SELVAM COLLEGE OF TECHNOLOGY, NAMAKKAL-03
DEPARTMENT OF ECE
TWO MARK QUESTIONS & ANSWERS

UNIT 1 – TRANSISTOR BIAS STABILITY

1. Why do we choose Q point at the center of the loadline?

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. If the point is fixed in the saturation region or the cut off region the positive and negative half cycle gets clipped off respectively.

2. Name the two techniques used in the stability of the Q point .explain.

Stabilization technique: 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 thermistors diodes. They provide compensating voltages & currents to maintain operating point constant.

3. Give the expression for stability factor.

$$S = \frac{(1-\beta)}{(1-\beta)\times\frac{\delta I_B}{\delta I_C}}$$

4. List out the different types of biasing.

Voltage divider bias
Base bias
Emitter feedback bias
Collector feedback bias

5. What do you meant by thermal runway?

Due to the self heating at the collector junction, the collector current rises. This causes damage to the device. This phenomenon is called thermal runway.

6. Why is the transistor called a current controlled device?

The output characteristics of the transistor depend on the input current. So the transistor is called a current controlled device.

7. Define current amplification factor?

It is defined as the ratio of change in output current to the change in input current at constant other side voltage.

8. What are the requirements for biasing circuits?

- The q point must be taken at the Centre of the active region of the output characteristics.
- Stabilize the collector current against the temperature variations.
- Make the q point independent of the transistor parameters.
- When the transistor is replaced, it must be of same type.

9. When does a transistor act as a switch?

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

10. What is biasing?

To use the transistor in any application it is necessary to provide sufficient voltage and current to operate the transistor. This is called biasing.

11. What is operating 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.

12. What is stability factor?

Stability factor is defined as the rate of change of collector current with respect to the rate of change of reverse saturation current.

13. What is d.c load line?

The d.c load line is defined as a line on the output characteristics of the transistor which gives the value of Ic & Vce corresponding to zero signal condition.

14. What are the advantages of fixed bias circuit?

This is simple circuit which uses a few components. The operating point can be fixed any where on the Centre of the active region

15. Explain about the various regions in a transistor?

The three regions are active region saturation region cutoff region.

16. Explain about the characteristics of a transistor?

Input characteristics: it is drawn between input voltage & input current while keeping output voltage as constant. Output characteristics: It is drawn between the output voltage &output current while keeping input current as constant.

17. What is the necessary of the coupling capacitor?

It is used to block the c signal to the transistor amplifier. It allows a c &blocks the d c.

18. What is reverse saturation current?

The current due to the minority carriers is called the reverse saturation current.

19. Why is the operating point selected at the Centre of the active region?

The operating point is selected at the Centre of the active region to get to perfect amplification. Moreover there is no distortion.

20. What are the basic rules of an operating point in an amplifier?

The operating point should be fixed on the load line. The upper end of the load line lies on the saturation region &lower end lies on the cutoff region.

21. What is an amplifier?

An amplifier is a device which produces a large electrical output of similar characteristics to that of the input parameters.

22. How are amplifiers classified according to the input?

1. Small – signal amplifier 2. Large – signal amplifier

23. How are amplifiers classified according to the transistor configuration?

1. Common emitter amplifier 2. Common base amplifier 3. Common collector amplifier

24. What is the different analysis available to analyze a transistor?

1. AC analysis 2. DC analysis

25. How can a DC equivalent circuit of an amplifier be obtained?

By open circuiting the capacitor.

26. How can a AC equivalent circuit of a amplifier be obtained?

By replacing dc supply by a ground and short- circuiting capacitors.

27. List the advantage of transistor?

- ✓ Low operating voltage
- ✓ Higher frequency
- ✓ Small size and ruggedness
- ✓ Does not require filament power

28. According to what criteria transistor used for voltage or current amplification

According to the three type of configuration transistor used for voltage or current amplification.

29. How transistors do amplification?

Passing the input current signal from a region of low resistance to a region of high resistance. This concept of transfer of resistance has given the name TRANSfer-resISTOR (Transistor)

30. Why CE configuration is widely used in amplifier circuit?

- ✓ Voltage gain and current gain greater than unity
- ✓ Ratio of output resistance to input resistance small 10Ω to 100Ω.
- ✓ Coupling is ideal between various transistor stages.

31. Write down the operating regions and bias conditions of a transistor?

Si.no	Region	Emitter-Base junction	Collector-Base junction
1	Cut-off	Reverse bias	Reverse bias
2	Active	Forward bias	Reverse bias
3	Saturation	Forward bias	Forward bias

32. Define DC biasing (or) discuss the importance of biasing? *(DEC-2008)*

In order to operate transistor in the desired region we have to apply external dc voltage of correct polarity and magnitude to the two junctions of the transistor. This is nothing but the biasing of the transistor. Because dc voltage is used to bias the transistor, biasing is known as dc biasing of the transistor.

33. Define DC operating point or quiescent point

When we bias a transistor we establish a certain current and voltage conditions for the transistor. These conditions are known as operating condition or dc operating point or quiescent point.

34. Operating point depends what are the parameter.

- ✓ β
- ✓ I_{co}
- ✓ V_{BE}
- ✓ Temperature

35. List the typical junction voltage of NPN transistor

Si.no	Transistor	$V_{CE(sat)}$	$V_{BE(sat)}$	$V_{BE(active)}$	$V_{BE(cut-in)}$	$V_{BE(cut-off)}$
1	Si	0.2v	0.8v	0.7v	0.5v	0v
2	Ge	0.1V	0.3V	0.2V	0.1V	0.1V

PNP- transistor only polarities will change.

