplifiers are required.
- Because of the high load currents the output transistor(s) used for power amplifier output stages such as the **2N3055** need to have higher voltage and power ratings than the general ones used for small signal amplifiers such as the **BC107**.

Types


Amplifiers
No. of Stages
Output
Input Signals
Frequency Range
Biasing Condition
Coupling Method
Transistor Configuration
Single Stage
Multistage
Voltage
Power
Small Signal
Large Signal
Audio
Power
Class A
Class B
Class C
Class AB
RC Coupled
Transformer Coupled
Direct Coupled
CE
CB
CC

Power Amplifier

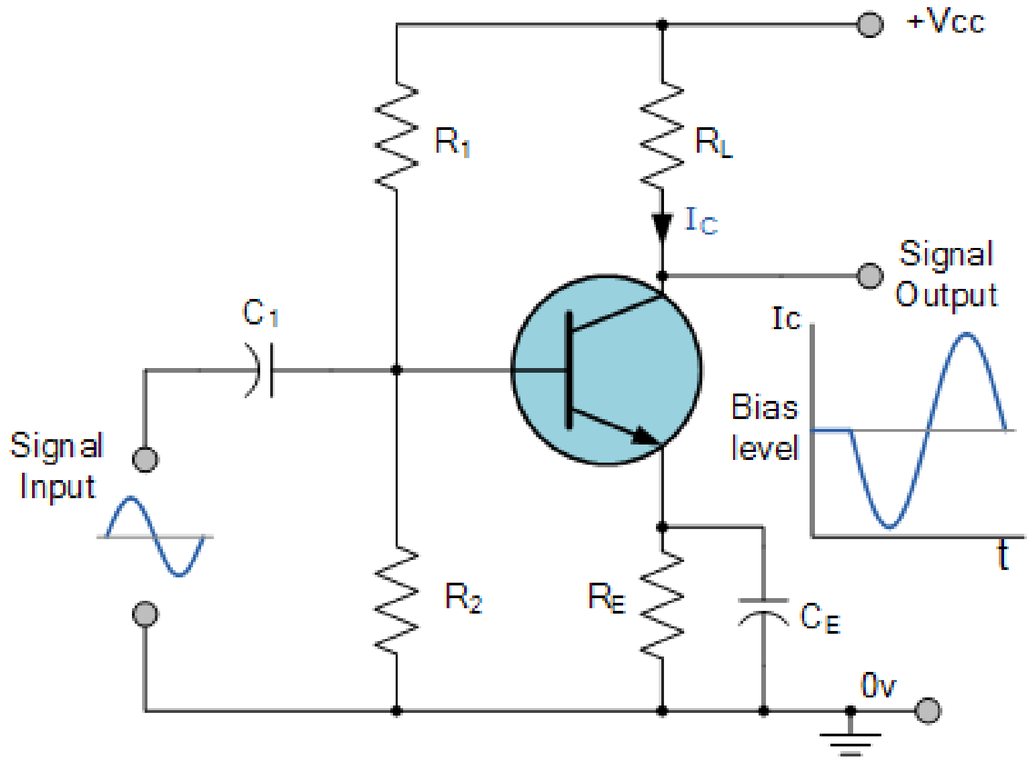
- The power amplifiers are classified based on their mode of operation that is the portion of the input cycle during which the collector current is expected to flow.
  - ✓ Class A power amplifier
  - ✓ Class B power amplifier
  - ✓ Class C power amplifier
  - ✓ Class AB power amplifier
  - ✓ Class D, E, G, S, T power amplifiers (Switching Power Amplifiers)

