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QUESTION BANK

Name of the Department : **Electronics and Communication Engineering**

Subject Code & Name : **EC8351 & Electronic Circuits-I**

Year & Semester : **II & III**

UNIT I BIASING OF DISCRETE BJT,JFET AND MOSFET

PART-A

1. Why biasing is necessary in BJT amplifers?

1) To have the amplified signal swing in both positive and negative polarities.
2) To operate the transistor in the desired region.
3) To keep the Q point in the desired position.
4) To establish a working current even without an input signal.
5) To achieve stability

2. Define biasing.

The transistor acts as a switch when it is operated at either cutoff region or saturation region. It acts an amplifier at linear region.

3. What is the need for biasing?

When a transistor is biased properly, it works efficiently and produces no distortion in the output signal and thus operating point can be maintained stable.

4. What is operating point (or) Quiescent Point.

For the proper operation of the transistor a fixed level of current and voltages are required. This values of currents and voltages defined at a point at which the transistor operate is called operating point. The Q – point is also called as operating point or bias point.

5. List the factors which affect the Q-Point.

Q-point varies with respect to following parameters,

1. Reverse saturation current (I_{CO})
2. Base-emitter voltage (V_{BE})
3. Current gain (β)

6. Why is the operating point selected at the centre of the active region?

The operating point of a transistor is kept fixed usually at the center of the active region in order that the input signal is well amplified. (i.e.) faithful amplification. Moreover there is no distortion.

7. What do you understand by DC & AC load line?

DC Load Line

It is the line on the output characteristics of a transistor circuit which gives the values of I_C & V_{CE} corresponding to zero signal (or) DC Conditions.

AC Load Line

This is the line on the output characteristics of a transistor circuit which gives the values of I_C & V_{CE} when signal is applied.

8. Define the 3 stability factors.

Stability factors S is defined as the rate of change of collector current I_C with respect to the collector leakage current I_{CO}, keeping V_{BE} and β constant.

Stability factor S' is defined as the rate of change of collector current I_C with respect to the base-emitter voltage V_{BE}, keeping I_{CO} and β constant.

Stability factor S'' is defined as the rate of change of collector current I_C with respect to the current gain β, keeping I_{CO} and V_{BE} constant.

9. What is thermal runaway?

The increase in the collector current increases the power dissipated as the collector junction. When temperature increases, collector current further increases. This process is cumulative. The excess heat produced at the collector base junction may even burn and destroy the transistor. This situation is called thermal runaway.

10. Give the standard equation for the stability factor S.

The collector current for a common emitter amplifier is given by

$$I_C = \beta I_B + (1+\beta) I_{CO}$$

Differentiating the above equation with respect to I_C we get,

$$\frac{dI_C}{dI_C} = \beta\left(\frac{dI_B}{dI_C}\right) + (1+\beta)\frac{dI_{CO}}{dI_C} \qquad S = \frac{dI_C}{dI_{CO}}$$

$$1-\beta\left(\frac{dI_B}{dI_C}\right) = (1+\beta)\frac{1}{S}$$

$$\boxed{S = \frac{1+\beta}{1-\beta\left(\frac{dI_B}{dI_C}\right)}}$$

The above equation can be considered as a standard equation for derivation of stability factor of other biasing circuits.

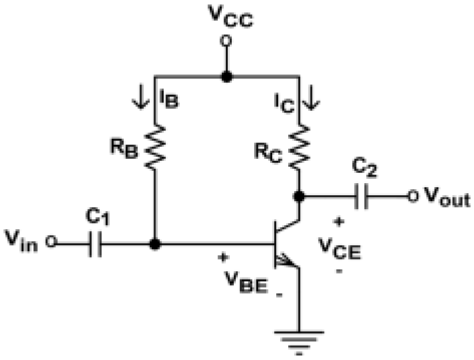
11. List the types of biasing circuits.

1) Fixed bias circuit or Base resistor method
2) Collector to base bias or Feedback resistor method
3) Voltage divider bias or Emitter bias or Self Bias

12. Why fixed bias circuit not used in practice.

The stability of the fixed bias circuit is very less. Since the stability factor of this circuit is S = 1+β which is a large quantity, stability is less. So, it is not used in amplifier circuits.

13. Sketch the fixed bias circuit.



14. List the advantages and disadvantages of fixed bias.

Advantages:

1) The fixed bias circuit is simple and has less number of components.

2) It gives very good flexibility as the Q-point can be set at any point in the active region by just adjusting the value of R_B.

Disadvantages:

1) I_C increases with temperature, Hence there is poor thermal stability. $I_C = \beta I_B$, Hence Ic depends on β, β may change from transistor to transistor, This will shift the operating point. Hence stabilization is very poor in fixed bias circuit.

15. Find collector and base current of circuit given in figure 3.

Given

$V_{CC} = 15V$, $R_C = 6\ K\Omega$,

$R_B = 980\ K\Omega$

$\beta = 100$ and $V_{BE} = 0.3\ V$

To Find

I_B and I_C

Solution

The base current is found from

$$I_B = \frac{V_{CC} - V_{BE}}{R_B} = \frac{15 - 0.4}{980 \times 10^3}$$

$$I_B = 15\mu A$$

The collector current is

$I_C = \beta I_B, = 100 \times 15 \times 10^{-6}$

$I_C = 1.5\ mA$

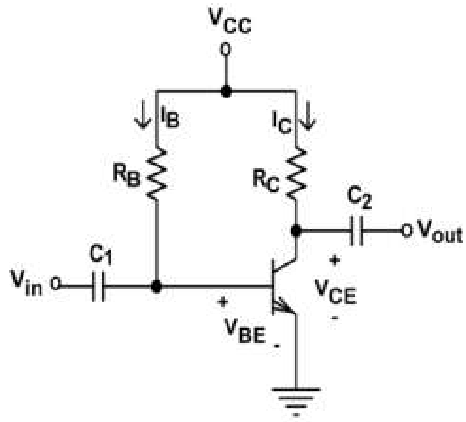
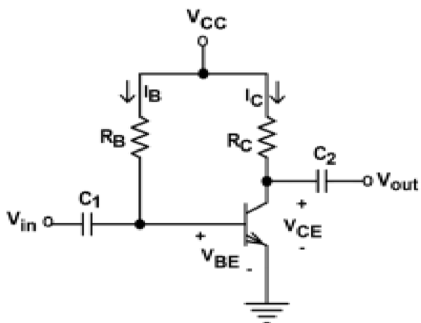


Figure 3

16. Find collector and base resistance of circuit given in figure.



Given

$V_{CC} = 15V, R_C = 6\ K\Omega, R_B = 980\ K\Omega$
$\beta = 100$ and $V_{BE} = 0.3\ V$

Solution

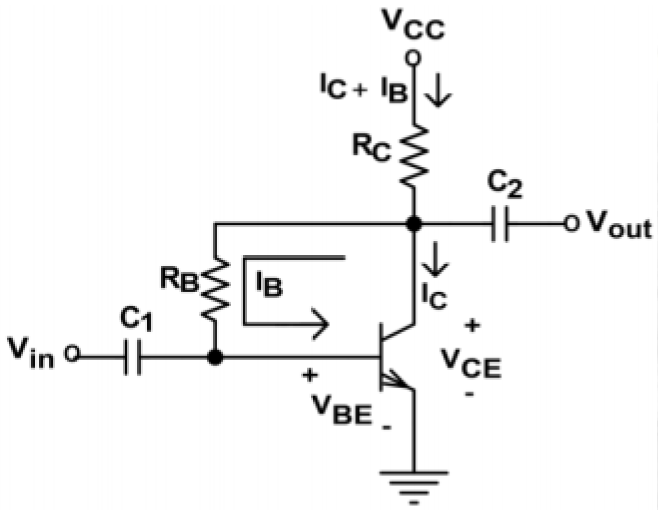
The base current is found from

$$R_B = \frac{V_{CC} - V_{BE}}{I_B} = \frac{15 - 0.3}{980 \times 10^3} = 15\mu A$$

The collector current is

$$I_C = \beta I_B, = 100 \times 15 \times 10^{-6} = 1.5\ mA$$

17. Draw the collector to base bias circuit.



18. What are the disadvantages of collector feedback bias?

1) The circuit does not provide good stable Q point.
2) The resistor R_B provides negative feedback which reduces the gain of the amplifier.

19. List the advantages of self bias.

The advantages of voltage divider bias circuit are as follows :

1) It has the smallest value of S among the three biasing circuits. This shows that the bias point stability is highest for the self bias circuit.

2) It is possible to avoid the loss of signal gain by connecting an emitter bypass capacitor across
R_E. This does not have any adverse effect on the virtues of self bias circuit.

20. Why voltage divider bias is commonly used in amplifier circuit?

The operating point will be in stable position in this biasing circuit. The stability will be considerably improved. I_C can be reduced by minimizing the collector leakage current I_{CO}.

21. Differentiate bias stabilization and compensation techniques.

Stabilization Techniques: This refers to the use of resistive biasing circuit which allows I_B to vary so as to keep I_C relatively constant with variations in I_{CO} and V_{BE}.

Compensation Techniques: This refers to the use of temperature sensitive devices such as thermistor, sensistor and diodes. They provide compensating voltages and currents to maintain Q-point constant.

22. What are the compensation techniques used for bias stability?

1) Diode compensation due to V_{BE} and I_{CO}
2) Thermistor compensation.
3) Sensistor compensation.

23. Why is temperature compensation required?

1) The reverse saturation current which doubles for every 10°C increase in temperature.
2) The Base – emitter voltage which decreases by 2.5 mV per °C.
3) The transistor current gain β varies as temperature varies. The variations of temperature affects I_C. Therefore, the operating point can shift due to temperature changes. Hence the temperature compensation is required.

24. Compare BJT and JFET.

S.No.	BJT	JFET
1.	Current controlled device	Voltage controlled device
2.	Low switching speed	High switching speed
3.	Low power gain	High power gain
4.	Possible to thermal runaway	Not possible to thermal runaway
5.	Low power gain	High power gain

25. Why thermal runaway is not there in FETs?

The FET has a positive temperature co-efficient of resistivity; when temperature increases, drain resistance also increases, reducing the drain current. Thus unlike BJT, thermal runaway does not occur with FET.

26. Write the different types of FET biasing circuits.

The FET biasing circuits are classified as,

- Gate bias or Fixed bias
- Self-bias
- Voltage divider bias
- Current source bias
- Drain feedback bias

27. When does a transistor act as a switch and an amplifier?

The transistor acts as a switch when it is operated at either cutoff region or saturation region. It acts an amplifier at linear active region.

PART-B

1. What is DC load line? How will you select the operating point? Explain it using common emitter amplifier characteristics.
2. Explain the bias compensation techniques in detail.