36. List the condition of saturation region

$I_B > I_C/\beta_{dc}$

37. List the condition of active region

- ✓ $V_{CE} > V_{CE(sat)}$
- ✓ $I_C = I_B\beta$

38. Where we select the operating point

- ✓ Near to saturation
- ✓ Near to cut-off
- ✓ At the centre of the load line
- ✓

39. Define bias stability

Designing the biasing circuit stabilize the Q-point is known as bias stability.

40. Define thermal runaway? *(NOV/DEC-2003), (NOV/DEC-2006), (DEC-2008)*

The increase in the collector current increases the power dissipated at the collector junction. This is turn further increases the temperature of the junction and hence increases the collector current. The 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.

41. Important factors do design bias circuit

- ✓ Temperature
  - I_{C0}
  - V_{BE}
  - β_{dc}
- ✓ Transistor current gain(h_{fe}/β)

42. Requirements of a biasing circuit?

- ✓ The emitter –base junction must be forward biased and collector-base junction must be reverse biased.opearating point should be fixed at the center of the active region.
- ✓ The circuit design should provide a degree of temperature stability
- ✓ The operating point should bemade independent of the transistor parameters.

43. What are the techniques is used to maintain the Q-point in the centre of the load line?

- ✓ Stabilization technique
- ✓ Compensation technique. ***(APRIL/MAY-2005)***

44. Define stability factor? And what its ideal value?

This indicates degree of change in operating point due to variation in temperature.

$S=1+\beta$

45. What is the advantage of using emitter resistance in the context of biasing?

Better stability factor S we have to keep ratio R_B/R_E as small as possible. Emitter resistance R_E is one parameter we can use to decrease ratio R_B/R_E by increasing R_E we can make R_B/R_E small. But as we increase R_E, drop I_ER_E will also increase and since V_{CC} is constant, drop across R_C will reduce. This shifts the operating point Q which is not desirable and hence there is limit for increasing R_E.

46. Why thermal runaway is not there in FETs? *(NOV/DEC-2005)*

FET is temperature dependent. In FET, as temperature increases drain resistance also increases', reducing the drain current. So thermal runaway does not occur in FET.

47. Why is it necessary to stabilize the operating point of transistor? *(APRIL/MAY-2004)*

Stabilization techniques refer to the use of resistive biasing circuits which allow I_B to vary so as to keep I_C relatively constant with variations in I_{C0} ,β and V_{BE}. To maintain the operating point stable. So that the transistor will always work in active region.

48. What is the need for biasing?

Apply external dc voltages or correct polarity and magnitude to the two junctions of the transistors, to operate it in the desired region.

49. What is meant by compensating techniques? *(MAY/JUNE-2006)*

Use of temperature-sensitive devices such as diodes, transistors, thermistors, etc., which provide compensating voltages and currents to maintain the operating point stable.

50. Why BJT needs temperature compensation against V_{BE} Changes? *(NOV/DEC-2005)*

I_{CBO} increases with increase in temperature, I_B reduces due to reduction in V_{BE}, maintaining I_C fairly constant.

51. Why do you fix the operating point in the middle of the dc load line?

We fix the operating point in the middle of the dc load line the output signal is sinusoidal waveform without any distortion, thus the point is the best operating point.

52. Write short notes on zero current drift in FET ***(APRIL/MAY-2008)***

In JFET, the drain current varies with changes in the temperature due to two factors. One factor increases drain current and other factor decreases drain current with increase in temperature. Therefore, it is possible to design biasing circuit which compensates these tow factors so that there is no change of drain current with temperature. Such biasing is called biasing for zero current drift.

53. FET is an unipolar device-justify

FET operation depends only on the flow of majority carriers holes for P-channel FETs and electrons for N-channel FET. Therefore they are called as unipolar devices.

54. Distinguish between FET and BJT

S.No	Parameter	BJT	FET
1	Control element	Current controlled device	Voltage controlled device
2	Device type	Bipolar devices	Uni-polar device
3.	Input resistance	Less	High
4.	Sensitivity	High	Less

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UNIT II – MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS

1. **Define small signal equivalent circuit?**
   The analysis of a non-linear device is complx.signal that takes up a relatively small percentage of an amplifier's operational range. With small input singles the transistor can be replaced with small signal linear model. This Model is also called small signal equivalent model.
2. **Define transconductance?**
   The change in the drain current due to change in gate to source voltage can be determined using the transconductance factor g_m.
   $\Delta I_d = g_m \Delta V_{GS}$.
3. **Define emitter bypass capacitor?**
   An emitter bypass capacitor C_E is connected in parallel with the emitter resistance, R_E to provide a low reactance path to the amplified ac signal. If it is not inserted, the amplified ac signal passing through R_E will cause a voltage drop across it. This will reduce the output voltage, reducing the gain of the amplifier.
4. **Define coupling capacitor?**
   The coupling capacitor C_s couples the output of the amplifier to the load or to the next stage of the amplifier. It blocks dc and passes only ac part of the amplified signal.
5. **Define input resistance**
   The ratio of V_1 to I_1 is called input resistance R_i ,of the amplifier. $R_i = V_1 / I_1$
6. **Define current gain**
   The ratio of output current to input current is called current gain,A_I, of the amplifier. $A_I = I_2 / I_1$.
7. **Define voltage gain**
   The ratio of output voltage to input voltage is called voltage gain,A_V ,of the amplifier. $A_V = V_2 / V_1$
8. **Define power gain**
   The ratio of signal power delivered to the load to the signal power at the input of the amplifier is the power gain,A_P, of the amplifier. $A_P = A_V \ A_I$
9. **Define voltage amplifier**
   The amplifier, in which voltage gain is more important that the power gain, is called a voltage amplifier.
10. **Define power amplifier**
    Power gain is more important than voltage gain is
    known as power amplifier.
11. **Define benefits of h-parameter.**
    - ✓ Real numbers at audio frequencies
    - ✓ Easy to measure
    - ✓ Can be obtained from the transistor static characteristic curves
    - ✓ Convenient to use in circuit analysis and design.
    - ✓ Most of the transistor manufacturers specify the h-parameter.
12. **State Miller's Theorem**.***(NOV/DEC-2006),(APRIL/MAY-2008)***

