Chapter 3 Transistor Amplifiers

One mark questions (knowledge)

- 1. What is an amplifier?
- 2. Define amplification.
- 3. What is faithful amplification?
- 4. What is the function of coupling capacitor in an amplifier?
- 5. What is meant by small signal amplifier?
- 6. What is meant by large signal amplifier?
- 7. Define voltage gain of an amplifier?
- 8. Write an expression for voltage gain in dB.
- 9. What is power gain?
- 10. Write the expression for power gain in dB.
- 11. Define bandwidth of an amplifier.
- 12. Mention the unit of bandwidth.
- 13. What is meant by frequency response of an amplifier?
- 14. What is buffer amplifier?
- 15. What is cascaded amplifier?
- 16. What is a power amplifier?
- 17. Write the expression for efficiency of power amplifier.
- 18. What is an RF amplifier?
- 19. What is meant by a single stage amplifier?
- 20. What is meant by multistage amplifier?
- 21. Define class A operation.
- 22. Define class B operation.
- 23. Define class AB operation.
- 24. Define class C operation.
- 25. Name the power amplifier whose operating point lies exactly at the center of the dc load line.
- 26. Name the power amplifier whose operating point lies exactly at the cut-off point on dc load line.
- 27. Name the power amplifier whose operating point lies slightly above the cut-off point on dc load line.
- 28. Name the power amplifier whose operating point lies slightly below the cut-off point on dc load line.

One mark questions (understanding)

- 1. Which amplifier is called as a unity gain amplifier?
- 2. Name the amplifier which has the highest current gain.
- 3. Which transistor amplifier has a phase shift of 180[°] between input and output signals?
- 4. Why is the CC amplifier called as an emitter follower?
- 5. Which transistor amplifier has voltage gain less than unity?
- 6. What is the function of bypass capacitor in amplifiers?
- 7. Mention the importance of dc equivalent circuit in the analysis of an amplifier.
- 8. Which equivalent circuit is used to derive the amplifier parameters?
- 9. Write the expression of voltage gain using r'_{e} model by considering the load resistor R_{L} .

- 10. Where is the operating point of class A operation located?
- 11. Where is the operating point of class B operation located?
- 12. Where is the operating point of class AB operation located?
- 13. Where is the operating point of class C operation located?
- 14. Which power amplifier has the highest power efficiency?

One mark questions (skill)

- 1. Sketch the graph showing cross-over distortion in push pull amplifier.
- 2. Draw the frequency response curve of direct coupled CE amplifier.

Two mark questions (knowledge)

- 1. Define the terms amplification and amplifier.
- 2. Define small and large signal amplifiers.
- 3. Define voltage gain and current gain of an amplifier.
- 4. Write the expression of voltage gain and power gain in decibels?
- 5. Define input impedance and output impedance of an amplifier.
- 6. What is frequency response of an amplifier? Define bandwidth of an amplifier.
- 7. Mention the steps involved in drawing dc equivalent circuit of an amplifier.
- 8. Mention the steps involved in drawing ac equivalent circuit of an amplifier.
- 9. Mention any two characteristics of CC amplifier.
- 10. Mention any two characteristics of CE amplifier.
- 11. Mention any two characteristics of CB amplifier.
- 12. Mention the disadvantages of direct coupled amplifier?
- 13. Write the advantages of RC coupled amplifier?
- 14. What is cascading? Mention any one type of cascading.

Two mark questions (understanding)

- 1. Why do we prefer to express the gain in decibel?
- 2. Classify amplifiers based on operating point.
- 3. Explain the factors affecting the gain at low and high frequencies.
- 4. Why is CE amplifier most commonly used in electronic circuits?
- 5. Explain the functions of the coupling and bypass capacitors?
- 6. Why the gain of a CE amplifier decreases at very low frequencies?
- 7. Why the gain of a CE amplifier decreases at very high frequencies?
- 8. Why the gain of a CE amplifier remains constant at mid frequencies?
- 9. Distinguish between voltage amplifiers and power amplifiers.
- 10. Why is the power amplifier called as a large signal amplifier?
- 11. Explain cross-over distortion in power amplifier.

Two mark questions (skill)

- 1. Draw the DC equivalent circuit for a single stage CE amplifier using voltage divider biasing.
- 2. Draw the circuit diagram of a single stage CE amplifier using voltage divider bias along with its input and output waveforms.
- 3. Draw the circuit diagram of CB amplifier with its input and output waveforms.
- 4. Draw the circuit diagram of a CC amplifier, show its input and output waveforms.

- 5. Draw the circuit diagram of a common source JFET along with its input and output waveforms.
- 6. Draw the ac equivalent circuit for a single stage CE amplifier using voltage divider biasing.
- 7. Draw the r'_{e} model of the transistor in CE mode.
- 8. Draw the frequency response of CE amplifier. Mention the expression for bandwidth.
- 9. Draw the circuit diagram of a class B push pull power amplifier.
- 10. Draw the circuit diagram of collector tuned class C power amplifier.
- 11. With the help of the wave form explain cross over distortion.
- 12. In a CE amplifier circuit R_c = 3.3K Ω and R_L = 4.7K Ω . Calculate the output impedance.
- 13. If the ac resistance of the emitter diode is 50Ω , $R_c = 20K\Omega$ and β of the transistor is 70, calculate the power gain and voltage gain of an amplifier.
- 14. Calculate the voltage gain of a CE amplifier if the value of R_c is 2.2K Ω , R_L is 3.3K Ω and r'_e is 52 Ω .

