Lecture Study Guideline

You need to follow three steps to study

Step 1: Watch the topic related video uploaded on LMS.

Step 2: Read the lecture notes attached.

Step 3: Read the topic from course book.

Topic: Power amplifiers

Step 1

Watch the topic related video uploaded on LMS.

Step 2

Power Amplifiers.

Power amplifiers are large-signal amplifiers.

We have four classes of power amplifier.

Class A

class B.

class AB.

class C.

classes are divided on the percentage of the input cycle for which the amplifier operates in its linear region.

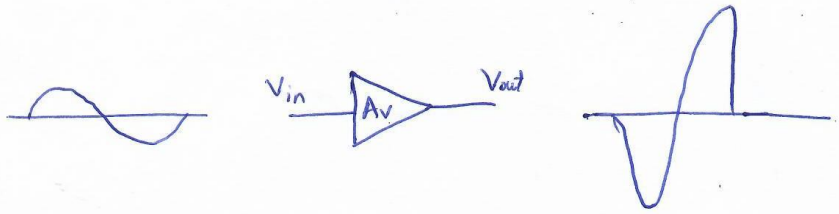
The emphasis is on power amplification.

Power amplifiers are normally used as the final stage of a communications receiver or transmitter to provide signal power to speakers or to a transmitting antenna.

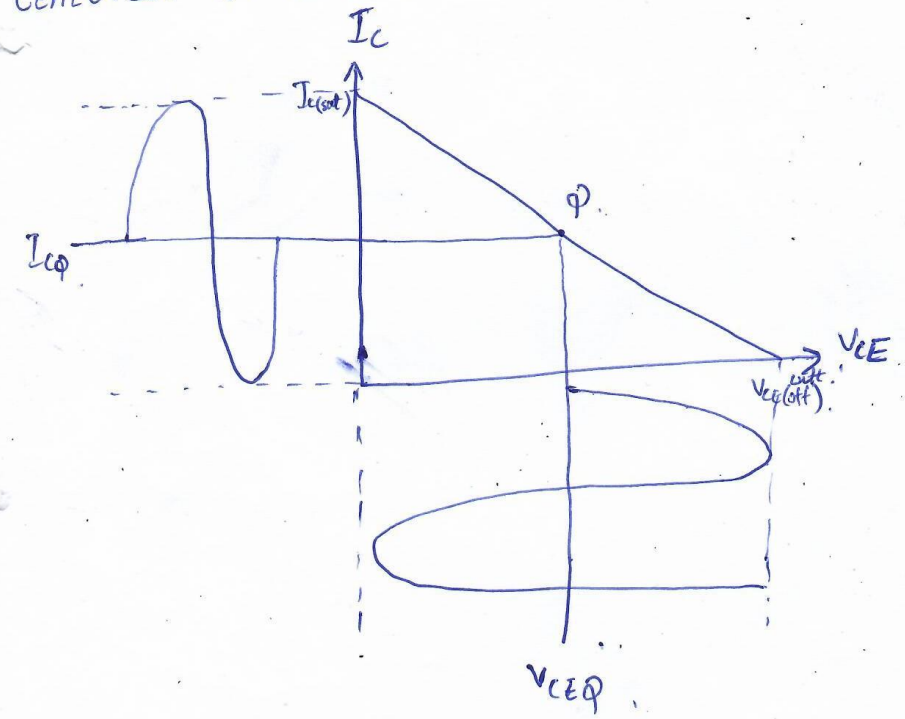
Class A power amplifier :-

When an amplifier is biased such a way that it always operates in the linear region where the output signal is an amplified replica of the input signal, it is a class A amplifier.

Class A power amplifiers are large signal amplifiers with the objective of providing power to a load.