Miller's theorem states that, the effect of resistance Z on the input circuit is a ratio of input voltage V_i to the current I which flows from the input to the output**.** Miller's theorem states that, the effect of resistance Z on the output circuit is a ratio of output voltage V_o to the current I which flows from the output to the input.

13. What are the techniques used to improve input impedance.

- ✓ Using direct coupling (Darlington connection)
- ✓ Using Bootstrap techniques

14. Define Darlington connection

Cascaded connection of two emitter followers is called Darlington connection.

15. Define complementary Darlington transistor

Darlington pair with the exception that a PNP transistor drivers an NPN transistor

16. Why the Darlington connection is not possible for more number of stages?

In Darlington connection of two transistors, emitter of the first transistor is directly connected to the base of the second transistor. Because of direct coupling dc output current of the first stage is $(1+h_{fe})I_{b1}$. If Darlington connection for n stage is $(1+h_{fe})^n$ times I_{b1}. Due to very large amplification factor even tow stage Darlington connection has large output current and output stage may have to be a power stage. As power amplifiers are not used in the amplifier circuits it is not possible to use more than two transistors in the Darlington connection.

17. Why bootstrapping technique is called so?

When $A_V \rightarrow 1$, is called bootstrapping. The name arises from the fact that, if one end of the resistor R_3 changes in voltage, the other end of R_3 moves through the same potential difference; it is as if R_3 is pulling itself up by its bootstraps.

18. What is the need for bootstrapped Darlington circuit?

Resistance between base and collector of transistor is given as $1/h_{ob}$, which is of the order of 2MΩ.to overcome this problem, same bootstrapping technique can be used with Darlington circuit.

19. list the three basic configuration of FET

- ✓ common source
- ✓ common drain
- ✓ Common gate.

20. Define common drain circuit?

In common drain amplifier circuit input is applied between gate and source and output is taken between source and drain.

21. Define common source circuit?

In common source amplifier circuit input is applied between gate and source and output is taken between drain and source.

22. Define common gate circuit?

In common drain amplifier circuit input is applied between source and gate output is taken between drain and gate.

23. Define drain resistance?

The change in the drain source voltage due to change in drain current with constant $\mathbf{V_{GS}}$ can be determined using the drain resistance r_d.

$\Delta V_{DS}=r_d \Delta I_D$.

24. Define decibels

To compare two powers on a logarithmic scale rather than on a linear scale. The unit of this logarithmic scale is called decibel (abbreviated dB)

25. Methods of coupling multistage amplifiers

- ✓ RC coupling
- ✓ Transformer coupling
- ✓ Direct coupling

26. Define RC coupling

The output signal of first stage is coupled to input of the next stage through coupling capacitor and resistive load at the output terminal of first stage.

27. Define Transformer coupling

The output signal of first stage is coupled to input of the next stage through an impedance matching transformer.

28. Define Direct coupling

The output signal of first stage is directly connected to the input of the next stage.

29. Define cascode?

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

30. Define differential amplifier or difference amplifier?

An amplifier which amplifies the difference between the two input signals is called differential amplifier.

31. Define differential gain?

The A_d is the gain with which differential amplifier amplifies the difference between two input signals. Hence it is called differential gain of the amplifier. $\mathbf{V_0=A_d\,(V_1-V_2)}$

32. Define common mode gain?

The gain with which it amplifies the average level of the two input signals to produce the output is called common mode gain A_C. $\mathbf{V_0=A_C\,(V_C)\&V_C=(V_1+V_2)/2}$

33. Features of differential amplifier.

- ✓ High differential voltage gain
- ✓ Low common mode gain
- ✓ High CMRR
- ✓ Two input terminals
- ✓ High input impedance
- ✓ Large bandwidth
- ✓ Low offset voltages and currents
- ✓ Low output impedance

34. List the configuration of differential amplifiers.

- ✓ Dual input, balanced output differential amplifier
- ✓ Dual input, unbalanced output differential amplifier
- ✓ Single input, balanced output differential amplifier
- ✓ Single input, unbalanced output differential amplifier

35. Define bisection theorem

A particular network which has mirror symmetry with respect to an imaginary line. If the entire network is denoted as N then it can be divided into two half

networks N/2 about the line of symmetry is called bisection theorem or Bartlett's bisection theorem.

36. **what is meant by CMRR of a differential amplifier*?(APRIL/MAY-2004),(NOV/DEC-2005),(MAY/JUNE-2006),(MAY/JUNE-2007),(DEC-2008)***

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 voltage gain A_d to common mode voltage gain A_c

$$\textbf{CMRR}=\rho=\left|A_d / A_c\right|$$

37. **Methods of improving CMRR**

To improve the CMRR, the common mode gain A_c must be reduced. The common mode gain A_c approaches zero as R_E tends to infinity. This is because R_E introduces a negative feedback in the common mode operation which reduces the common mode gain A_c. Thus higher the value of R_E, lesser is the value of A_c and higher is the value of CMRR. The differential gain A_d is not dependent on R_E

38. **R_E cannot select high why?**

- ✓ Large R_E needs higher biasing voltage to set the operating Q point of the transistor.
- ✓ This increase the overall chip area.