3. Explain the voltage divider bias method using BJT and derive an expression for stability factor.
4. Compare the various methods of biasing using BJT with their stability factor.
5. With neat diagram, explain the working of fixed bias, self bias and voltage divider bias for JFET common source amplifier.
6. With neat diagram, explain the various biasing of E-MOSFET.
7. Analyze the voltage divider bias of BJT, and determine the change in Q-point with a variation in β for the values of 50, 100 and 150. The parameters are V_{CC} = 10 V, R_1 = 56 KΩ, R_2 = 12.2 KΩ, R_C = 2 KΩ, R_E = 0.4 KΩ, and $V_{BE(on)}$ = 0.7 V.
8. Calculate the drain current and drain-to-source voltage of a circuit shown in fig.1. For the circuit shown in fig.1, assume that V_{TN} = 0.35 V and K_n = 25μA/V^2. The circuit parameters are V_{DD} = 2.2 V, R_1 = 355 KΩ, R_2 = 245 KΩ, and R_D = 100 KΩ.

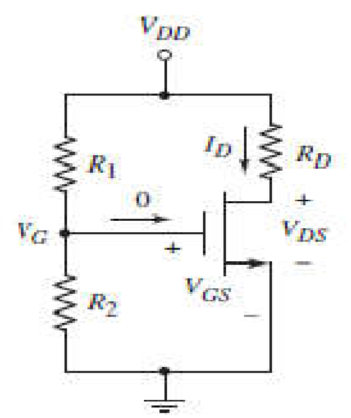
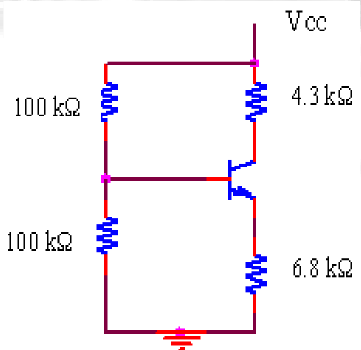


fig.1

9. For the following circuit find the Q-point if V_{CC} = 15V and β = 100; V_{BE} = 0.7V.



10. In an N-channel JFET, biased by potential divider method, the operating point has to be at I_{DSS} = 12mA. If V_{DD} = 12V, R_1 = 20K Ω and R_2 = 10K Ω, R_D =1.2K Ω and V_P= -4V. Find the values of I_D, V_{GS}, V_G, V_{DS} and V_S.
11. Design a voltage-divider bias circuit in which V_{CE} = 7 V, V_E = 6 V, and I_C = 2 mA. The supply voltage is 20 V.
12. Design a JFET circuit with voltage divider biasing. Consider the circuit shown in figure 1.38 with transistor parameters are I_{DSS} = 12mA, V_P = – 4V and R_1 + R_2 =

100 KΩ. Design the circuit such that the dc drain current is I_D = 6mA and the dc drain to source voltage is V_{DS} = 4V.

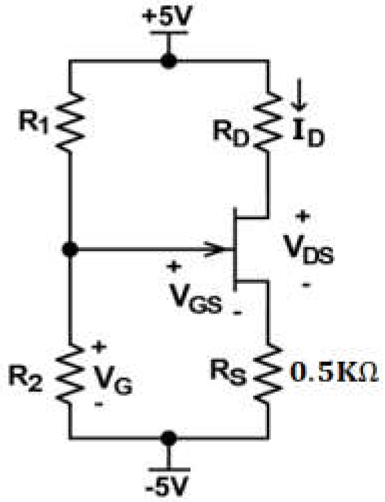


Figure 1.38

13. For the circuit shown in fgure 1.41 assume that V_T = 1V, Kn = 0.1 mA/V^2. Find V_{GS}, I_D, V_{DS}.

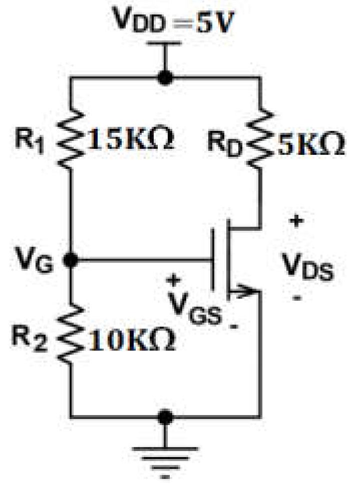


Figure 1.41

14. Design voltage divider bias circuit for NMOS, such that I_{DQ} = 500 µA, V_{DD} = 12V, V_{DS} = 3V, Kn = 1 mA/V^2, V_T = 1V, V_S = 1.5 V. Assume the current of 1 µA through R_1 and R_2.

UNIT II BJT AMPLIFIERS

PART-A

1. What is an amplifier?

An amplifier is a circuit, which can be used to increase the amplitude of the input current or voltage at the output by means of energy drawn from an external source.

2. Mention the classifications of amplifiers based on the transistor configuration.

1) Common Emitter Amplifier
2) Common Base Amplifier
3) Common Collector Amplifier

3. Why are common emitter amplifiers more popular?

™ The CE configuration is the only configuration which provides both voltage gain as well as current gain greater than unity. In case of CB configuration current gain is less than unity and in case of CC configuration voltage gain is less than unity.

In a common emitter circuit, the ratio of output resistance to input resistance is small, may range 10Ω to 100 Ω.

4. Define diffusion resistance.

Diffusion resistance is defined as the ratio of base emitter voltage to input base current.

$r_\pi = \beta V_T / I_{CQ}$

5. What is transconductance?

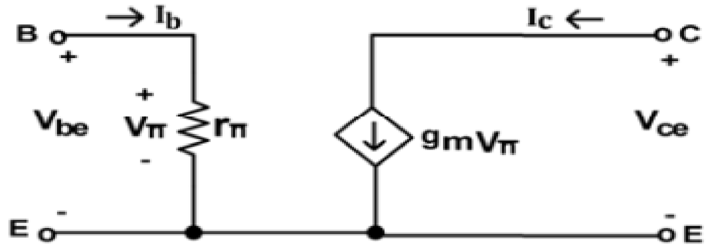
The term I_{CQ} / V_T is a conductance. Since this conductance relates collector current to a voltage in the base-emitter circuit, the parameter is called a trans-conductance and it is given by $g_m = I_{CQ} / V_T$. (unit is siemens – denoted by S)

6. List the small signal parameters of BJT amplifier.

The small signal parameters of BJT amplifiers are

1) r_π – Base to Emitter input resistance
2) g_m – Transconductance(unit issiemens– denoted by S)
3) r_o – Small signal output resistance

7. Draw the small signal equivalent circuit of npn transistor.



8. How to draw the AC equivalent circuit?

The following conditions to be followed for drawing the ac equivalent circuit.
1) Coupling capacitors and bypass capacitor act as a short circuit.
2) Replace all the dc source by a short circuit, i.e. V_{CC} is connected to ground

9. Compare the CE, CB and CC amplifiers.

Parameters	CE	CB	CC
Voltage gain	High	High	Less than 1
Current gain	High	Less than 1	High
Input resistance	Moderate	Low	High
Output Resistance	Moderate	High	Low

9. List the applications of CE amplifier.

Low noise amplifiers and radio frequency amplifiers, as they offer medium input resistance, medium output resistance, medium voltage gain, medium current gain and high power gain.

10. Which amplifier is called as voltage follower? Why?

The common collector transistor amplifier configuration is called as voltage follower. Since it has unity voltage gain and because of its very high input impedance. It doesn't draw any input current from the signal. So, the input signal is coupled to the output circuit without making any distortion.

11. What is loading effect?

When the input resistance $R_i << R_S$, the circuit draws more current. Hence the voltage drop across R_S is more. Voltage across R_i is reduced. This is called loading effect.

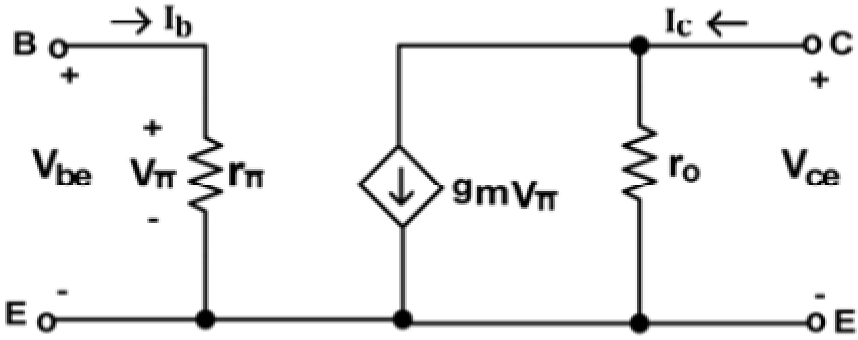
12. List the advantages of unbypassed R_E.

1) Provides stability in the Q-point by shunting ac voltage drop across R_E.
2) Loading effect is not there.

13. What is meant by voltage swing limitations?

In the linear amplification process, when a symmetrical sinusoidal signals are applied to the input of an amplifier we get amplified sinusoidal signals at the output. It is possible to obtain maximum output symmetrical swing. If the output exceeds this limit, a portion of the output signal will be clipped resulting signal distortion.

14. Draw the small signal equivalent circuit of npn transistor including early effect.



15. List the applications of CC amplifier.

The low output impedance allows a source with a large output impedance to drive a small load impedance; CC amplifier functions as a voltage buffer.

16. List the application of CB amplifier.

CB amplifier is used as a current buffer, since it has a current gain of approximately unity.

17. What is a Differential amplifier?

An amplifier that has two inputs and produces an output signal that is a function of the difference between the two given inputs is called differential amplifier.

18. What is the need of constant current circuit in differential amplifier?

The necessary for constant current source for differential amplifier is to increase the common mode rejection ratio without changing the quiescent current and without lowering the forward current gain.

19. State differential and common mode gain.

Differential gain is defined as the ratio of output voltage to the differential voltage.

$$A_d = \frac{V_o}{V_d}$$

Common mode gain is defined as the ratio of output voltage to the common mode voltage.

$$A_C = \frac{V_o}{V_C}$$

20. Define CMRR.

The ability of a differential amplifier to reject a common mode signal is expressed by a ratio called common mode rejection ratio denoted as CMRR. It is defined as the ratio of the differential mode voltage gain to common mode voltage gain.

$$\text{CMRR} = \rho = \frac{A_d}{A_C}$$

21. List the methods to improve the CMRR.

1) To use constant current source bias.
2) To use an active load.
3) To use a current mirror circuit.

22. List the features / advantages of differential amplifier.

The features of differential amplifier are

1) High CMRR.
2) Large bandwidth.
3) High differential voltage gain.
4) Low common mode gain.

23. What are the applications of a differential amplifier?

- To measure many physical quantities,
- It can be used as a direct coupled amplifier,
- It is used in operational amplifier.

24. State the various configurations of differential amplifier.

A differential amplifier is classified into following four configurations:

1) Dual input, balanced output.
2) Dual input, unbalanced output.
3) Single input, balanced output.
4) Single input, unbalanced output.

25. Mention the modes of operation in differential amplifer.

1) Differential mode operation.
2) Common mode operation.

