K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY, SAMAYAPURAM, TRICHY - 621 112

DEPARTMENT OF ECE

EC8452 – ELECTRONIC CIRCUITS - II

QUESTION BANK

(FOR II B.E ECE)

EC8452 ELECTRONIC CIRCUITS II **L T P C 3 0 0 3**

OBJECTIVES:

 To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits

 To study about feedback amplifiers and oscillators principles

 To design oscillators. To study about turned amplifier.

 To understand the analysis and design of LC and RC oscillators, amplifiers, multi vibrators, power amplifiers and DC convertors.

UNIT I FEEDBACK AMPLIFIERS AND STABILITY 9

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

UNIT II OSCILLATORS 9

Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt‘s oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

UNIT III TUNED AMPLIFIERS 9

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method.

UNIT IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.

UNIT V POWER AMPLIFIERS AND DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course,

the student should be able to:

 Analyze different types of amplifier, oscillator and multivibrator circuits

 Design BJT amplifier and oscillator circuits

 Analyze transistorized amplifier and oscillator circuits

 Design and analyze feedback amplifiers

 Design LC and RC oscillators, tuned amplifiers, wave shaping circuits, multivibrators, power amplifier and DC convertors.

TEXT BOOKS:

1. Sedra and Smith, ―Micro Electronic Circuits‖; Sixth Edition, Oxford University Press, 2011. (UNIT I, III,IV,V)

2. Jacob Millman, _Microelectronics‘, McGraw Hill, 2nd Edition, Reprinted, 2009. (UNIT I,II,IV,V)

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, ―Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., ―Pulse Digital and Switching Waveforms‖, TMH, 2000.
4. Millman and Halkias. C., Integrated Electronics, TMH, 2007

UNIT-I –FEEDBACK AMPLIFIERS

1. What is meant by feedback?

   A portion of the output signal is taken from the output of the amplifier and is combined with the normal input signal. This is known as feedback.

   (OR)

   Feedback is a part of output is sampled and fedback to the input of the amplifier.
2. Give the different types of feedbacks used in amplifier circuits.
   1. Positive feedback
   2. Negative feedback.
3. Define the positive feedback.

   When input signal and part of the output signal are in phase, the feedback is calledPositive feedback.
4. Define negative feedback.

   When input signal and part of the output signal are in out of phase, the feedback is called negative feedback.
5. What type of feedback is used in oscillator?

   Positive.
6. Give classification of amplifiers.

   The amplifiers can be classified into four broad categories: voltage, current, Tranconductance and Tranresistance amplifiers.
7. What is node sampling?

   When the output voltage is sampled by connecting the feedback network in shunt across the output, the connection is referred to as voltage or node sampling.
8. What is loop sampling?

   When the output current is sampled by connecting the feedback network in series with the output, the connection is referred to as current or loop sampling.
9. Define feedback factor or feedback ratio.

   The ratio of the feedback voltage to output voltage is known as feedback factor or feedback ratio.
10. What is the purpose of mixer network in feedback amplifier?

    The mixer network is used to combine feedback signal and input at input of an amplifier.
11. What are the advantages of introducing negative feedback?
    1. Input resistance is very high.
    2. Output resistance is low.
    3. The transfer gain A_f of the amplifier with feedback can be stabilized against Variations of the h-parameters or hybrid π parameters of the transistors or the Parameters of the others active devices used in the amplifiers.
    4. It improves the frequency response of the amplifiers.
    5. There is a significant improvement in the linearity of operation of the feedback.
12. List the four basic feedback topologies.
    1. Voltage amplifier with voltage series feedback.
    2. Transconductance amplifier with current-series feedback.
    3. Current amplifier with current-shunt feedback

4. Transresistance amplifier with voltage shunt feedback

13. Give the expression for gain of an amplifier with feedback.

$$A_{vf} = A_V / 1 + A_V \beta$$

Where, A_{vf} – feedback voltage gain. A_V – Voltage gain.

β - Feedback factor

14. What is loop gain or return ratio.

A path of a signal from input terminals through basic amplifier, through the feedback network and back to the input terminals forms a loop. The gain of this loop is the product $-A\beta$. This gain is known as loop gain or return ratio.

15. What is sensitivity of the transfer gain?

The fractional change in amplification with feedback divided by the fractional change without feedback is called the sensitivity of the transfer gain.