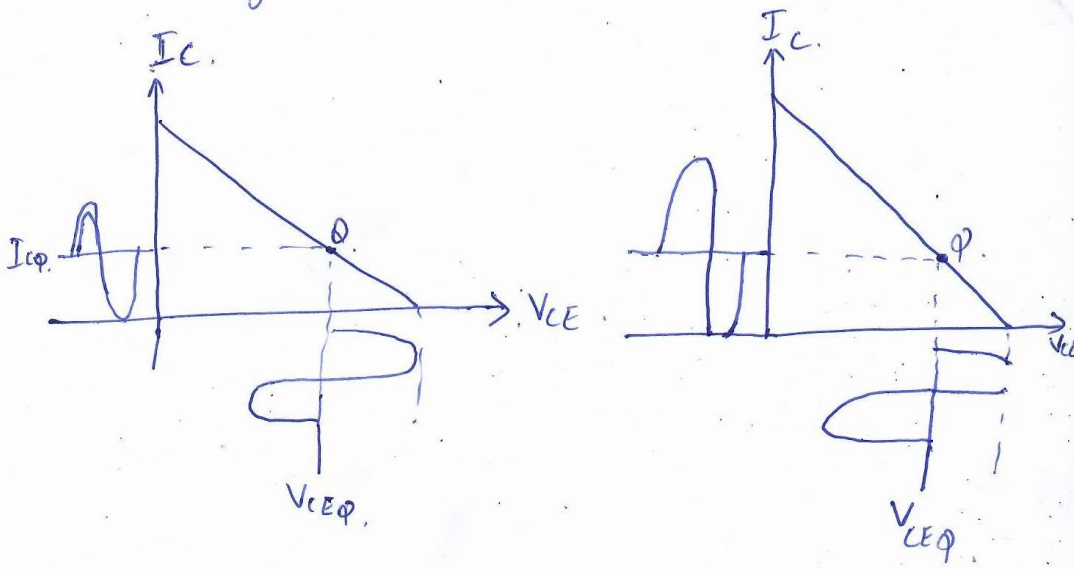
Centered Q-Point :-



When the Q point is at the centre of AC load line, a maximum class A signal can be obtained.

collector current can vary from its saturation to its cutoff value of zero.

collector to emitter voltage also swings in the same way like collector current.



In this case Q point is moved away from center toward cutoff. The output variation is limited by cutoff in this case.

Also draw if Q point move towards saturation region.

Power Gain :-

The power gain of an amplifier is the ratio of the power delivered to the load to the input power.

$$\text{Power gain } A_p = \frac{P_L}{P_{in}} \quad \text{——— (1)}$$

where A_p power gain, P_L signal power delivered to the load, P_{in} is signal power delivered to the amp.

$$P = VI \qquad I = \frac{V}{R} \text{ (by ohm's law)}$$

$$P = \frac{V^2}{R}$$

output power delivered to the load is

$$P_L = \frac{V_L^2}{R_L}$$

Input power delivered to the amplifier is

$$P_{in} = \frac{V_{in}^2}{R_{in}}$$

Using values of P_L and P_{in} eqn (1)

$$A_p = \frac{V_L^2}{R_L} \cdot \frac{R_{in}}{V_{in}^2}$$

$$\frac{V_L}{V_{in}} = A_V \text{ (voltage gain)}.$$

$$A_p = \frac{V_L^2}{V_{in}^2} \frac{R_{in}}{R_L} = A_V^2 \left(\frac{R_{in}}{R_L}\right).$$

$A_p = A_V^2 \left(\frac{R_{in}}{R_L}\right)$ This is valid for all type of amplifiers.

Example:

Common-collector amplifier.

Input resistance $R_{in} = 10K\Omega$.

Load resistance $R_L = 100\Omega$.