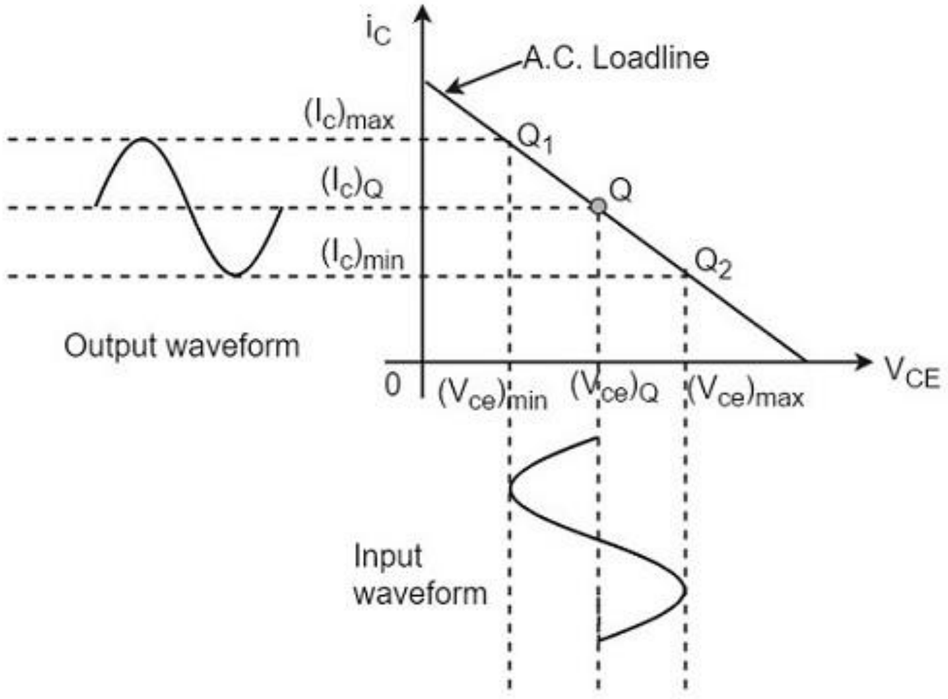


Class A Power Amplifier

- A Class A power amplifier is one in which the output current flows for the entire cycle of the AC input supply. Hence the complete signal present at the input is amplified at the output.
- Class A amplifier is defined as one that has the Q-point (bias point) approximately at the centre of the ac load line. This enables the circuit to produce maximum equal positive and negative changes in Vce.