16. What is desensitivity?

The reciprocal of the sensitivity is called the desensitivity D. it is given as D $= 1+A\beta$

17. What is the effect of lower cut-off frequency with negative feedback?

Lower cutoff frequency with feedback is less than lower cutoff frequency without feedback by factor $(1+A_{mid}\beta)$

18. What is the effect of upper cut-off frequency with negative feedback?

Upper cutoff frequency with feedback is greater than upper cutoff frequency without feedback by factor $(1+A_{mid}\beta)$

19. What is the effect of negative feedback on bandwidth?

Bandwidth of amplifier with feedback is greater than bandwidth of amplifier without feedback.

20. Why gain bandwidth product remains constant with the introduction of negative feedback?

Since bandwidth with negative feedback increases by factor $(1+A\beta)$ and gain decreases by same factor, the gain-bandwidth product of an amplifier does not altered, when negative feedback is introduced.

21. What is the effect of negative feedback on feedback distortion?

The frequency distortion is reduced with the negative feedback.

22. What is the effect of negative feedback on noise? The noise is reduced with the negative feedback.

23. What is the effect of negative feedback on non linear distortion? The linear distortion is reduced with the negative feedback.

24. What are the types of distortions in an amplifier?

1. Frequency
2. Noise and non linear

25. What type of feedback is employed in emitter follower amplifier?

Voltage series feedback.

26. A feedback amplifier has an open loop gain of 600 and feedback factor $\beta = 0.01$. Find the closed loop gain with feedback.

$$A_{vf} = A_V / 1 + A_V \beta$$

$$= 600/ (1+ 600*0.01)$$

$$= 85.714.$$

27. The distortion in an amplifier is found to be 3%, when the feedback ratio of negative feedback amplifier is 0.04. When the feedback is removed, the distortion becomes 15%. Find the open and closed loop gain.

Solution:

Given: $\beta = 0.04$

Distortion with feedback = 3%,

Distortion without feedback = 15%

$D = 15/3 = 5.$

Where $D = 1+A\beta = 5$

$A = 100.$

28. Which is the most commonly used feedback arrangement in cascaded amplifiers and why?

Voltage series feedback is the most commonly used feedback arrangement in cascaded amplifiers. Voltage series feedback increases input resistance and decreases output resistance. Increase in input resistance reduces the loading effect of previous stage and the decrease in output resistance reduces the loading effect of amplifier itself for driving the next stage.

29. Voltage gain of an amplifier without feedback is 60dB. It decreases to 40dB with feedback. Calculate the feedback factor.

Solution:

Given: $A_v = 60dB$ and $A_{vf} = 40$ dB. We know that,

$$A_{vf} = A_V / 1+ A_V\beta$$

$$\beta = (A_V - A_{vf}) / (A_V A_{vf})$$

$$= (60-40) / (60*40)$$

$$\beta = 0.00833.$$

30. State the nyquist criterion for stability of feedback amplifiers?

1. The amplifier is unstable if the curve encloses the point -1+j0. The system is called as unstable system.
2. The amplifier is stable if the curve encloses the point -1+jo. That system is called as stable system.

31. What is nyquist diagram?

The plot which shows the relationship between gain and phase-shift as a function of frequency is called as nyquist diagram.

32. Write the steps which are used to identify the method of feedback topology?

1. Identify topology (type of feedback)
   a) To find the type of sampling network.
   b) To find the type of mixing network
2. Find the input circuit.
3. Find the output circuit.
4. Replace each active device by its h-parameter model at low frequency.
5. Find the open loop gain (gain without feedback), A of the amplifier.
6. Indicate X_f and X_o on the circuit and evaluate $\beta = X_f X_O$.
7. Calculate A, and β, find D, A_i,R_{if},R_{of},and R_{of}'.

33. Write down the various characteristics of topology?

Characteristics	Topology			
	Voltage series	Current series	Current shunt	Voltage shunt
Sapling signal, X_O	Voltage	Voltage	Current	Current
Mixing signal	Voltage	Current	Current	Voltage
To find input	V_0=0	I_0= 0	I_0=0	V_0=0

loop, Set				
to find output loop, set	$I_i=0$	$I_i = 0$	$V_i = 0$	$V_I = 0$
Signal source	Thevenin	Thevenin	Norton	Norton
$\beta = X_f / X_0$	V_f / V_0	V_f/I_0	I_f/I_0	I_f/I_0
$A=X_0/X_i$	$A_V=V_0/V_i$	$G_M=I_0/V_i$	$A_I =I_0/I_i$	$R_M=V_0/I_i$
$D=1+ \beta A$	$1+ \beta A_v$	$1+ \beta G_M$	$1+ \beta A_I$	$1+ \beta R_M$
A_f	A_V/D	G_M/D	A_I/D	R_M/D
R_{if}	R_iD	R_iD	R_i/D	R_i/D
R_{Of}	$R_0/(1+\beta A_V)$	$R_0(1+\beta G_M)$	$R_0(1+\beta A_I)$	$R_0/(1+\beta R_M)$
R_{Of}'	$R_0'/(1+\beta A_V)$	$R_0(1+\beta A_V)$ $/(1+\beta A_V)$	$R_0(1+\beta A_V)/$ $(1+\beta A_V)$	$R_0'/(1+\beta R_M)$