Voltage gain for common collector $A_V = 1$

$$A_p = A_V^2 \left(\frac{R_{in}}{R_L}\right).$$

$$A_p = \frac{10K\Omega}{100\Omega}$$

$$\boxed{A_p = 100.}$$

Efficiency :

The efficiency of any amplifier is the ratio of the signal power supplied to a load to the power from the dc supply.

$$eff = \frac{P_{out}}{P_{DC}}$$

For class A amplifier, maximum efficiency is

$$P_{out} = 0.5 I_{CQ} V_{CEQ}$$

$$P_{DC} = 2 I_{CQ} V_{CEQ}$$

$$eff_{max} = \frac{0.5 I_{CQ} V_{CEQ}}{2 I_{CQ} V_{CEQ}}$$

$$eff_{max} = 0.25 \text{ or } 25\%$$

This is the maximum efficiency for class A amplifiers and it could not be greater than that value.

Step3: Read topic 9.1 from text book (Thomas L Floyd 7th edition)

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Topic: Class B & Class AB Amplifiers

Step 1

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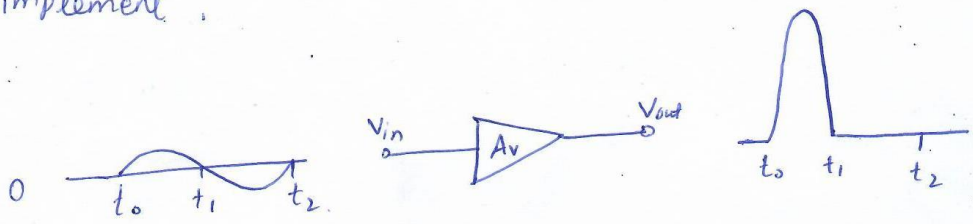
Step 2

Class B operation :

An amplifier is biased at cutoff so that it operates in the linear region for 180° of the input cycle and is in cutoff for 180, it is a class B amplifier.

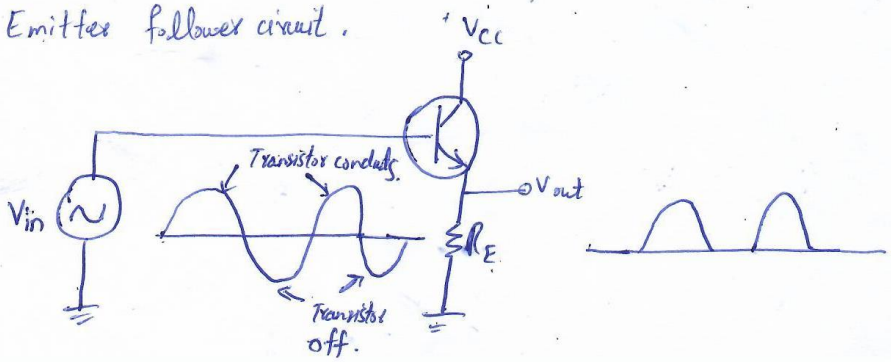
class B gives more output power as compared to class A amplifier. But it is difficult to implement.



Q- point is at cutoff region.

In class B $I_{CQ} = 0$ $V_{CEQ} = V_{CE(cutoff)}$.

Emitter follower circuit.



Class B Push-Pull operation :-

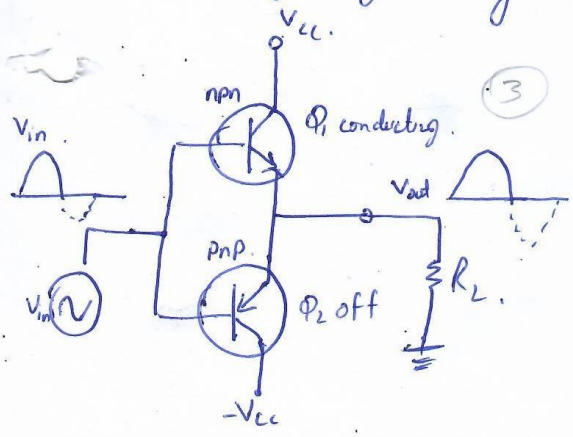
Class B operates only in one cycle to overcome this problem we will add a second class B amplifier which will operate in -ve half cycle. The combination of these two amplifiers together is called push-pull operation.

Two types of push pull amplifiers are used

(i) Transformer coupling.

(ii) Complementary Symmetry Transistor.