26. A differential amplifier has a differential gain of 500. Determine the common mode gain if CMRR is 80 dB.

$$\text{CMRR in dB} = 20\log_{10}\left|\frac{A_d}{A_C}\right|$$

$$80 = 20\log_{10}\left|\frac{A_d}{A_C}\right|$$

$$4 = \log_{10}\left|\frac{500}{A_C}\right|$$

$$10000 = \left|\frac{500}{A_C}\right| \quad A_C = 0.05$$

27. For a differential amplifier has the following parameters are: $V_{CC} = 10$ V, $R_C = 3.3$ KΩ, Ro = 10 KΩ, β = 66, $V_T = 0.026$ V and $I_Q = 2$ mA. Calculate CMRR in dB.

$$\text{CMRR} = \frac{1}{2}\left[1+\frac{(1+\beta)R_o I_Q}{V_T\beta}\right]$$

$$\text{CMRR} = \frac{1}{2}\left[1+\frac{(67\times10\times10^3\times2\times10^{-3})}{(66\times0.026)}\right] = 390.9$$

CMRR in decibels is given by

$$\text{CMRR}|_{dB} = 20\log_{10}\text{CMRR} = 20\log_{10}390.9 = 51.84\text{ dB}$$

28. List the features of Darlington amplifier.

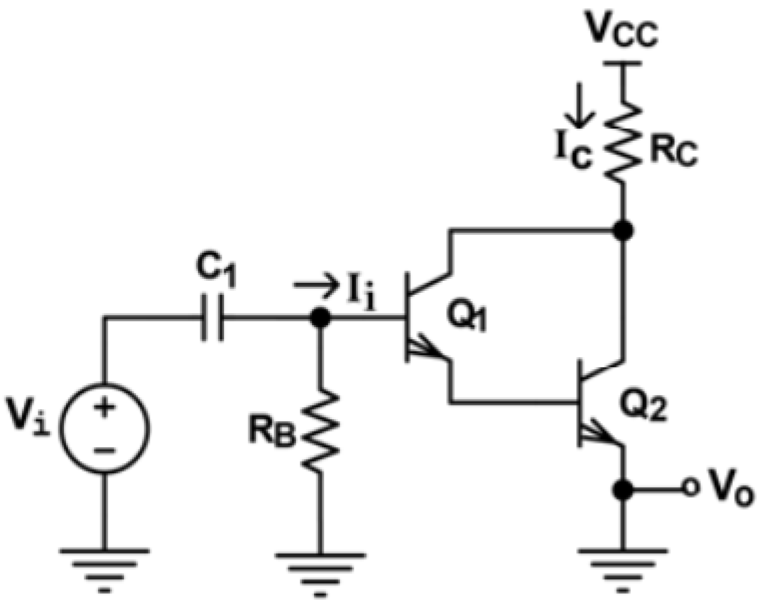
The features of a differential amplifier are

1) High current gain.
2) Low voltage gain.
3) High input impedance.
4) Low output impedance.

29. What is a Darlington pair? What is its significance?

The direct coupling- cascaded connection of two emitter followers is called a Darlington connection. The main feature of the Darlington connection is that the composite transistors act as a single unit with a current gain that is the product of the current gains of the individual transistors. Darlington transistor is commonly used as emitter follower. This gives an equivalent circuit of two emitter followers in cascade, thereby increasing the input impedance.

30. Draw the Darlington amplifier circuit.



31. What are the methods to improve input impedance?

The input impedance can be increased using two techniques:

1. Using direct coupling- Darlington connection
2. Using bootstrap technique

32. What does bootstrapping mean?

In Darlington transistor pair circuits, the input impedance is reduced because of the biasing resistors in the circuit. To overcome this, decrease in the input resistance due to the biasing network, a small capacitor and resistance are added in the circuit. This improves the input impedance of the darlington pair circuit. C is added at the input side and R3 is connected between output and input circuits. This technique is known as bootstrapping.

33. Mention two disadvantages which are specific to Darlington connection.

(i) The main drawback of the Darlington pair is that the leakage current of the first transistor is also amplified by the second stage, hence the overall leakage current may be high, so Darlington connection of three or more is impractical.

(ii) The principal merit of Darlington circuit is its high input impedance. But the biasing arrangement reduces the input impedance considerable in the case of ordinary emitter follower as well as Darlington emitter follower.

34. What are the requirements of a multistage amplifier?

(1) Gain should be sufficiently high
2) Bandwidth should be adequately large
3) Input impedance should match with the source impedance
4) Output impedance should match with the load resistance

35. What are the limitations of multistage amplifiers?

1) The bandwidth of multistage amplifier is always less than that of the bandwidth of a single stage amplifier.
2) Nonlinear distortion is more in multistage amplifiers than single stage amplifier.

36. Distinguish between cascade and cascode amplifier.

The cascade amplifier is constructed from a series of common emitter amplifiers.

The cascode amplifier consists of a common emitter amplifier in series with a common base amplifier.

37. List the merits and demerits of cascade amplifier.

Merits

1) It provides high voltage gain and high input impedance
2) It provides high current gain and high output resistance

Demerits

1) It requires two transistors and requires dual power supply

38. List the features of cascode amplifier.

1) It provides high voltage gain.
2) It provides high input impedance.
3) It provides very high output resistance.
4) It also provides high slew rate and high stability.

39. List the applications of cascade amplifier.

1) Mainly used in tuned RF amplifiers in T.V. circuits.
2) It is also used as wideband amplifier.

40. What is the gain of multistage amplifier?

The voltage gain of a multistage amplifier is the product of voltage gains of the individual stages. The overall voltage gain is very high in multistage amplifiers.

41. Sketch the ac equivalent circuit of Figure 1.

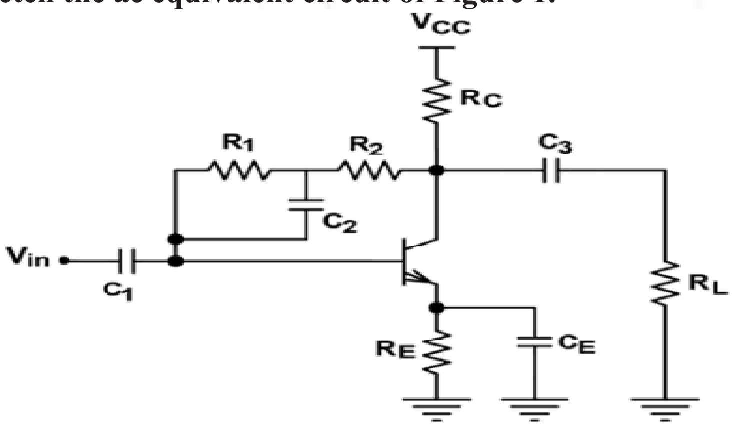
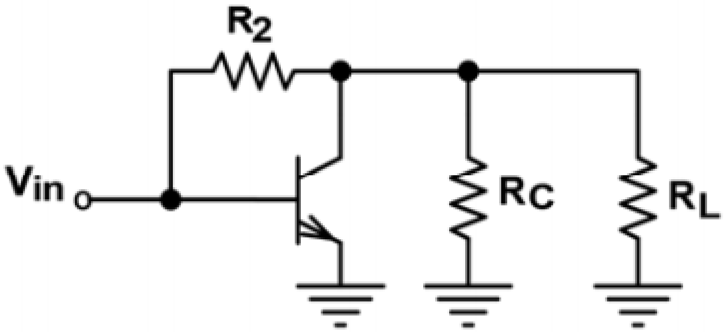


Figure 1



42. List the applications of cascode amplifier.

1) It is very useful as a multiplying mixer circuit in super heterodyne receivers.
2) Cascoding can be used in current mirrors to increase the output impedance of the output current source.

43. Why capacitive coupling used to connect a signal source to an amplifier?

Coupling capacitors blocks dc voltage but freely pass as signal, because of this biasing conditions are maintained constant.

44. What is AC load line? What is the slope of AC load line?

AC Load Line

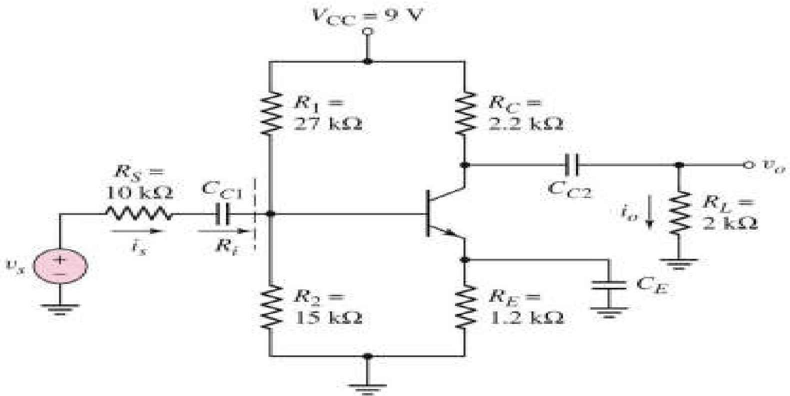
This is the line on the output characteristics of a transistor circuit which gives the values of I_C & V_{CE} when signal is applied.

The slope of AC load line is usually higher than slope of DC load line. The slope of AC load line would be $-1 / (R_c \parallel R_L)$

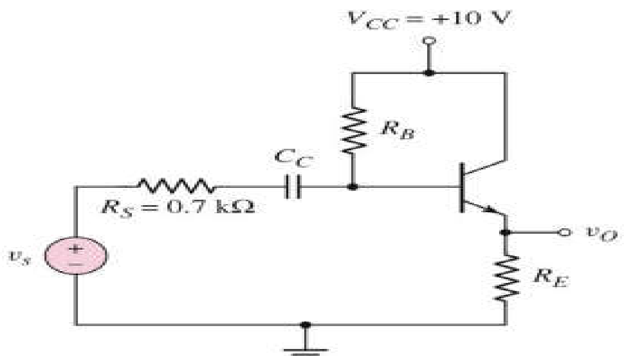
PART-B

1. Explain the working principle of common emitter amplifier with bypassed RE and derive the expression of R_i, A_v and R_o.
2. A common emitter amplifier with bypassed R_E circuit has the following parameters: V_{CC} = 15 V, R_1 = 47 KΩ, R_2 = 3 KΩ, R_C = 3 KΩ, R_E = 100 Ω, R_S = 500 Ω. Assume β = 100, V_{BE} = 0.7 V, V_T = 0.026V, V_A = 100 V. Determine the small signal voltage gain, input resistance and output resistance.
3. Explain the working principle of common emitter amplifier with unbypassed R_E and derive the expression of R_i, A_v and R_o.
4. A common emitter amplifier unbypassed RE circuit has the following parameters are: V_{CC} = 15 V, R_1 = 42 KΩ, R_2 = 3 KΩ, R_C = 4.7 KΩ, R_E = 500 Ω and R_S = 100 Ω Assume β = 100, V_{BE} = 0.3 V and V_T = 0.026 V. Determine the small signal voltage gain and input resistance.
5. Explain the working principle of common collector amplifier. Derive the expression of R_i, A_v and R_o.
6. An emitter follower circuit has the following parameters are: V_{CC} = 12 V, R_1 = R_2 = 47 KΩ, β = 100, R_E = 1 KΩ, R_S = 500 Ω, V_{BE} = 0.7 V, V_T = 0.026 V and V_A = 80 V. Determine the small signal voltage gain and input resistance.