PART – B

1. Derive the expressions for gain with positive and negative feedback.

2. What is the effect of negative feedback on stability, distortion, noise, input and output impedance of a feedback amplifier?

3. An amplifier, without feedback, has a voltage gain of 500, lower cut-off frequency f_1 = 100 Hz, upper cut-off frequency f_2 = 250 KHz and a distortion of 10%. Determine the amplifier voltage gain, lower cut-off frequency and upper cut-off frequency and distortion, when a negative feedback is applied with feedback ratio of 0.01.

4. An amplifier, with feedback has voltage gain of 100. When the gain without feedback changes by 20 % and the gain with feedback should not vary more than 2 %. If so, determine the values of open loop gain A and feedback ratio β.

5. What is the effect of a voltage series feedback on input and output resistance of a BJT amplifier? Explain the same, with necessary circuit, equivalent circuit and equations.

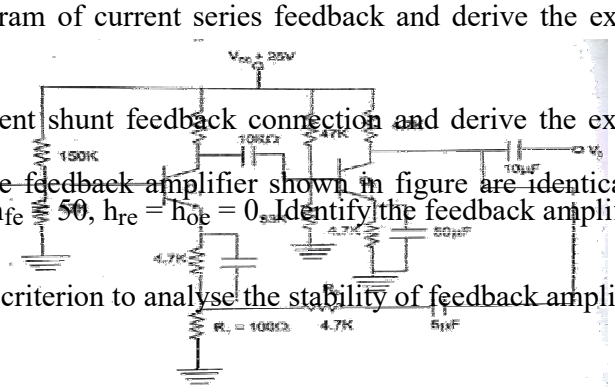
6. Draw the circuit diagram of voltage shunt feedback amplifier and derive the expressions for R_{if} and R_{of}.

7. With block diagram of current series feedback and derive the expressions for R_{if} and R_{of}.

8. Explain the current shunt feedback connection and derive the expressions for R_{if} and R_{of}.

9. Transistors in the feedback amplifier shown in figure are identical and the parameters are h_{ie} = 1.1 K, h_{fe} = 50, h_{re} = h_{oe} = 0. Identify the feedback amplifier and calculate A_{of}, R_{if} and R_{of}.

10. Explain Nyquist criterion to analyse the stability of feedback amplifier



UNIT-II – OSCILLATORS

1. What is an oscillator?

An oscillator is a circuit which basically acts as a generator, generating the output signal which oscillates with constant amplitude and constant desired frequency.

2. What is the difference between open loop and closed loop gain of the circuit?

S.NO	Open loop gain	Closed loop gain
1.	The gain of the amplifier is ratio of output to input when no feedback is used is called open loop gain	The ratio of the output to input, considering the overall effect of the feedback is called closed loop gain.

3. State the Barkhausen criterion for an oscillator.

1. The total phase shift around a loop, as the signal proceeds from input through amplifier, feedback network back to input again, completing a loop, is precisely 0^0 or 360^0.
2. The magnitude of the product of the open loop gain of the amplifier (A) and the feedback factor β is unity. i.e., A β = 1. 4.

4. Explain the concept of positive feedback.

The feedback is a property which allows to feedback the part of the output, to the same circuit as its input. Such a feedback is said to be positive whenever the part tf the output that is fed back to the amplifier as its input, is in phase with the original input signal applied to the amplifier.

5. From where starting voltage for the oscillator is derived?

Every resistance has some free electrons. Under the influence of room temperature, these free electrons move randomly in various directions. In such a movement of the free electrons generate a voltage called noise voltage, across the resistance. Such noise voltage provides the starting voltage for the oscillator.

6. Why in practice A β is kept greater than unity.

To amplify small noise voltage present, so that oscillations can start, A β is kept initially greater than unity.

7. Give the over all classification of oscillators?

a. Waveform type (sinusoidal, square, triangular,etc.,)
b. Circuit components (LC, RC,etc.,)
c. Range of frequency –A.F (audio), R.F (radio)
d. Type of feedback (RC phase shift, Wein bridge are feedback used, UJT relaxation oscillators uses no feedback)

8. What are the frequency sensitive arms?

The arms which decide the frequency of oscillations i.e., R_1-C_1 and R_2-C_2 are the frequency sensitive arms.