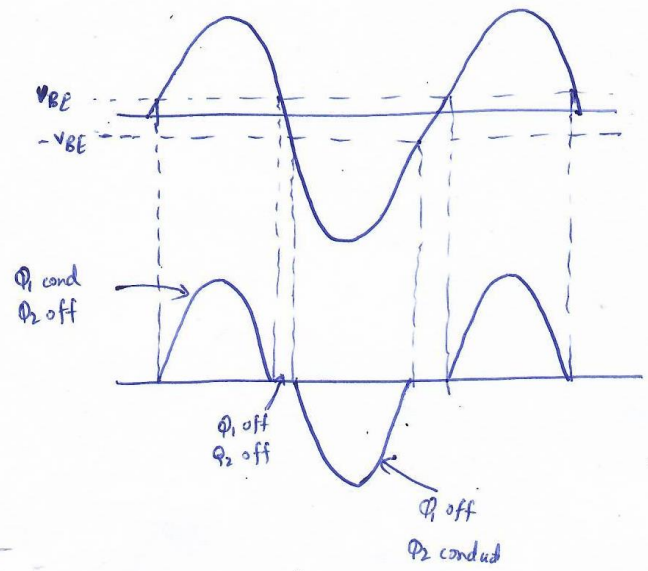
Complementary Symmetry Transistor :-



(3)

Similarly for -ve half cycle Q_2 conducting and Q_1 is off.

5(a).



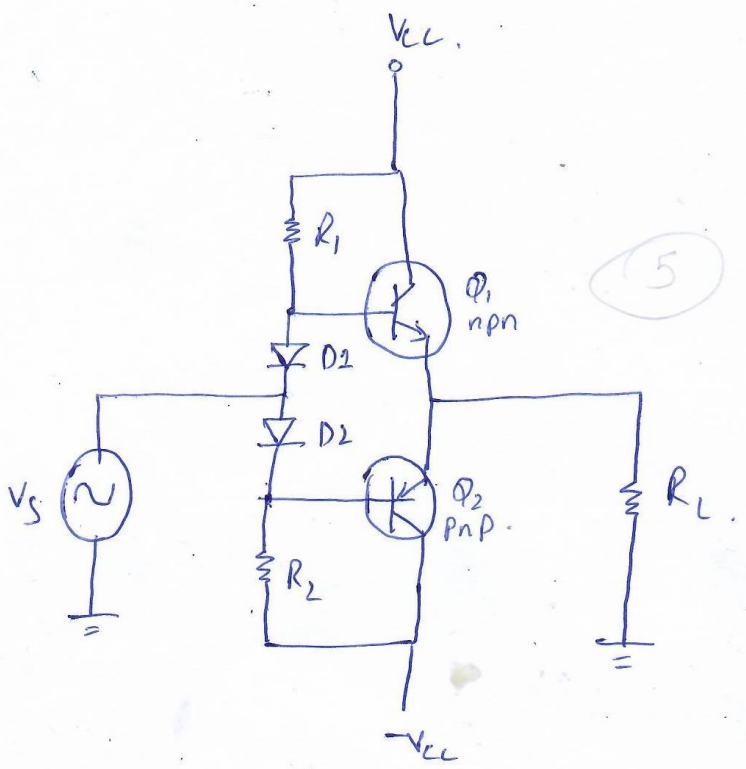
Crossover distortion : (2)

When both Q_1 and Q_2 become off and no output is generated for small interval of time this is called crossover distortion.

To overcome this problem we modified this type and resultant amplifier is called Class AB operation.

Biasing the Push-Pull amplifier for class AB operation :-

Two arrangements are used one voltage divider and other diode arrangement.



Diode characteristics of D1 and D2 are closely matched to the characteristics of the tranistor base-emitter junction, current in the diodes and the current in the transistors are the same this is called current mirror. This current mirror produces the desired class AB operation and eliminates crossover distortion.

Step3: Read topic 9.2, 9.3 from text book (Thomas L Floyd 7th edition)