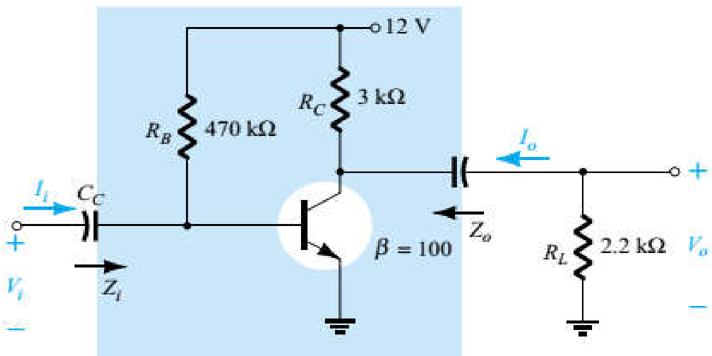
7. Explain the working principle of differential amplifier and derive the expression for CMRR using small signal analysis.
8. Explain the biasing circuit of Darlington amplifier and derive the expressions for current gain, input impedance.
9. Explain the operation of cascade amplifier and derive voltage gain, input and output impedance.
10. Explain the operation of cascode amplifier and derive voltage gain, input and output impedance.
11. Consider the following circuit. The transistor parameters are β = 100, $V_{BE(on)}$ = 0.7 V and V_A = 100 V. Determine R_i, A_v, Ro and A_i.



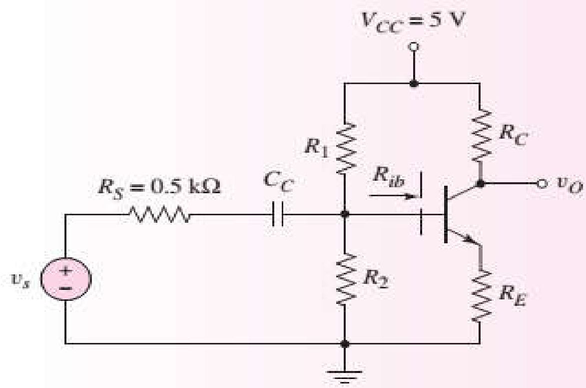
12. The transistor parameters for the following circuit are: V_{BE} = 0.7 V, β = 100 and V_A = ∞. Calculate the transistor parameters of R_i, R_i', R_o and A_v if I_B = 9.9 µA and R_E = 5 KΩ.



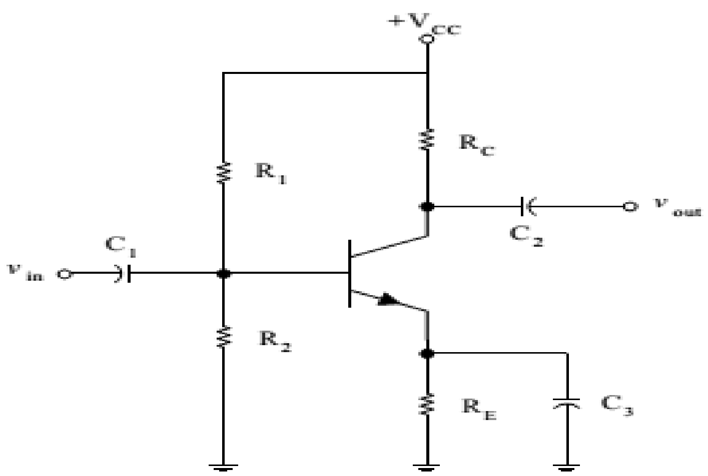
13. Draw the ac and dc load lines and find the Q-point of the following circuit.



14. Calculate the small signal voltage gain of an emitter follower circuit. Given $\beta = 100$, $V_A = 80$ V, $I_{CQ} = 0.793$ mA, $V_{BE(on)} = 0.7$ V and $V_{CEQ} = 3.4$ V.
15. For the following circuit, let $R_E = 0.6$ KΩ, $R_C = 5.6$ KΩ, $\beta = 120$, $V_{BE}(on) = 0.7$ V, $R_1 = 250$ KΩ, and $R_2 = 75$ KΩ. For $V_A = \infty$, determine the small-signal voltage gain Av and the input resistance looking into the base of the transistor.



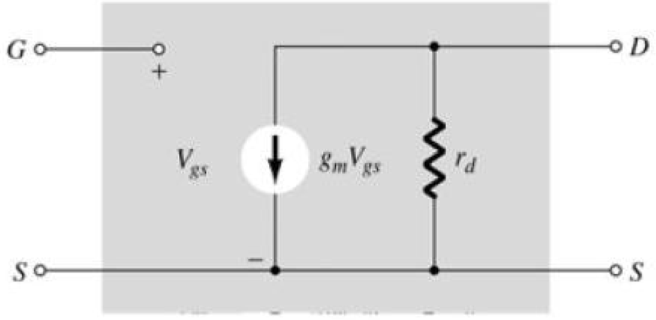
16. A common emitter amplifier with bypassed R_E circuit has the following parameters are: $V_{CC} = 12$ V, $R_1 = 47$ KΩ, $R_2 = 4.7$ KΩ, $R_C = 3$ KΩ, $R_E = 100$ Ω, $R_S = 500$ Ω, $\beta = 100$, $V_{BE} = 0.7$V, $V_T = 0.026$V and $V_A = 100$ V. Determine the small signal voltage gain, input resistance and output resistance.
17. Determine output voltage of an op-amp for the input voltages of $V_1 = 150$ µV, $V_2 = 140$ µV. The amplifier has a differential gain of 4000 and the value of CMRR is 10^5.
18. For the following circuit, find I_C and V_{CE}. Given that $V_{CC} = 18$ V, $R_1 = 39$ KΩ, $R_2 = 3.9$ KΩ, $R_C = 4$ KΩ, $R_E = 1.5$ KΩ and $\beta = 140$.



UNIT III SINGLE STAGE FET, MOSFET AMPLIFIERS

PART-A

1. Draw the small signal equivalent circuit of FET.



2. What are the basic circuit configurations used in FET?

i) Common source amplifier configuration.
ii) Common drain configuration.
iii) Common gate configuration.

3. What is Body effect?

The threshold voltage is not constant with respect to the voltage difference between the substrate and the source of the MOS transistor. This is known as body effect.

4. Compare the characteristics of common source, common drain and common gate amplifier.

Parameters	Common source	Common drain	Common gate
Voltage gain	High	Less than 1	High
Current gain	High	High	Less than 1
Input resistance	Moderate	High	Low
Output Resistance	Moderate	Low	High

5. List the Small signal parameters of MOSFET amplifiers.

i) Transconductance

$$g_m = 2\,K_n\,(V_{GS} - V_T) = 2\,\sqrt{K_n I_{DQ}}$$

$$K_n = \frac{1}{2}\,\mu_n\,C_{ox}\left(\frac{W}{L}\right)$$

Where,

K_n - Process gain factor, μ_n - Mobility carrier, C_{ox} - Gate oxide capacitance, W - Width of the channel, L - Length of the channel, λ - Channel length modulation factor

ii) Small signal output resistance

The small signal output resistance is given by, $r_o \cong [\lambda I_{DQ}]^{-1}$

6. List the features of MOSFET amplifers.

i) It has zero offset voltage.
ii) MOSFETs are easier to fabricate.
iii) MOSFETs are widely used in digital VLSI circuits.

7. Define 'Threshold voltage'.

The minimum gate to source voltage at which the FET starts to conduct is called as threshold voltage.

8. What is pinch off voltage?

The maximum drain to source voltage at which the channel between drain to source pinches off is called as pinch off voltage.

9. List the advantages of unbypassed R_S.

i) Provides stability in the Q-point.
ii) To avoid Loading effect.

10. Which transistor configuration is called source follower? Why?

A common drain (CD) amplifier circuit is called source follower. The output signal follows the input signal (i.e. the phase shift between output and input signals 0º); hence the name source follower.

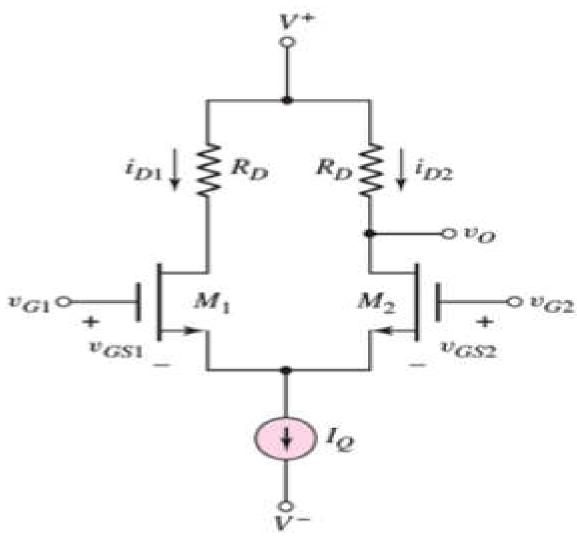
11. What is the effect of including source resistor in FET amplifier?

The source resistor is introduced to stabilize the Q point against variations in the MOSFET parameters. The source resistor acts as a negative feedback resistor; so voltage across R_S will reduce the actual input voltage applied to the transistor; thereby finally reducing the voltage gain.

12. What is the effect of including source bypass capacitor in FET amplifier?

A bypass capacitor connected across the source resistor in the common source circuit will minimize the loss in the small signal voltage gain, while maintaining Q-point stability.

13. Draw the basic FET differential pair.



14. Illustrate the features of FET differential pair.

At low frequencies, the input impedance of a MOSFET is essentially infinite, which means that both the differential- and common-mode input resistances of a MOSFET diff-amp are infinite. The CMRR for the MOSFET diff-amp is also a strong function of the output resistance of the constant-current source.

15. What is BiCMOS circuits?

It consists of BJT and MOS transistors in the same integrated circuit: the bipolar technology, which uses npn and pnp bipolar junction transistors; and the MOS technology, which uses NMOS and PMOS fled-effect transistors. The advantages of these two technologies can be utilized by combining bipolar and MOS transistors in the same integrated circuit. Hence the name BiCMOS Technology. BiCMOS technology is especially useful in digital circuit design, but also has applications in analog circuits.

16. List the advantages of BiCMOS Technology.

i) The bipolar junction transistors have a larger transconductance than MOS transistors.
ii) MOS transistors have essentially infinite input impedance at low frequencies and have very high packaging density.

17. List the merits and demerits of BiCMOS differential amplifier technology.

Merits

i) The infinite input resistance.
ii) The zero input bias current.

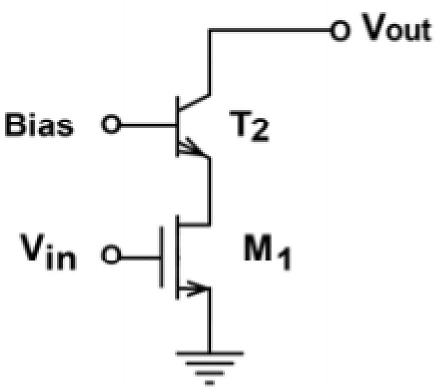
Demerits

i) The MOSFET is used in the input stage, the offset voltage is relatively high compare to that of a bipolar input circuit.

18. List the features of BiCMOS inverter.

i) It has high input impedance and low output impedance
ii) The inverter also has high drive capability but occupies a relatively small area.