39. **What are the other methods to improve CMRR without R_E?**

- ✓ Constant current bias method
- ✓ Current mirror circuit.

40. **Define current mirror circuit?**

The circuit in which the output current is forced to equal the input current is called as current mirror circuit. In a current mirror circuit, the output current is the mirror image of input current.

41. **List the advantage of current mirror circuit?**

- ✓ Provides very high emitter resistance R_E.
- ✓ Requires fewer components than the constant current bias.
- ✓ Simple to design
- ✓ Easy to fabricate.
- ✓ With properly matched transistors, collector current thermal stability is achieved.

42. **Define active load**

The current mirror circuit can be used as a collector load instead of R_C. Such a load is called an active load.

43. **List the advantage of active load**

- ✓ provides very high ac resistance
- ✓ provides high differential mode voltage gain
- ✓ A_d High
- ✓ CMRR High

44. Application of differential amplifier

- ✓ Limiter
- ✓ Amplitude modulator.

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UNIT III – FREQUENCY RESPONSE OF AMPLIFIERS

1. What is the Bandwidth of an amplifier? (May/June 2007)

Band width of an amplifier is defined as the difference between f1 and f2.
Here f2 is in the high frequency region and f1 is in the low frequency region.
These two frequencies are also referred to as the half power frequencies.

2. Give the significance of the coupling and bypass capacitor on bandwidth of amplifiers? (Nov/Dec 2005)

At high and medium frequencies the coupling capacitors behave as short circuits. A t low frequency the circuit gain is reduced. As the signal frequency decreases the capacitor reactance increase and circuit gain continues to fall, reducing the output voltage.

3. How the rise time and band-width are interrelated? (Nov/Dec 2005)

Here,

$$Bw = F_H - F_L$$
$$\sim F_H$$
$$BW = 0.35/ t_r$$

4. List out the applications of the optocouplers(Nov/Dec 2008)

- It is used in the high voltage applications where the voltages of the input and output differ by several thousand volts.
- The response of the optocoupler is so small that they can be used to transmit data in megahertz.

- Capable of wideband signal transmission.

5. How the frequency response of an amplifier be improved?

The frequency response can be improved by connecting the compensating network externally to the system. Such Techniques are as follows

i) Dominant pole Compensation

ii) Pole –zero Compensation

6. What is the Dominant pole Compensation Technique?

In this Technique the dominant pole is introduced by adding a compensating network which is nothing but the R-C network.

7. What is the Pole Zero Compensation technique?

In this method the transfer function is modified by adding the pole and zero with the help of compensating network. The zero is added at high frequency and the pole is added at the low frequency.

8. Define the Rise time of an amplifier? (May/June 2007)

It is defined as the time that indicates how fast the amplifiers can response to the discontinuity in the input voltage. It is given by,

9. Define Sag in an amplifier? (May/June 2006)

The lower 3db frequency can be determined from the output by measuring the Sag.

The lower 3db frequency in terms of sag or tilt is given by

$$P = (t1 / R1C1) * 100$$

10. What are the two compensating techniques used in frequency compensation? Two types of compensating techniques are used, they are,

a. External compensation b. internal compensation

11. What is compensated op-amp?

Op-amp, which uses a capacitor internally for compensation, is called compensated op-amp. This op-amp has a high gain stability and low bandwidth.

12. What are the methods used in external compensation technique?

a. Dominant-pole compensation

b. Pole-zero compensation

13. Define slew rate?

Slew rate can be defined as the maximum rate of change of output voltage of op-amp with respect to time.

14. How can the slew rate be made faster?

The slew rate can be made faster by having a high charging current or a small capacitance value.

15. What are the methods to improve slew rate?

a. The slew rate can be improved with higher closed-loop gain and dc supply voltage. But the slew rate also varies with temperature. i.e., slew rate decreases with increase in temperature.

b. Another method for improving slew rate is, the rate at which voltage across the capacitor increases is gain by, $dVc/dt = I / C$. where, I is the maximum current furnished by the op-amp to the capacitor C. From the equation it is clear that for a higher slew rate, op-amp should have either a higher current or a small value of capacitor.

16. How high pass RC circuit be used as a differentiator?

In some RC circuits, capacitor C stores some of the charges on each cycle ; ie it integrate or adds the charges on each pulse until it become charged to some definite value. RC circuits used to integrate pulses are called RC integrator circuit or low pass filter.

17. How low pass RC circuit be used as a integrator?

In some RC circuits, the wave form of the voltage across the capacitor is substantially the same as that of the applied voltage, whereas the voltage across the resistor has a new waveform which is depend upon how fast the applied voltage changes. Because of their ability to differentiate between rates of change of the applied voltage, these circuits are called differentiator.

18. Give the effect of internal transistor capacitances

At high frequencies the internal transistor capacitances known as junction capacitances reduces the circuit gain

19. Briefly explain why dominant pole high frequency compensation method used in amplifiers (May/June 2007)

- As the noise frequency components are outside the smaller bandwidth, The noise immunity of the system improves.
- Adjusting value of fd adequate phase margin and stability of the system is assured.