9. What is the gain requirement in the wein bridge oscillator?

The gain requirement for wein bridge oscillator is minimum 3.

10. How to obtain Hartley oscillator from the basic form of LC oscillator

Using X_1 and X_2 as inductors and X_3 as capacitor, Hartley oscillator from basic form of LC oscillator is obtained.

11. How to obtained colpitt's oscillator form basic form of LC oscillator?

Using X_1 and X_2 as capacitors and X_3 as inductors, colpitt's oscillator from basic form of LC oscillator is obtained.

12. Write down the advantages of RC phase shift oscillator.

a) Simplicity of the circuit.

b) Useful for frequencies in the audio range.

c) A sine wave output can be obtained.

13. Write down disadvantages of RC phase shift oscillator.

a) Poor frequency stability.

b) It is difficult to get a variable frequency output, because to change the frequency, we need to vary all the resistors and capacitors simultaneously which is practically very difficult.

14. Write down the advantages, disadvantages and applications of Hartley oscillator. Advantages:

a) It is easy to tune

b) It can operate over a wide frequency typically from few Hz and several MHz.

c) It is easy to change the frequency by means of a variable capacitor.

Disadvantages:

a) Poor frequency stability. Applications:

a) it is used as local oscillator in radio and TV receivers. b) In the function generator.

c) In RF sources

15. Write down the advantages, disadvantages and applications of colpitt's oscillator. Advantages:

a) Simple construction.

b) It is possible to obtain oscillations at very high frequencies. Disadvantages:

a) It is difficult to adjust the feedback as it demands change in capacitor values. b) Poor frequency stability.

Application:

a) As a high frequency generator.

16. Write down the comparison between LC oscillators and crystals oscillators.

S.NO	Crystal oscillator	LC oscillator
1.	Frequency of oscillations depends on the dimensions of crystal	Frequency of oscillations is dependent on values of L and C
2.	Accuracy depends only on the fine cut of the crystal	Accuracy mainly depends on tolerances of L and C
3.	Q is very high and it is stable	Q is less as compared to the crystal
4.	Miller crystal oscillator, pierce crystal oscillator are the examples of crystal oscillator	Hartley, colpitt's and clap oscillators are the examples of LC oscillators.

17. Write down the advantages, disadvantages and applications of crystal oscillator. Advantages:

a) Very high frequency stability.

b) Very low frequency drift due to change in temperature and other parameters.

c) It is possible to obtain very high, precise and stable frequency of oscillations.

d) The Q is very high.

Disadvantages:

a) These are suitable for high frequency applications.

b) Crystals of low fundamental frequencies are not easily available. Applications:

a) As a crystal clock in microprocessors.

b) In the frequency synthesizers.

c) In the radio and TV transmitters.
d) In special types of receivers.

18. Give the comparison between RC and LC oscillators.

S.NO	RC oscillators	LC oscillators
1.	Frequency of oscillations is dependent on values of R and C	Frequency of oscillations is dependent on values of L and C
2.	These are used at low and medium frequencies	These are preferred at high frequencies
3.	Phase shift and wein bridge oscillators are the examples of RC oscillators	Hartley, colpitt's and clapp oscillators are the examples of LC oscillators

19. Write down the general applications of oscillators.
a) As a local oscillator in radio receivers.
b) In T.V receivers.
c) In signal generators.
d) As clock generation for logic circuits.
e) AM and FM transmitters.
f) In phase lock loops.

20. Write down the comparison of RC oscillators.

S.No	Parameter	Phase shift oscillator	Wein bridge oscillator
1.	Feedback network	Consists of three identical RC sections connected in cascade	Uses wien bridge circuit as feedback network
2.	Phase shift introduced by the feedback network	180^0 at frequency of oscillations	0^0 at frequency of oscillations
3.	Phase shift introduced by the amplifier	180^0 at frequency of oscillations	0^0 at frequency of oscillations
4.	Frequency of oscillations	$f = \frac{1}{2\pi\sqrt{6}RC}$	$f = \frac{1}{2\pi RC}$
5.	Value of β	β = -1/29 for oscillator using OP-AMP	β = + 1/3 for oscillator using OP-AMP
6.	minimum value of gain	$A \geq 29$ for sustained oscillations	$A \geq 3$ for sustained oscillations
7.	Variable output frequency	Possible but difficult	Possible and easy
8.	Amplitude or gain stabilization	Necessary	Necessary

21.What is the principle behind the operation of a crystal oscillator?