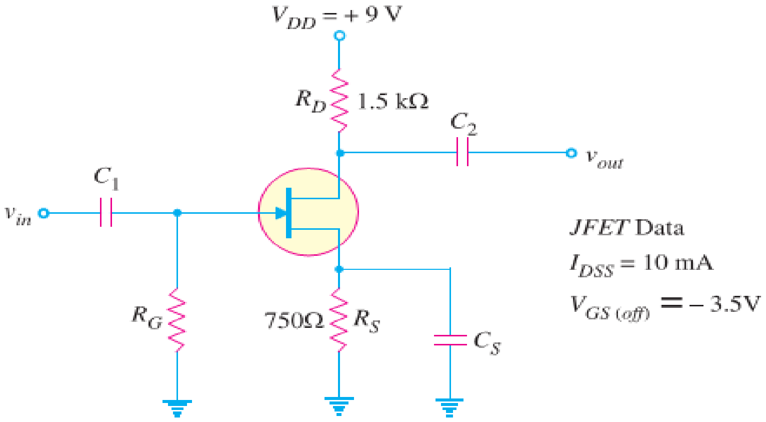
19. Draw the BiCMOS cascode configuration.



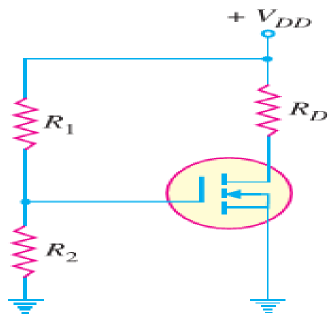
PART-B

1. Derive gain, input and output impedance of common source JFET amplifier with neat circuit diagram and equivalent circuit.
2. Derive gain, input and output impedance of JFET source follower with neat circuit diagram and its equivalent circuit.

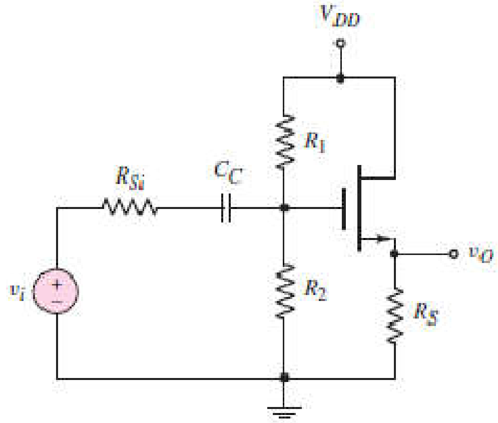
3. Explain the working principle of common source MOSFET amplifier without R_S and derive gain, input and output resistances using small signal equivalent circuit.
4. Explain the working principle of common source MOSFET amplifier with R_S and derive gain, input and output resistances using small signal equivalent circuit.
5. Derive gain, input and output impedance of MOSFET source follower with neat circuit diagram and its equivalent circuit.
6. Explain the following methods of BiCMOS circuits:
i) Darlington Pair ii) Cascode configuration iii) Inverter
7. MOSFET common source amplifier without source resistor has the following parameters, V_{DD} = 12 V, R_1 = 150 KΩ, R_2 = 50 KΩ, R_D = 3.3 KΩ, R_{Si} = 500 Ω, Kn = 0.5mA/V2, V_T = 1V and λ = 0.01 V^{-1}. Determine the small signal voltage gain, input and output resistances.
8. A MOSFET common source amplifier with source resistor has the following parameters, V_{DD} = 12 V, R_1 = 100 KΩ, R_2 = 20 KΩ, R_D = 5 KΩ, R_S = 500 Ω, Kn= 1mA/ V^2,V_T = 1 V and λ= 0. Determine the small signal voltage gain.
9. A source follower MOSFET circuit has the following parameters, V_{DD} = 10V, R_1 = 25KΩ, R_2 = 100KΩ, R_S = 1.5KΩ, R_{Si} = 100 Ω Kn = 6mA/V2, V_T = 1 V, I_D = 6mA, V_{GS} = 2.25 V, λ= 0.01V^{-1}. Calculate the small signal voltage gain, R_i and R_o.
10. For the following JFET amplifier circuit, calculate the voltage gain with R_S bypassed by a capacitor and with R_S unbypassed.



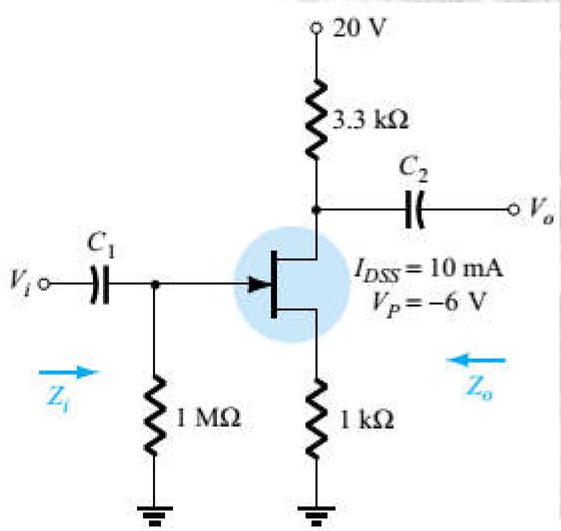
11. Describe the small signal voltage gain, input and output resistance of the circuit. The MOSFET parameters are: V_{DD} = 10 V, R_1 = 70.9 KΩ, R_2 = 29.1 KΩ and R_D = 5 KΩ, V_T = 1.5 V, K_n = 0.5 mA/V^2 and λ = 0.01 V^{-1}, assume R_{sig} = 4 KΩ.



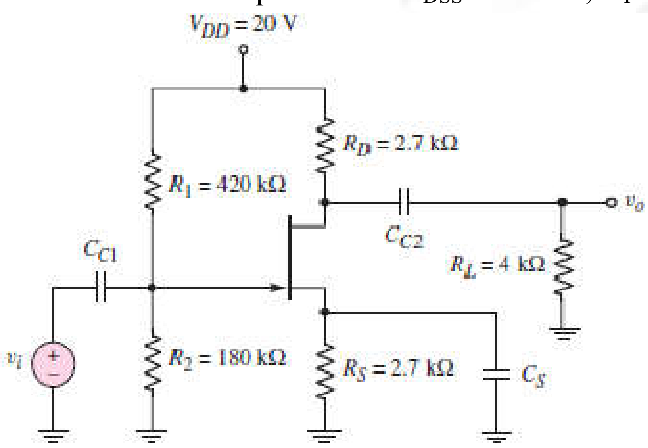
12. Calculate the small-signal voltage gain, input and output resistance of the source-follower circuit in figure shown below. Assume that R_1=162 kΩ, R_2=463 kΩ, R_S = 0.75 kΩ, R_{Si} = 4 kΩ, V_{DD} = 12V, V_{TN} = 1.5 V, λ = 0.01$V^{-1}$and K_n = 4 mA/V^2.



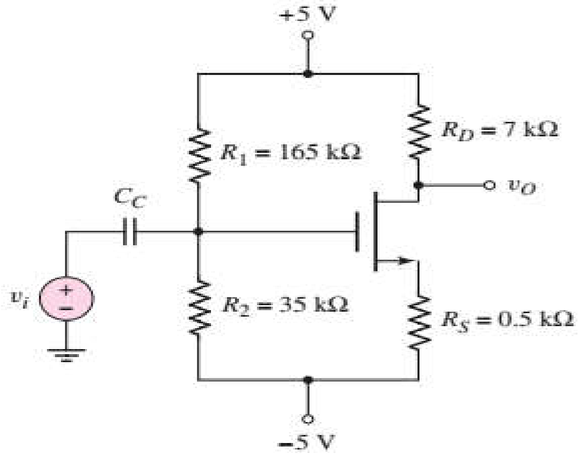
13. The self-bias configuration of Fig.1 has an operating point defined by V_{GSQ} = -2.6 V and I_{DQ} = 2.6 mA, with I_{DSS} = 8 mA and V_P = -6 V. The value of y_{os} is given as 20 µS. Determine g_m, r_d, Z_i, Z_o and A_v.



14. Determine the small-signal voltage gain of a JFET amplifier. Consider the circuit shown in figure below with transistor parameters: I_{DSS} = 12 mA, V_P = - 4 V and $\lambda = 0.08\ V^{-1}$



15. Determine the small signal voltage gain of a common source circuit containing a source resistor. The transistor parameters are: V_{TN} = 0.8V, $K_n = 1\ mA/V^2$ and $\lambda = 0$.



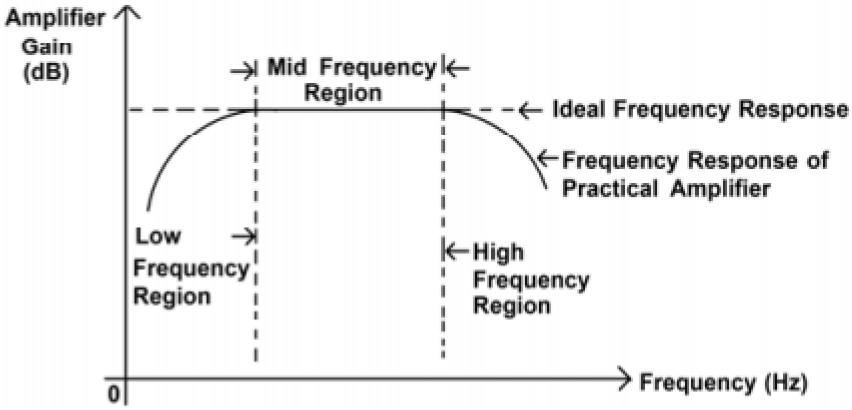
16. A common drain JFET amplifier circuit has the following parameters are : $V_{DD} = 15$ V, $R_G = 1$ MΩ, $R_S = 5$ KΩ, $r_d = 150$ KΩ and $g_m = 5$mS. Calculate i) input impedance ii) output impedance iii) voltage gain.

UNIT IV FREQUENCY RESPONSE OF AMPLIFIERS

PART-A

1. Define the frequency response of Amplifier.

The frequency response of an amplifier can be defined as the variation of output quantity with respect to input signal frequency. In otherwise it can be defined as a graph drawn between the input frequency and the gain of an amplifier.



2. Define octaves and decade.

The octaves and decades are the measures of change in frequency.

Octave:

A doubling or halving of the frequency is called octave (For example an increase in frequency from 100 Hz to 200 Hz or decrease in frequency from 100 KHz to 50 KHz).

Decade:

A ten-times change is called decade (For example frequency from 100 Hz to 1000 Hz is called 1 decade).

3. Define bandwidth.

Bandwidth of the amplifier is defined as the difference between higher cut off frequency and lower cut off frequency. Bandwidth = $f_H - f_L$

4. Define Lower & Upper cut off frequencies of an amplifier.

Lower cut-off frequency

The frequency (on lower side) at which the voltage gain of the amplifier is exactly 70.0% of the maximum gain is known as lower cut off frequency.

Upper cut-off frequency

The frequency (on higher side) at which the voltage gain of the amplifier is exactly 70.0% of the maximum gain is known as upper cut off frequency.