Three mark questions (knowledge)

- 1. Define the input impedance, output impedance and current gain of an amplifier.
- 2. Define class A, class B and class C power amplifiers.

Three mark questions (understanding)

- 1. Compare CE, CB and CC amplifier with respect to voltage gain and phase relation.
- 2. Compare CE, CB and CC amplifier with respect to input and output impedance.
- 3. Derive the expression for voltage gain and output impedance of single stage CE amplifier with r'_{e} model.
- 4. Derive the expressions for power gain and input impedance of single stage CE amplifier using r'_{e} model.
- 5. Explain in brief the frequency response of a single stage CE amplifier.
- 6. Write any three differences between the voltage amplifiers and power amplifiers.

Three mark questions (skill)

1. Draw the graphical representation and amplification for small signal by choosing Q point near active region.

Five mark questions (knowledge)

- 1. Write the procedure involved in obtaining AC and DC equivalent circuits of voltage divider biasing CE amplifier. Write the AC equivalent circuit.
- 2. What is a cascaded amplifier? What is the need for cascading? Obtain an expression for overall voltage gain of a cascaded amplifier.

Five mark questions (understanding)

- 1. Compare CE, CB and CC amplifiers.
- 2. With a circuit diagram describe the working of a CB amplifier and draw its input and output waveforms.
- 3. Explain the working of CE amplifier with a circuit diagram using voltage divider bias and draw its input and output waveforms.
- 4. Explain the working of CC amplifier with a circuit diagram and draw input and output waveforms.

- 5. Explain the working of common source JFET amplifier with its circuit diagram and draw input and output waveforms.
- 6. Explain with a circuit diagram the working of class B push pull power amplifier.
- 7. Explain with the circuit diagram, the working of Direct coupled CE amplifier. Draw the frequency response.
- 8. With a circuit diagram explain the working of two stage RC coupled CE amplifier. Draw its frequency response curve.

Five mark questions (skill)

- 1. With a circuit diagram describe the working of a CB amplifier and draw its input and output waveforms.
- 2. Explain the working of CE amplifier with a circuit diagram using voltage divider bias and draw its input and output waveforms.
- 3. With a circuit diagram describe the working of push-pull amplifier and draw its input and output waveforms.

Problems:

 A three stage amplifier has a first stage voltage gain of 10, second stage voltage gain of 50 and third stage voltage gain of 400. If the input voltage given at the first stage of amplifier is 10μV, calculate the output of each stage. Also find the total voltage gain in dB.

(Ans:
$$V_{o1}$$
=0.1mV, V_{o2} =5mV, V_{o3} =2V, $A_v dB$ = 106.02 dB)

2. Find the voltage gain and input resistance of a single stage CE amplifier if $V_{CC} = 18V$, $R_1 = 47 \text{ K}\Omega$, $R_2 = 12\text{K}\Omega$, $R_C = 3.3 \text{ K}\Omega$, $R_E = 1000 \Omega$, $R_L = 10\text{K}\Omega$, $\beta = 100$, $V_{BE} = 0.3 \text{ V}$ and $r'_e = 52\text{mV/I}_E$.

(Ans: $Z_{\text{IN}}\text{=}$ 1.33 K Ω and $A_{\text{V}}\text{=}160$)

3. For the circuit given below $R_1 = 100K\Omega$, $R_2 = 10K\Omega$, $R_c = 2.2K\Omega$, $R_E = 220\Omega$, $V_{CC} = 15V$, $I_E = 3.41$ mA and $\beta = 100$, calculate the voltage gain, r'_e , power gain, A_V in dB and A_P in dB.

(Ans: A_V = 288.7, r'_e = 7.62 Ω , A_P = 28870, A_V in dB = 49.20dB and A_P in dB = 44.60dB)



- 4. For the CE amplifier circuit using silicon transistor given below, find
 - i) voltage across $10k\Omega$ ii) I_E iii) r'_e iv) A_v v) A_i . Given $\beta = 100$, $V_{BE} = 0.3$ and $r'_e = \frac{26mV}{I_E}$. Ans (i) $V_{10k} = 1.36V_{,}$ ii) $I_E = 3mA$, iii) $r_e^{-1} = 8.67\Omega$ iv) $A_v = -253.8$ v) $A_i = 100$)



- 5. CE amplifier circuit using Germanium transistor is shown in figure, calculate
- i) voltage across 12 k Ω ii) I_{E} , iii) $Z_{in\,(base)}$ iv) $A_{v}\,$ v) $Z_{o}.$

Given: $r'_e = \frac{52mV}{l_E}$, V_{BE} = 0.3 and β=150. Ans (i) V_{12k} = 3.66V ii) I_E = 3.36mA iii) Z_{in(base)} = 2.32kΩ iv) A_v = -323.2 v) Z_o = 5kΩ)



- If an amplifier is provided with input voltage of 5mV, the maximum voltage gain is 2000 for signal frequency of 2 KHz. It falls to 1414 at 10 KHz and 50Hz. Find the output voltage, gain in dB, upper cut-off frequency, lower cut-off frequency and bandwidth.
- (Ans: V₀=10V, A_{Vmax} in dB= 66.02dB, f_L= 50 Hz, f_H= 10 KHz and BW= 9.95 KHz)
 7. A three-stage amplifier has a first stage voltage gain of 100, second stage voltage gain of 200 and third stage voltage gain of 400. Find the total voltage gain in dB.

(Ans: 138dB)