20. What are the advantages of pole zero compensation techniques?

As compared to dominant pole compensation technique there is improvement in bandwidth equal to f1-f2.

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UNIT IV – LARGE SIGNAL AMPLFIERS

1. What are the classifications of a power amplifier?

The various classes of power amplifiers are as follows

- Class A amplifier
- Class B amplifier
- Class C amplifier
- Class AB amplifier

The position of the Q point on the load line decides the class of operation of the power amplifier.

2. Define the class A amplifier?

The power amplifier is said to be class b if the Q point and the input signal are selected such that the output signal is obtained for the full cycle of the input signal.

3. What are the active devices used in power amplifiers? (Nov/Dec 2008)

- CC or the emitter follower is used because of low output impedance
- CE is used for impedance matching

4. Why Class A amplifier must not be operated under no signal condition?

Under no signal condition, the entire DC power input $P_{DC}=V_{CC}I_{CQ}$ is dissipated as the heat. Thus power dissipation is maximum under no signal condition. This may increase the transistor junction temperature beyond safe value, which may lead to transistor damage. To avoid this, class A amplifier must not be operated under no signal condition.

5. What is the classification of Class A amplifier?

- Directly coupled
- Transformer coupled

6. What are the advantages of directly coupled power amplifier?

- The circuit is simple to design and implement
- The load is connected directly to the collector circuit .Hence the output transformer is not necessary.

7. What are the disadvantages of the directly coupled power amplifier?

- Power dissipation is more
- The output impedance is high
- The efficiency is high due to large power dissipation

8. List any two advantages of the transformer coupled class A power amplifier? (Nov/Dec 2006)

- Efficiency of the operation is high compared to directly coupled amplifier.
- Impedance matching required for maximum power transfer is possible.

9. What is heat sink? Give its advantages*? (APRIL/MAY-2008)*

A heat sink is a mechanical device which is connected or press fit to the case of the transistor that provides a large surface area, to dissipate the developed heat. The heat sink carries the heat to the surroundings.

Advantages:

- ✓ The temperature of the case gets lowered
- ✓ The power handling capacity of the transistors can approach the rated maximum value.

10. Why the efficiency of the Class A resistive loaded power amplifier is less than the transformer coupled counterpart? (May/June 2006)

This is because power dissipation is large in the transformer coupled counterpart.

11. What is the conversion efficiency in power amplifiers? (May/June 2006)

The efficiency of an amplifiers represent the amount of ac power delivered or transferred to the load from the dc source ie. Accepting dc power input.

12. Define the class C operation? (May/June 2007)

The power amplifier is said to be class b if the Q point and the input signal are selected such that the output signal is obtained for less than half cycle for the full cycle of the input signal. For this operation Q-point is to be shifted below x-axis.

13. Which power amplifier gives minimum distortion? Why?(Nov/Dec 2005)

Class A amplifier gives minimum distortion because output is obtained for the entire cycle of the input signal.

14. What is crossover distortion in a power amplifier and how to eliminate it?

(MAY/JUNE-2007)(APRIL/MAY-2003)

For making transistor ON, it is necessary that V_{BE} voltage must exceed 0.7V. Due to this, in class B amplifier while crossing over from one half cycle to other, as long as input is below 0.7V, none of the transistor is ON and output is Zero. Due to this, there is distortion in the output, which is called the cross over distortion. To overcome this distortion, a small forward bias is kept applied to the transistors so that when input is zero, this additional forward bias can make the transistor ON immediately elimination cross over distortion.

15. Compare the efficiency of class A, B, C, AB (Nov/Dec 2007)

CLASS	A	B	C	AB
Efficiency	Poor,25% to 50%	Better,78.5%	Higher than 78.5% but less than 100%	Higher than A but less than B

16. What is class AB operation?

The power amplifier is said to be class AB if the Q point and the input signal are selected such that the output signal is obtained for more than 180 but less than 360 for the full input signal. For this operation Q-point is above x-axis but below the midpoint of the load line.

17. What are the advantages of heat sink?(Nov/Dec 2006)

- Power handling capacity of the transistors can approach the rated maximum value.
- It causes the temperature of the case to be lowered.

18. Define Push pull Class B amplifier?

In the Push pull Class B amplifier both the transistors used are of same type ie either n-p-n or p-n-p.It requires two transformers as follows

- Driver transformer or input transformer
- Output transformer

19. Explain Complementary symmetry class B amplifier?

This amplifier circuit uses one n-p-n and the other p-n-p transistor instead of same type of transistors. It is the transformer less circuit.

20. Mention two conditions to be satisfied by a complementary symmetry power stage?

(May/June 2006)

- The Common Collector configuration is used tom match the output impedance for maximum power transfer
- The voltage feedback is to be used to reduce the output impedance for matching.

21. What are the disadvantages in Complementary symmetry class B amplifier?

- The circuit needs two separate voltage supplies.
- The output is distorted by cross over distortion.

22. What is the configuration used in complementary symmetry power amplifier? How does it help?

The configuration used n complementary symmetry power amplifier is common collector. This configuration has lowest output impedance due to which impedance matching for the low impedance loads like loudspeaker is easily possible.

23. Define thermal resistance in the context of power amplifier?

The temperature rise of a junction is proportional to the power dissipation. The constant of proportionality between the two is called thermal resistance. It is defined as the temperature rise per unit watt of heat dissipation.

$$T_2\text{-}T_1$$

$$\theta = \frac{\quad}{P_d} \quad {}^0C/W$$

24. Define conversion efficiency of a power amplifier. What is its value for class C power amplifier? *(MAY/JUNE-2006) (MAY/JUNE-2007)*

The ratio of AC power delivered to the load to the DC power input is called conversion efficiency of a power amplifier.