5. What is the effect of coupling capacitors on the bandwidth of the amplifier?

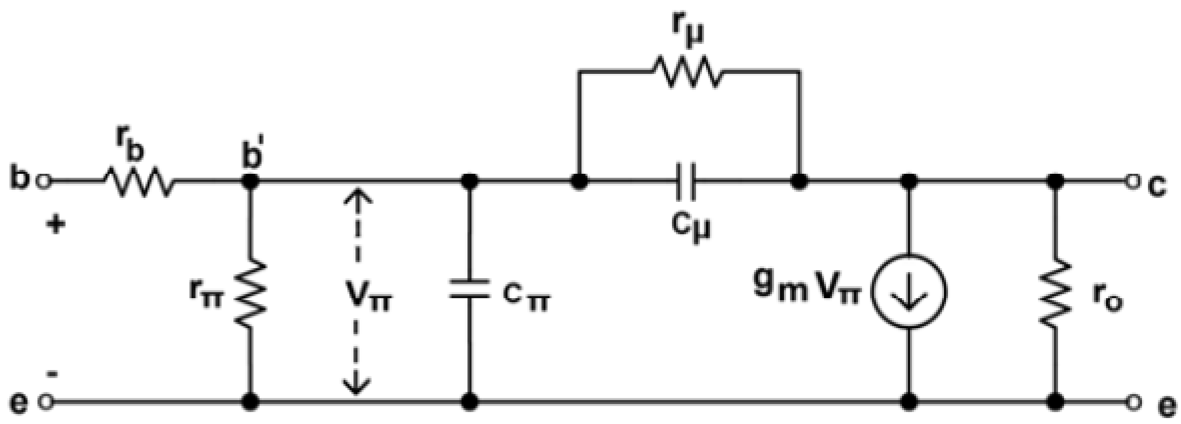
The reactance of capacitor is $X_C = 1/2\pi f_c$. At medium and high frequencies, X_C is very small, so that all the coupling capacitors behave as short circuit. At low frequencies, X_C increases. This increase in X_C drops the signal voltage across the capacitor and reduces the amplifier gain.

6. State the reason for fall in gain at low and high frequencies in case of amplifiers.

The coupling capacitance has very high reactance at low frequency. Therefore it will allow only a small part of signal from one stage to next stage and in addition to that the bypass capacitor cannot bypass or shunt the emitter resistor effectively. As a result of these factors, the voltage gain rolls of at low frequency.

At high frequency the reactance of coupling capacitor is very low. Therefore it behaves like a short circuit. As a result of this the loading effect of the next stage increases which reduces the voltage gain. Hence the voltage gain rolls off at high frequencies.

7. Sketch the hybrid - π model for a transistor in the CE configuration.



8. Why are h parameters not used at high frequencies?

- The values of h-parameters are constant at high frequencies.
- The h-parameters are also complex in nature at high frequencies.

9. What is the effect of bypass capacitors on the bandwidth of the amplifier?

At low frequencies, the bypass capacitor C_E is not a short circuit. So, the emitter is not at ac ground. X_C in parallel with R_E creates an impedance. The signal voltage drops across this impedance reducing the circuit gain.

10. What is the effect of Transistor's Internal Capacitances on the bandwidth of the amplifier?

At high frequencies, the internal capacitances, commonly known as junction capacitances do come into play, reducing the circuit gain. At higher frequencies, the reactance of the junction capacitances are low. As frequencies increase, the reactances of junction capacitances reduce. When these reactances become small, they produce shunting effect as they are in parallel with junctions. This reduces the circuit gain and hence the output voltage reduces. When C_{be} is very small, a large portion of output voltage is fed back to the base. The feedback voltage is out of phase with the input signal V_i. So, the effective input to the amplifier is reduced which ultimately reduces the output voltage and gain.

11. Define α cutoff frequency(f_α).

It is the frequency at which the transistors short circuit common base current gain drops by 3 dB or $1/\sqrt{2}$ times from its maximum value at low frequency. Alpha cut of frequency mathematically expressed as

$$f_\alpha = \frac{1}{2\pi r_\pi (1+h_{fb}) C_\pi}$$

12. Define β cutoff frequency.

It is the frequency at which the transistors short circuit common emitter current gain drops by 3 dB or $1/\sqrt{2}$ times from its maximum value at low frequency. It is given as

$$f_\beta = \frac{1}{2\pi r_\pi (C_\pi + C_\mu)}$$

13. Define unity gain frequency (or) transition frequency (f_T).

It is the frequency at which the transistors short circuit common emitter current gain becomes unity. It is an important parameter of high frequency characteristics of a transistor. This parameter being the product of short circuit current gain and bandwidth.

$f_T = \beta.f_\beta$.

Also,

$$\boxed{f_T = \frac{g_m}{2\pi (C_\pi + C_\mu)}}$$

It represents the Gain-Band width Product, GBW, (Gain x BW)of a transistor. GBW is constant for a given transistor. This means that, if the circuit gain is increased the BW gets reduced and vice-versa.

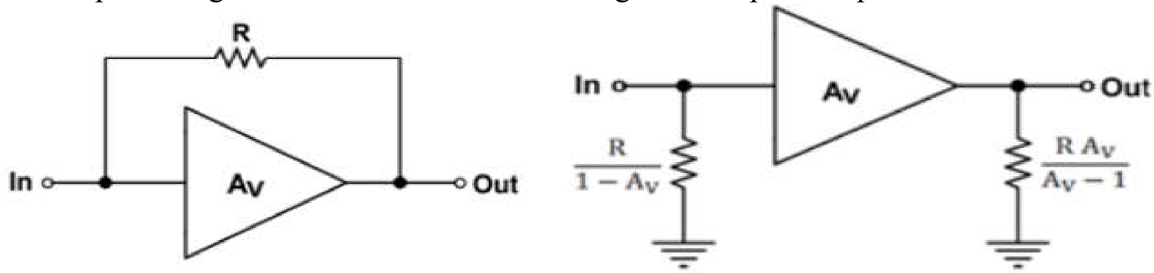
14. What is Miller effect?

For the analysis purpose, in transistor amplifiers, it is necessary to split the resistances and capacitances connected between the input and output nodes into two separate components with the same effect: one of the component is connected between input node and ground and another one is connected between output node and ground. This is achieved using Miller theorem.

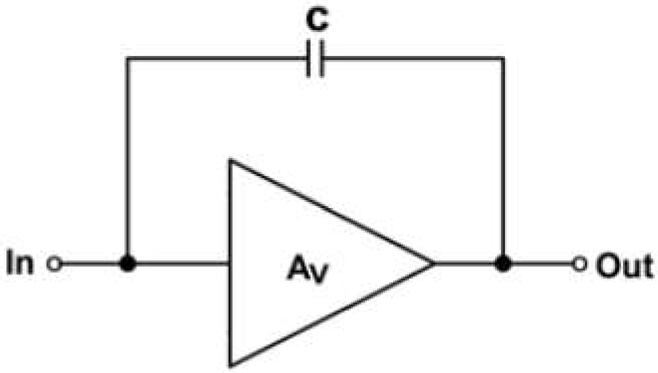
Miller resistance:

Miller theorem states that, the effective resistance on the input circuit is defined as the ratio of input voltage to current and current flowing from input to output.

Miller theorem states that, the effective resistance on the output circuit is defined as the ratio of output voltage to current and current flowing from output to input



Miller Capacitance:



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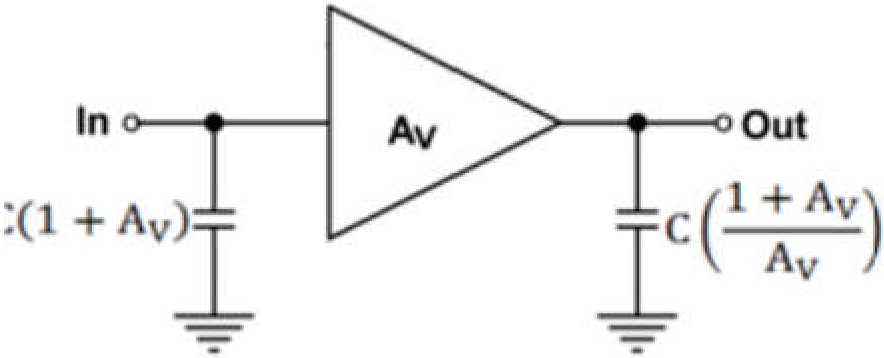
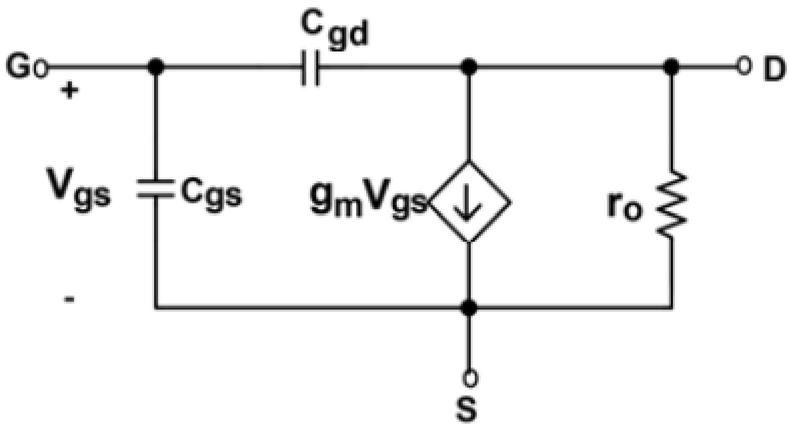


15. Sketch the high frequency equivalent circuit model for MOSFET.



16. Define Gain bandwidth product.

It is the product of mid band gain and bandwidth.

$$GBW = A_{v\ (mid)} \times BW$$

17. What is meant by amplifier rise time? Give the relationship between bandwidth and rise time.

The time required for the collector current to rise from 10% to 90% of the maximum value is called amplifier rise time.

$$\text{Rise time}(t_r) = 0.35 / \text{Bandwidth (BW)}$$

18.

Find the unity gain bandwidth of a MOSFET whose $g_m = 3$ mA/V, $C_{gs} = 15$ pF and $C_{gd} = 10$ pF.

Given

$g_m = 3$ mA/V, $C_{gs} = 15$ pF and $C_{gd} = 10$ pF

Solution

$$f_T = \frac{g_m}{2\pi(C_{gs} + C_{gd})} = \frac{3\times10^{-3}}{2\pi\times(15^{-12} + 10^{-12})} = 19.09\ \mathrm{MH_Z}$$

Answer : $F_T = 19.09\ \mathrm{MH_Z}$

19. Determine the 3 dB frequency of the short-circuit current gain of a bipolar transistor.

Consider a bipolar transistor with parameters $r_\pi = 2.6\,\mathrm{k\Omega}$, $C_\pi = 0.5\,\mathrm{pF}$, and $C_\mu = 0.025\,\mathrm{pF}$.