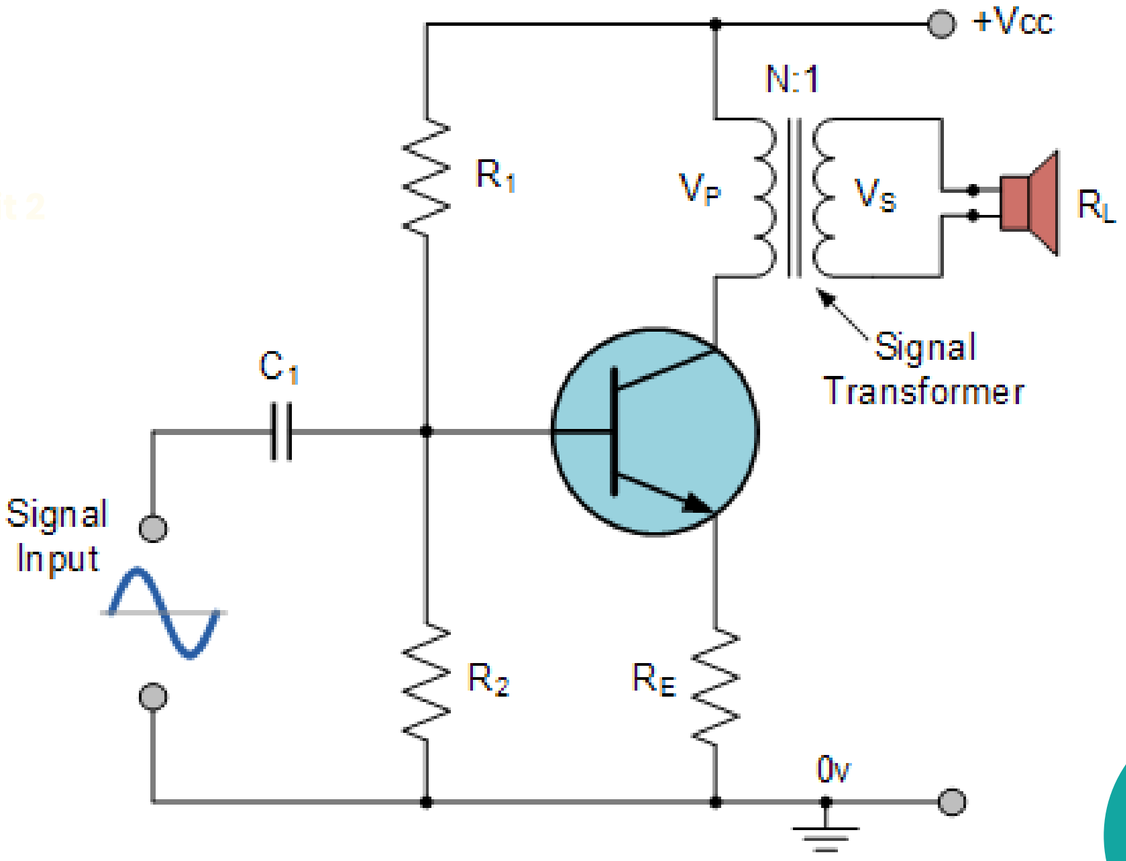
Class A Power Amplifier





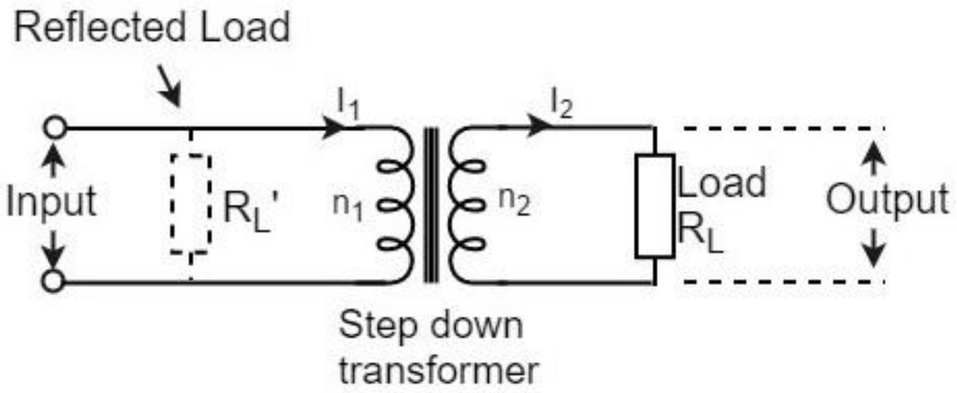
Transformer Coupled Class A Power Amplifier

- Here R1 and R2 provide potential divider arrangement.
- The resistor Re provides stabilization, Ce is the bypass capacitor and Re to prevent a.c. voltage. The transformer used here is a step-down transformer.
- The high impedance primary of the transformer is connected to the high impedance collector circuit. The low impedance secondary is connected to the load (generally loud speaker).



Transformer Coupled Class A Power Amplifier

- As the Collector current, Ic is reduced to below the quiescent Q-point set up by the base bias voltage, due to variations in the base current, the magnetic flux in the transformer core collapses causing an induced emf in the transformer primary windings.
- This causes an instantaneous collector voltage to rise to a value of twice the supply voltage 2Vcc giving a maximum collector current of twice Ic when the Collector voltage is at its minimum.



$$\frac{V_1}{V_2} = \frac{n_1}{n_2} \; and \; \frac{I_1}{I_2} = \frac{n_1}{n_2}$$

$$\frac{V_1}{I_1} = \left(\frac{n_1}{n_2}\right)^2 \frac{V_2}{I_2}$$

$$R'_L = \left(\frac{n_1}{n_2}\right)^2 R_L = n^2 R_L$$

Class A Power Amplifier

- The efficiency of a power amplifier is a measure of how good the amplifier is at converting the dc input (supply) power (Pi) into ac output power (P0) dissipated in the load.

$$= \frac{(P_O)_{ac}}{(P_{in})_{dc}}$$

- The dc supply power is ; $P_i = V_{cc} \times I_{avg}$ ie, $P_i = V_{cc} \times I_{CQ}$
- The maximum ac power delivered to the transformer primary can be calculated as follows:

$$P'_o = V_{rms} \times I_{rms} = (V_p/\sqrt{2}) \times (I_p/\sqrt{2})$$

$$P'_o = 0.5\, V_p I_p$$

Class A Power Amplifier

- Using the highest possible current and voltage, and assuming that the transformer is 100% efficient,

$$P_0 = 0.5V_{cc} \times I_{CQ}$$

- The maximum theoretical efficiency for a class A transformer-coupled power amplifier can now be determined as

$$\eta = \frac{P_o}{P_i} \times 100\% = \frac{0.5 V_{CC} I_{CQ}}{V_{CC} I_{CQ}} \times 100\%$$

$$= 50\%$$