% conversion efficiency=P_{AC}/P_{DC}X100

For class C power amplifiers, the conversion efficiency is almost 100%

25. What is meant by harmonic distortion or non linear distortion? *(APRIL/MAY-2004)*

At the output of power amplifiers, along with the fundamental frequency (f) component, additional frequency components are also present whose frequencies are integral multiples of fundamental frequency such as 2f, 3f…. . These are called harmonics. The output gets distorted due to these components. This is called the harmonic distortion.

26. Define voltage amplifier? *(NOV/DEC-2008)*

The system consists of many stages connected in cascade. Hence basically it is a multistage amplifier. The input is sound signal of a human speaker and the output is given to the loud speaker which is an amplified input signal. The input and the intermediate stages are small signal amplifiers. The sufficient voltage gain is obtained by all the intermediate stages. Hence these stages are called voltage amplifiers.

27. List the features of large signal amplifiers

- ✓ input signal level or amplitude of a power amplifier is large
- ✓ output of power amplifier has large current and voltage swings
- ✓ h parameter not used here
- ✓ low output impedance
- ✓ large size
- ✓ large power dissipation rating

28. Define class C amplifier?

The power amplifier is said to be class **B** amplifier if the Q-point and the input signal are selected, such that the output signal is obtained only for one half cycle for a full input cycle. The position of the Q-point is shifted on X-axis i.e. transistor is biased to cut-off.

29. List the application of Class C amplifier

- ✓ tuned circuit
- ✓ radio frequency circuit
- ✓ mixer
- ✓ converter
- ✓ radio receivers
- ✓ Wireless communication.

30. Define class D amplifier?

The amplifier consists of two complementary symmetry transistors driving a load RL. This means one transistor in PNP and other is NPN.Thus entire power input is available to the load. Hence efficiency of class D amplifier is almost 100%.

31. List the advantages and disadvantages of directly coupled class A amplifier?

Advantage:

- ✓ Circuit simple
- ✓ Output transformer is not necessary
- ✓ Circuit cheaper
- ✓ Less number of components required as load is directly coupled

Disadvantage:

- ✓ Load resistance is directly connected in collector and carries the quiescent collector current. This causes considerable wastage of power.
- ✓ Power dissipation is more. Hence power dissipation arrangements like heat sink are essential
- ✓ The output impedance is high hence circuit cannot be used for low impedance loads, such as loudspeakers
- ✓ The efficiency is very poor, due to large power dissipation

32. List the advantages and disadvantages of transformer coupled class A amplifier?

Advantage:

- ✓ Efficiency higher than directly coupled
- ✓ The Dc bias current flows through load
- ✓ Impedance matching required

Disadvantage:

- ✓ The circuit is complicated to design.
- ✓ The circuit bulkier, heavier and costlier
- ✓ Frequency response of the circuit is poor.

33. Define frequency distortion?

The change in gain of the amplifier with respect to the frequency is called frequency distortion. The frequency distortion is not significant in AF power amplifiers.

34. List the advantages and disadvantages of push pull class B amplifier?

Advantage:

- ✓ Efficiency higher than class A
- ✓ No input signal, power dissipation is zero
- ✓ Reduce harmonic distortion
- ✓ The Dc bias current flows opposite direction.
- ✓ Ripple present in supply voltage also get eliminated
- ✓ Impedance matching possible

Disadvantage:

- ✓ Two center tap transformers are necessary
- ✓ The circuit bulkier, heavier and costlier
- ✓ Frequency response of the circuit is poor.

35. List the advantages and disadvantages of complementary symmetry B amplifier?

Advantage:

- ✓ Transformerless,its weight, size and cost are less
- ✓ Due to CC impedance matching possible
- ✓ Frequency response improves

Disadvantage:

- ✓ The circuit needs two separate voltage supplies
- ✓ The output is distorted to cross over distortion.

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TWO MARK QUESTIONS & ANSWERS

UNIT-V RECTIFIERS AND POWER SUPPLIES

1. **Define rectifiers?**
   A rectifier is a device which converts a.c. voltage to pulsating d.c. voltage, using one or more p-n junction diode.

2. **Write down the important characteristics of a rectifier circuit?**
   A) Waveform of the load current.
   B) Regulation of the output voltage
   C) Rectifier efficiency
   D) Peak value of current in the rectifier circuit.
   E) Peak value of voltage across the rectifier element in the reverse direction (PIV)
   F) Ripple factor
3. **Write down the various rectifiers circuits?**
   A) half wave rectifier
   B) full wave rectifier
   C) bridge rectifier
4. **Define ripple factor?**
   The output of the rectifier is of pulsating d.c. type. The amount of a.c.content in the output can be mathematically expressed by a factor called ripple factor.
   Mathematically it is defined as the ratio of R.M.S. value of the a.c.component in the output to the average or d.c.component present in the output.

$$\text{Ripple factor} = \frac{\text{R.M.S value of a.c.component of output}}{\text{Average or d.c. component of output}}$$

5. Define half wave rectifier?

In half wave rectifier, rectifying element conducts only during half cycle of input a.c.supply. The negative half cycles of a.c.supply are eliminated from the output.

6. Define transformer utilization factor (T.U.F)

The factor which indicates how much is the utilization of the transformer in the circuit is called transformer utilization factor (T.U.F)

The T.U.F. is defined as the radio of d.c.power delivered to the load to the a.c.power rating of the transformer. While calculating the a.c.power rating, it is necessary to consider r.m.s.value of a.c. voltage and current.