Solution: From Equation (7.68), we find

$$f_\beta = \frac{1}{2\pi r_\pi(C_\pi + C_\mu)} = \frac{1}{2\pi(2.6\times10^3)(0.5+0.025)(10^{-12})}$$

or

$$f_\beta = 117\,\mathrm{MHz}$$

20. Calculate the bandwidth f_β and capacitance C_π of a bipolar transistor.

Consider a bipolar transistor that has parameters $f_T = 20\,\mathrm{GHz}$ at $I_C = 1\,\mathrm{mA}$, $\beta_o = 120$, and $C_\mu = 0.08\,\mathrm{pF}$.

Solution: From Equation (7.74), we find the bandwidth as

$$f_\beta = \frac{f_T}{\beta_o} = \frac{20\times10^9}{120} \rightarrow f_\beta = 167\,\mathrm{MHz}$$

The transconductance is

$$g_m = \frac{I_C}{V_T} = \frac{1}{0.026} = 38.46\ \mathrm{mA/V}$$

The C_π capacitance is determined from Equation (7.73). We have

$$f_T = \frac{g_m}{2\pi(C_\pi + C_\mu)}$$

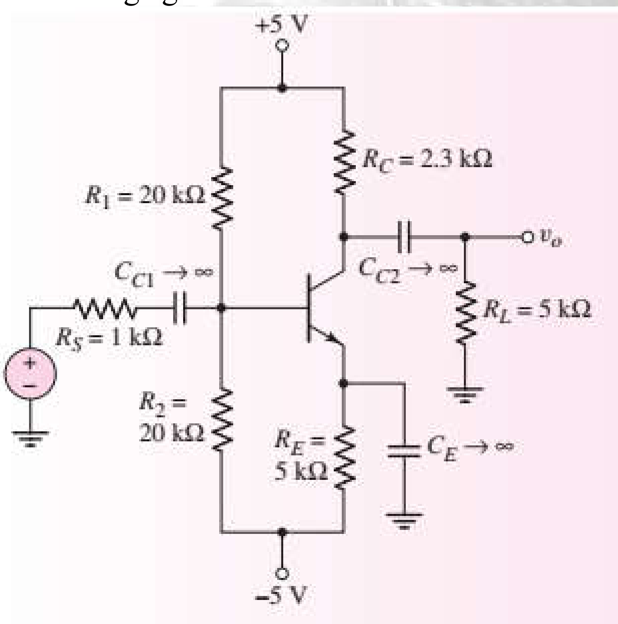
or

$$20\times10^9 = \frac{38.5\times10^{-3}}{2\pi(C_\pi + 0.08\times10^{-12})}$$

which yields $C_\pi = 0.226$ pF.

PART-B

1. Explain the effects of following capacitors on the frequency response of an amplifier: (i) Coupling capacitor, (ii) Bypass Capacitor and (iii) Internal capacitor
2. Explain the high frequency analysis of common emitter amplifier with short circuit current gain and derive fα, fβ, and fT.
3. Explain in detail with neat diagram the low frequency response of BJT amplifier.
4. Derive the high frequency analysis of CE nad CS amplifiers with neat circuit.
5. Determine the upper corner frequency and midband gain of a common emitter circuit. The parameters are: $V^+ = 5$ V, $V^- = -5$ V, $R_S = 0.1$ kΩ, $R_1 = 40$ kΩ, $R_2 = 5.72$ kΩ, $R_E = 0.5$ kΩ, $R_C = 5$ kΩ, and $R_L = 10$ kΩ. The transistor parameters are: $\beta = 150$, $V_{BE(on)} = 0.7$ V, $V_A = \infty$, $C_\pi = 35$ pF, and $C_\mu = 4$ pF.
6. The transistor in figure has parameters $\beta = 125$, $V_A = 200$ V, $V_{BE(on)} = 0.7$ V, $C_\pi = 24$ pF and $C_\mu = 24$ pF. Calculate the miller capacitance, upper 3 dB frequency and the small signal mid band voltage gain.

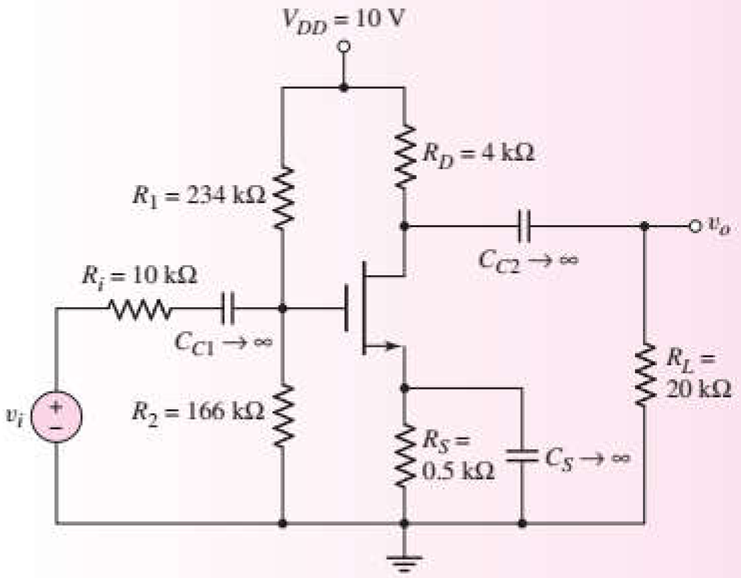


7. A BJT is biased at $I_C = 0.15$ mA, and has parameters $\beta_o = 150$, $C_\pi = 0.8$ pF, and $C_\mu = 0.012$ pF. Determine f_β and f_T. $f_T = 1.13$ GHz)

8. Calculate the bandwidth f_β and capacitance C_π of a bipolar transistor. Consider a bipolar transistor that has parameters $f_T = 20$ GHz at $I_C = 1$ mA, $\beta_o = 120$, and $C_\mu = 0.08$ pF.

9.

For the circuit in Figure , the transistor parameters are $K_n = 0.8\ \text{mA/V}^2$, $V_{TN} = 2\ \text{V}$, $\lambda = 0$, $C_{gs} = 100\ \text{fF}$, and $C_{gd} = 20\ \text{fF}$. Determine (a) the midband voltage gain, (b) the Miller capacitance, and (c) the upper 3 dB frequency of the small-signal voltage gain.



UNIT V POWER SUPPLIES AND ELECTRONIC DEVICE TESTING

PART-A

1. What are the requirements of linear mode power supply?

i) The ac ripple should be low.

ii) It should be able to furnish the maximum current needed for the unit, maintaining the voltage constant.

iii) Over voltage protection must be incorporated.

2. What is rectifier? What are the types of rectifier?

It is defined as an electronic device used for converting AC voltage to pulsating DC using one or more PN diodes.

- Half Wave Rectifiers.
- Full Wave Rectifiers.
- Bridge Rectifiers.

3. **Point out the advantages and disadvantages of linear power supply.**

Advantages of linear mode power supplies include simplicity, reliability, low noise levels and low cost.

Disadvantages of linear power supplies include size, high heat loss, and lower efficiency levels.

4. Define ripple factor.

The ratio of rms value of ac component to the dc component in the output is known as ripple factor.

$$r = \frac{I_{rrms}}{I_{DC}}$$

5. List the advantages and disadvantages of Half wave rectifier.

Advantages of Half Wave Rectifier:

1. It is cheap and requires a very few number of components to construct.
2. It is simple as its circuit design is easy to construct.

Disadvantage of Half Wave Rectifier:

1. Since, power is delivered only during one half of the cycle of the input alternating voltage, therefore, its power output and rectification frequency is low.
2. Transformer utilization factor is also low.
3. The DC output power produced from the half wave rectifier is not satisfactory to make a general power supply.

6. Drive ripple factor equation for FWR.

The ripple factor is given by,

$$r = \frac{V_{rrms}}{V_{DC}}$$

$$V_{rrms} = \sqrt{V_{rms}{}^2 - V_{DC}{}^2}$$

For full wave rectifier,

$$V_{rms} = \frac{V_m}{\sqrt{2}} \text{ and } V_{DC} = \frac{2V_m}{\pi}$$

Substituting these values, we get ripple factor for FWR as: r = 0.483

7. What is peak inverse voltage?

It is defined as the maximum reverse voltage that a diode can withstand without destroying the junction. The peak inverse voltage across a diode is the peak of the negative half cycle.

8. What is meant by regulation?

It is defined as change in DC output voltage as load changes from no load to full load.

9. Define voltage regulation.

The voltage regulation is the factor which tells about the change in the d.c. output voltage as load changes from no load to full load condition.

$$\boxed{\%\text{V.R.} = \frac{V_{\text{NL}} - V_{\text{FL}}}{V_{\text{FL}}} \times 100\%}$$

10. What is filter? Give some examples.

The output of a rectifier circuit is not pure d.c; but it contains ripples which are undesired. To minimize the ripple content in the output, the circuit is used between the rectifier and the load which is called filter circuit. It eliminates the ripple contents from the output of the rectifier and provides smooth d.c. voltage at the output. Thus filter is an electronic circuit composed of capacitor, inductor or combination of both and connected between the rectifier and the load so as to convert pulsating d.c. to pure d.c.

Examples:

1. Capacitor filter
2. RC filter
3. LC filter
4. Π- Type Filter

11. Why capacitor input filter is not suitable for variable loads?

1. Ripple factor is dependent on the load.
2. Regulation is relatively poor.
3. Diodes have to handle large peak currents.

12. Compare shunt capacitor filter with series inductor filter.

Parameter	Shunt Capacitor	Series Inductor
Place of filter	Across the load	In series with load
Useful in	Reducing ripple in load voltage	Reducing ripple in load current
Lowest ripple in load voltage at	No load or light loads	Heavy loads
Suitable for	Light load application	Heavy load application
Surge current	Very high and must be controlled	Low and need not be control
Ripple factor	1/ 4√3 FCR	R/3√2 WL
Size of filter	Small and compact	Bulky

13. What are the advantages of LC filter?

1. Very good load regulations.
2. Ripple factor is low and does not depend on the load.
3. This filter is suitable for light as well as heavy loads.
4. Diodes do not have to carry surge current

14. What are the advantages of CLC or ∏ Type filter?

1. Same as those of shunt capacitor filter.
2. In addition to that the ripple factor is very low.
3. High dc voltage (approx Vm

15. What are the advantages and disadvantages of series inductor filter?

Advantages

1. Low ripple factor at heavy load currents.
2. No surge current through diode.
3. Reduces ripple in the o/p.

Disadvantages

1. It is bulky.
2. It is more costly.
3. Ripple factor is poor at light loads (small load current).

16. What are the advantages and disadvantages of shunt capacitor filter?

Advantages (Shunt capacitor filter)

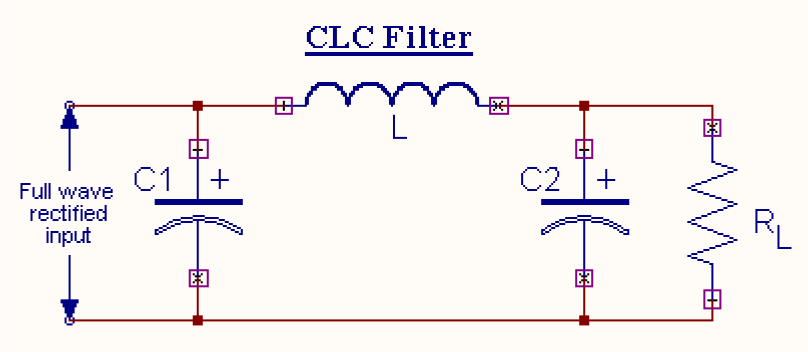
1. Easy to design.
2. Reduction in ripple content of the o/p voltage.
3. Increase in the average load voltage.
4. Small size and low cost.