The T.U.F. for half wave rectifier can be obtained as,

A.C. power rating of transformer = $E_{RMS}\ I_{RMS}$

7. Write down the disadvantages of half wave rectifier circuit?

A) The ripple factor of half wave rectifier circuit which is quite high. The output contains lot of varying components.
B) The maximum theoretical rectification efficiency is found to be 40%.
C) The circuit has low transformer utilization factor, showing that the transformer is not fully utilized.
D) The d.c.current is flowing through the secondary winding of the transformer which may cause dc saturation of the core of the transformer. To minimize the saturation, transformer sizes have to be increased accordingly. This increases the cost.

8.Define rectifier efficiency?

The rectifier efficiency is defined as the ratio of output d.c. power to input a.c.power.

$\eta = Pdc / Pac$

9. Explain about full wave rectifier circuit?

The full wave rectifier conducts during both positive and negative half cycles of input a.c.supply. In order to rectify both half cycles of a.c.input, two diodes are used in this circuit.

The diodes feed a common load R_L with the help of a center tap transformer. The a.c.voltage applied through a suitable power transformer with proper turn's ratio.

10. Comparison of full wave and half wave rectifier circuit?

S.No	Parameter	Half wave rectifier	Full wave rectifier
1.	D.C.load current	Less with compare to FWR	Twice to that in HWR
2	D.C. load voltage	Less with compare to FWR	Twice that in HWR
3	Efficiency	less	twice
4.	ripple factor	high	less
5	DC power output	Less compare to FWR	Four times larger

11. Write down the uses of bridge rectifier circuit?

A) A power rectifier circuit for converting ac power to dc power
B) A rectifying system in rectifier type ac meters, such as ac voltmeter, in which the ac voltage under measurement is first converted inti dc and measured with conventional meter. In this system, the rectifying elements are either copper oxide type or selenium type.

12. Write down the advantages and disadvantages of bridge rectifiers?

Advantages:

A) The current in both the primary and secondary of the power transformer flows for the entire cycle and hence for a given power output, power transformer of a small size and less cost may cost may be used.
B) No center tap is required.
C) It reduces the losses and danger of saturation.
D) Large powers are required.
E) As two diodes conduct in series in each half cycle, inverse voltage appearing across diodes gets shared. Hence the circuit can be used for high voltage applications. Such a peak reverse voltage appearing across diode is called peak inverse voltage rating (PIV) of diode.

Disadvantages:

a) Which uses four diodes as compare to two diodes in normal full wave rectifier.
b) This gives same voltage drop.
c) It reduces the output voltage.

13. Define filter

A capacitor in a power supply used to reduce the variation of the output voltage from a rectifier. A type of circuit that passes or blocks certain frequencies to the exclusion of all others.

14. Define choke?

Ideally, inductance acts as short circuit for d.c., it cannot be placed in shunt arm across the load, otherwise the d.c.will be shorted. Hence, in a filter circuit, the inductance is always connected in series with the load. The inductance used in filter circuits is also called “choke”.

15. Write two types of filter circuits

a) Capacitor input filter
b) Choke input filter

16. Define surge current?

In a capacitor input filter the forward resistance of diodes is very small hence a large current flows through the two forward biased diodes D_1 and D_2 instantaneously. This is called surge current.

If the instant of closing the switch is such that the secondary voltage is at its peak, the surge current is also at its maximum. Such a peak surge current can destroy the diodes.

17. Give the comparison between capacitor input and LC filter

S.No	Capacitor input filter	LC filter
1.	The first element of the filter as locked from rectifier side is capacitor.	The first element of the filter as locked from rectifier side is inductor
2.	The surge current is possible which is limited by using surge limiting resistor.	The surge current through diodes is absent.
3.	Possibility of large back e.m.f. is absent	Possibility of large back e.m.f. which is

	hence bleeder resistance is not required.	harmful to diodes and capacitor. To avoid this, bleeder resistance is used.
4.	The ripple voltage is a function of load current i.e. loads resistance.	The ripple voltage is not dependent on the load.
5.	The regulation is poor	The regulation is better
6.	Not suitable for variable loads	Suitable for variable loads
7.	The d.c. output voltage is higher as the capacitor always charges to peak value	The d.c.output voltage is low compared to capacitor.
8.	Normally used for single phase, high voltage, fixed load applications.	Used is polyphase rectifier systems employing mercury are rectifiers.

18. Define voltage multipliers

The voltage multipliers are used to step up the output voltage level to two, three or more times the peak voltage of the input. Such circuits use clamping action. Such circuits can be used in bridge rectifiers to increase the level of output d.c. voltage.

19. Write various voltage multiplier circuits

1. Voltage doublers
2. Voltage Tripler
3. Voltage quadrapler

20. Explain about half wave doubler

If load is connected to the circuit, the voltage across C_2 drops during positive half cycle and is again recharged to $2V_M$ in the next negative half cycle. As capacitor charges in alternate half cycle, the circuit is called half wave doubler circuit.

21. Write down the advantages, applications and limitations of half wave doublers.

Advantages:

a) It uses the clamping action to increase peak rectified voltage without increasing the rating of the input transformer.

b) It is economical

c) The centre tap transformer is also not required in the multiplier circuit

Applications:

a) It is used in the high voltage low current applications
b) In television receivers
c) In cathode ray tube (CRT) anode voltages.

Limitations:

a) More number of diodes and capacitor are added to a chain
b) Low output voltage gain.

POWER SUPPLIES:

22. Define unregulated power supply?

The d.c output voltage increases with increasing in the input voltage whereas it decreases with increase in load current. Since the D.C. output voltage does not remain constant with variations in the input voltage or load current, this type of power supply is called unregulated power supply.

23. Write-down the factors affecting the load voltage.

The various factors which affect the load voltage in a power supply are,

a) The load current (I_L)
b) The line voltage
c) The temperature

24. Define load regulation?

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).

The load regulation is denoted as LR and mathematically expressed as,

$$LR = V_{NL} - V_{FL}$$

Where V_{FL} – Load voltage with no load current

V_{NL}- Load voltage with full load current

25. Write down the various performance parameters of power supplies?

a) Load regulation (LR)
b) Line regulation or source regulation (SR)
c) Output resistance (R_{OUT})
d) Voltage stability factor (S_V)
e) Temperature stability factor (S_T)
f) Ripple rejection (RR)
g) Total change in output voltage.

26. Give the linear electronic voltage regulator components.

The basic voltage regulator in its simplest form consists of,

1. Voltage reference, V_R
2. Error amplifier
3. Feedback network
4. Active series or shunt control element

27. What are the types of voltage regulators?

There are two types of voltage regulators available namely,

a) Shunt voltage regulator
b) Series voltage regulator.

28. Define derating factor

The reduction in maximum power dissipation is according to a factor called factor. This is called power derating of a zener.

The derating factor is expressed as mW / ^{0}C and hence derated power dissipation can be obtained as,

$$P_{D(Derated)} = P_{D(MAX)} - (\text{ Derating factor}) \Delta t$$

29. Write down the limitations of zener diode shunt regulators.

1. The maximum load current that can be supplied is limited to ($I_{Zmax} - I_{Zmin}$)
2. A large amount of power is wasted.
3. The stability factor and output resistance are not very low, as desired for regulator circuit.

30. Define linear regulators.

The regulator in a power supply is an important unit which keeps the output d.c. voltage constant under the variable load and variable input conditions. The most of the regulators used in conventional power supplies are series voltage regulators which are called linear regulators.

31. Write down the need of switched mode power supply.

The linear power supply has following limitations:

1. The required input step down transformer is bulky and expensive.
2. Due to low line frequency (50Hz) large values of filter capacitors are required.
3. The efficiency is very low.
4. Input must be greater than the output voltage.
5. More power is dissipation in the series pass transistor.
6. For higher input voltages, efficiency decreases.
7. The need for dual supply is not economical and feasible to achieve with the help of linear regulators.

32. Write down the types of switching regulators.

There are three basic configurations of the switching regulators:

1. Step down or bulk switching regulator
2. Step up or boost switching regulator
3. Inverting type switching regulator

33. Write down the advantages and disadvantages of step down switching regulator.

Advantages:

1. Higher efficiency
2. Simple to design
3. Low ripple content
4. Small output filter
5. Low switch stress
6. Large tolerance
7. Low cost, size and weight.

Disadvantages:

1. Single output
2. No isolation between input and output
3. High input ripple current
4. The input voltage must be always slightly greater than output
5. Slow transient response compared to linear regulator.

34. What is a bleeder resistor?

In case of choke filter, when R_L is increased, I_{DC} decreases but I_{2M} remains same. At a certain stage, it is possible that I_{DC} becomes less than I_{2m} and for a certain period, the net current in the circuit may become zero. When current is interrupted, it develops large back e.m.f. which may damage diodes and capacitor. To avoid this, a resistance is connected across the load which draws a minimum current through choke to avoid zero current condition. This resistance is called a bleeder resistance R_B. It is so selected that it draws a minimum current through choke. Practically R_B is selected as 900L.

35. Where is SMPS used?

The SMPS is used where perfect D.C. voltage is required for the power functioning of the circuit. It is used in computers, printers, inverters, stabilizers etc.

36. What is 'peak inverse voltage '? What is its value for the HWR?

The peak inverse voltage is the peak voltage across the diode in the reverse direction ie when the diode reverse biased .In HWR the diode is reverse biased and hence the maximum value of voltage that can exist across the diode is nothing but Em.

37. Define the ripple factor for half wave and full wave rectifier? (May/June 2007)

For half wave:

Ripple factor = $[(Im) / (Im / \prod)]^2 - 1 = 1.4674$

$= 1.211$

For full wave:

Ripple factor = **Im / 2**

$=0.48$

38. Define voltage regulation (April/May 2008)

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

39. What are the advantages of the bridge rectifier over the center tapped rectifier? (May/June 2006)

No center tap is required for the transformer secondary. Hence wherever possible the ac voltage can be directly applied to the bridge.

- Net d.c component flowing is zero which reduces the losses and danger of saturation.
- The circuit can be used for high voltage applications.

40. Name the types of linear voltage regulator

- Transistor Series regulator
- Transistor Shunt regulator
- Zener regulator

41. What are the disadvantages of linear regulator?

- Input step down transformer is bulky and expensive.
- Due to low frequency large value of filter capacitor is required.
- Efficiency is low
- More power dissipation.

42. What are the components of SMPS?

- voltage source
- switching transistor
- pulse generator
- filter

43. What are the types of SMPS?

- step down switching regulator
- step up switching regulator
- inverting switching regulator

44. What are series and shunt regulators?

If the control element is connected in series with the load, the circuit is said to be series regulator

If the control element is connected in shunt with the load, the circuit is said to be shunt regulator.

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