Disadvantages

1. Ripple factor is dependent on the load.

2. Regulation is relatively poor.
3. Diodes have to handle large peak currents.

17. Construct the diagram of CLC filter.



18. Define TUF.

The transformer utilization factor (**TUF**) of a **rectifier** circuit is defined as the ratio of the DC power available at the load resistor to the AC rating of the secondary coil of a transformer.

19. Summarize the TUF of HWR and FWR.

Transformer utilization factor of half wave rectifier:

TUF = DC Power Output / VA Rating of Transformer

$= [(I_m V_m)/\pi^2] / [(V_m I_m) /(2x\sqrt{2})]$

$= [(2x\sqrt{2})/\pi^2]$

$= 0.2865$

TUF of Center Tapped Full Wave Rectifier:

$= [(4I_mV_m)/\pi^2] / [0.6035V_mI_m]$

$= [(4\times0.6035)/\pi^2]$

$= [(4\times0.6035)/\pi^2]$

$= 0.672$

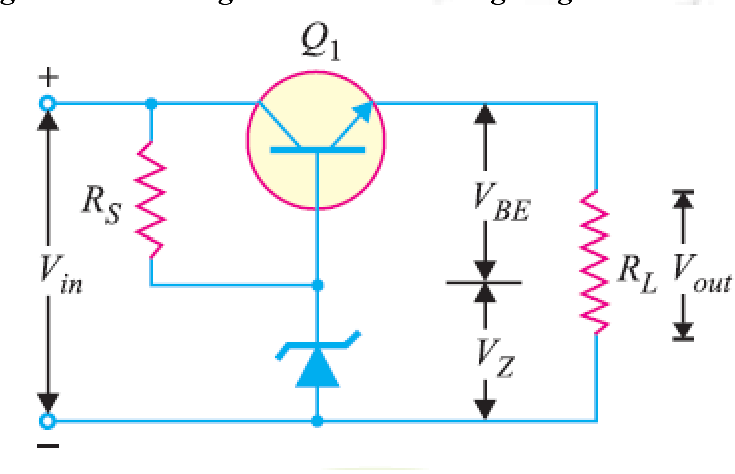
TUF of Bridge Rectifier

$= [(4I_mV_m)/\pi^2] / [V_mI_m/2]$

$= 8/\pi^2$

$= 0.8106$

20. Design the block diagram of Series voltage regulator.



21. Analyze the the importance of over voltage protection.

Overvoltage protection is an essential part of any electrical and electronic system. It ensures that the system runs as designed and undamaged despite changes in external conditions, specifically those that cause overvoltage and power surges.

22. What is meant by switched mode power supply?

A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state. A switched-mode power supply is also known as a switch-mode power supply or switching-mode power supply.

Switching power supplies have high efficiency and are widely used in a variety of electronic equipment, including computers and other sensitive equipment requiring stable and efficient power supply.

23. What are the advantages of switched-mode power supply (SMPS)

Advantages of switched-mode power supplies:

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density
- Very low ripple content.
- No need of dual supply.
- Transistor is operated as a switch hence power dissipation is very small.
- Transistor power dissipation is not dependent on the input and output voltage levels.

24. Compare linear power supply and SMPS.

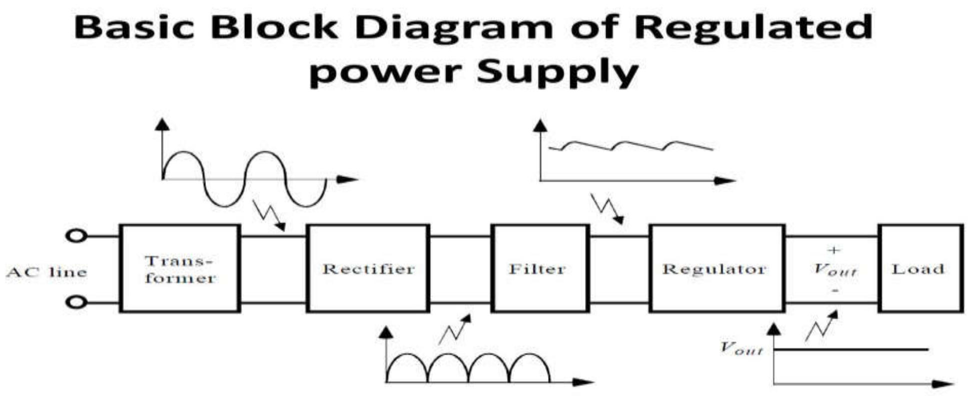
PARAMETERS	LINEAR POWER SUPPLY	SWITCH MODE POWER SUPPLY
Efficiency	Low	High
Voltage Regulation	Regulation is done by regulator	Regulation is done by feedback circuit
Magnetic material used	St alloy or CRGO core is used	Ferrite core is used
Noise and Electromagnetic interference	It is immune to noise and electromagnetic interference	Effect of noise and electromagnetic interference is quite significant, thus EMI filters are required.
Transient response	Faster	Slower
RF interference	No RF interference	Switching produces more RF interference
Complexity	Less complex	More complex

25. Categorize the troubleshooting techniques in electronic circuits.

- Confirm the Problem in the Circuit. ...
- Consider Visual Inspection First. ...
- Select Troubleshooting Tools. ...
- Power up the Circuit. ...
- Check the Power Supply Block. ...

- Check the Individual Components. ...
- Check the Main Controller. ...
- Check the Loads by Metered Power Supply.

26. Draw the block diagram of regulated DC power supply.



27. What are the types of SMPS?

- DC-DC Converter.
- Forward Converter. ...
- Flyback Converter. ...
- self-oscillating Flyback Converter.

28. Compare series and shunt voltage regulators.

BASIS OF COMPARISON	SHUNT VOLTAGE REGULATOR	SERIES VOLTAGE REGULATOR
Connection	Shunt voltage regulator is connected in parallel/shunt with the load.	Series voltage regulator is connected in series with the load.
High Load Currents	Shunt voltage regulator has good voltage regulation even at high load currents.	Series voltage regulator does not have an effective voltage regulation at high load currents.
Suitability	The regulator is suitable for light loads.	The regulator is suitable for heavy loads.
Output DC	In the shunt voltage regulator, the output DC voltage is constant.	In the series voltage regulator, the output DC voltage is not constant.
Control Element	In the shunt voltage, the control element has to bear the load voltage across it. Therefore, it is a high voltage low current device.	In the series voltage, the control element has to carry the load current. Therefore, it is high current low voltage device.
Efficiency	Shunt voltage regulator has good efficiency for low load current.	Series voltage regulator has good efficiency for higher load currents.

29. Compare different types of rectifiers.

Particulars	*Type of rectifier*		
	Half-wave	*Full-wave*	*Bridge*
No. of diodes	1	2	4
Maximum efficiency	40.6%	81.2%	81.2%
V_{dc} (no load)	V_m/π	$2V_m/\pi$	$2V_m/\pi$
Average current/diode	I_{dc}	$I_{dc}/2$	$I_{dc}/2$
Ripple factor	1.21	0.48	0.48
Peak inverse voltage	V_m	$2V_m$	V_m
Output frequency	f	2f	2f
Transformer utilisation factor	0.287	0.693	0.812
Form factor	1.57	1.11	1.11
Peak factor	2	$\sqrt{2}$	$\sqrt{2}$

30. Define ripple factor, efficiency, transformer utilization factor, form factor, peak factors?

Ripple factor= RMS value of ac component/Average value
Efficiency= dc output power / ac input power
TUF= dc power delivered to load/ac rating of transformer secondary
Form factor= rms/ average
Peak factor= peak value/ rms value

31. Compare different types of filters?

	Type of Filter				
	None	*L*	*C*	*L-Section*	*π-Section*
V_{dc} at no load	$0.636\ V_m$	$0.636\ V_m$	V_m	V_m	V_m
V_{dc} at load I_{dc}	$0.636\ V_m$	$0.636\ V_m$	$V_m - \frac{4170\ I_{dc}}{C}$	$0.636\ V_m$	$V_m - \frac{4170\ I_{dc}}{C}$
Ripple factor Γ	0.48	$\frac{R_L}{16000\ L}$	$\frac{2410}{CR_L}$	$\frac{0.83}{LC}$	$\frac{3330}{LC_1C_2R_L}$
Peak inverse voltage (PIV)	$2V_m$	$2V_m$	$2V_m$	$2V_m$	$2V_m$

32. State any two reasons – unregulated power supply is not suitable for many applications.

In unregulated power supply, the output voltage changes as the load changes. The output voltage changes as the input supply voltage changes.

33. State the basic concept of SMPS.

The pulse width modulation is the basic principle of the switching regulators. The average value of repetitive waveform is proportional to the area under the waveform so the switching regulators use the fact that of duty cycle of the pulse waveform is varied, the average value of the voltage also changes proportionally.

34. Where is SMPS used?

The SMPS is used where perfect d.c. voltage is required for the proper functioning of the circuit. It is used in computers, printers, inverters, stabilizers etc.

35. Define the two types of user agents in the electronic mail system.

- Command driven: It normally accepts a one character command from the keyboard to perform its task.
- GUI based: They contain GUI components that allow the user to interact with the software by using both the keyword and mouse.

36. Define line regulation and load regulation.

The line regulation is defined as the change in regulated load voltage for a specified range of line voltage, typically 230V ± 10%.

The load regulation is the change in the regulated output voltage when the load current is changed from minimum(no load) to maximum(full load).

37. State the three basic configurations of the switching regulators.

- Step down or Buck switching regulator
- Step up or Boost switching regulator
- Inverting type switching regulator

38. Why protection circuit is required for the regulator?

If the load terminals are shorted accidently then,

- Large amount of load current will flow
- The pass transistor Q_1 will get destroyed
- The diodes used in unregulated power supply, supplying the input voltage V_{in} to regulated circuit may get destroyed

To avoid all such possibilities, protection circuit is required for the regulator.

39. Define source effect.

The output voltage (ΔE_0) due to change in the input voltage is called source effect.

40. What is load effect?

Load effect is defined as the output voltage changes when the load current is increased from zero to its specified maximum level ($I_{L(max)}$).

PART-B

1. Derive the expression for the rectification efficiency, ripple factor, transformer utilization factor, form factor and peak factor of half wave rectifier.
2. Derive the expression for the rectification efficiency, ripple factor, transformer utilization factor, form factor and peak factor of full wave rectifier.
3. Explain different types of filters used in power supply circuits.

4. Explain linear series and shunt voltage regulators with neat diagram.
5. Explain the function of switching regulators with diagram.
6. Draw the block diagram of SMPS and explain its operation.
7. Design a 12V regulated DC power supply with a maximum load current of 150 mA.