At series resonant frequency, the crystal appears resistive in the ciruit, impedance is at a minimum and current flow is maximum. As the frequency is increased beyond the point of series resonance, the crystal appears inductive in the circuit. Thus operating the crystal at

a frequency slightly higher than series resonant frequency it operates as an inductor and replacing inductor by such a crystal in oscillator tank circuit, a stable frequency as decided by the crystal can be achieved.

PART – B

1. Derive the general condition for oscillation for a LC oscillator and derive the frequency of oscillation for a colpitts oscillator.

2. Explain the working of a Hartley oscillator with a neat circuit diagram and derive the frequency of oscillation.

3. Derive the expressions for frequency of oscillation and condition for sustained oscillation of RC phase shift oscillator with neat circuit diagram.

4. A Hartley oscillator has L_1 = 5 mH, L_2= 25 mH and frequency of oscillation ranging from 700 KHz to 1 MHz. Determine the value of Cover this frequency range.

5. With neat circuit diagrams explain the working principle of the following:

   i. Tuned collector oscillator

   ii. Franklin oscillator

   iii. Armstrong oscillator

6. What is a Wien Bridge? How is it used as an oscillator? Derive the necessary equations.

7. Draw the circuit diagram and explain the working principle of RC phase shift oscillator. Also derive the expression for frequency of oscillation and condition for sustained oscillation.

8. Explain the working of Miller and Pierce crystal oscillators with neat circuit diagrams. Give two applications.

9. Explain the working of Clap oscillator with neat circuit diagrams. Give two applications.

UNIT –III - TUNED AMPLIFIERS

1. What do you mean by tuned amplifiers?

   The amplifiers which amplify only selected range of frequencies (narrow band of frequencies) with the help of tuned circuits (parallel LC circuit) are called tuned amplifiers.

2. What are the various types of tuned amplifiers?

   (1) Small signal tuned amplifiers

   a. Single tuned amplifiers

      (i) Capacitive coupled

      (ii) Inductively coupled (or) Transformer coupled

   b. Double tuned amplifiers

   c. Stagger tuned amplifiers

   (2) Large signal tuned amplifiers

3. Give the expressions for the resonance frequency and impedance of the tuned circuit.

$$f_r = \frac{1}{2\pi\sqrt{LC}} \ \& \ Z_R = \frac{L}{CR}$$

4. What is the response of tuned amplifiers?

   The response of tuned amplifier is maximum at resonant frequency and it falls sharply for frequencies below and above the resonant frequency.

5. When tuned circuit is like resistive, capacitive and inductive?
   (1) At resonance, circuit is like resistive.
   (2) For frequencies above resonance, circuit is like capacitive.
   (3) For frequencies below resonance, circuit is like inductive.

6. What are the various components of coil losses?
   (1) Copper loss
   (2) Eddy current loss
   (3) Hysteresis loss

7. Define Q factor of resonant circuit.
   (1) It is the ratio of reactance to resistance.
   (2) It also can be defined as the measure of efficiency with which inductor can store the energy.

   Q=2π *(Maximum Energy Stored per cycle / Energy dissipated per cycle)

8. What is dissipation factor?
   (1) It is defined as 1/Q.
   (2) It can be referred to as the total loss within a component.

9. Define unloaded and loaded Q of tuned circuit.
   (1) The unloaded Q or Q_U is the ratio of stored energy to dissipated energy in a reactor or resonator.
   (2) The loaded Q or Q_L of a resonator is determined by how tightly the resonator is coupled to its terminations.

10. Why quality factor is kept as high as possible in tuned circuits?
    1. When Q is high, bandwidth is low and we get better selectivity. Hence Q is kept as high as possible in tuned circuits.
    2. When Q is high inductor losses are less.

11. List various types of cascaded Small signal tuned amplifiers.
    1. Single tuned amplifiers.
    2. Double tuned amplifiers.
    3. Stagger tuned amplifiers.

12. How single tuned amplifiers are classified?
    1. Capacitance coupled single tuned amplifier.
    2. Transformer coupled or inductively coupled single tuned amplifier.

13. What are single tuned amplifiers?

    Single tuned amplifiers use one parallel resonant circuit as the load impedance in each stage and all the tuned circuits are tuned to the same frequency.

14. What are double tuned amplifiers?

    Double tuned amplifiers use two inductively coupled tuned circuits per

stage, both the tuned circuits being tuned to the same frequency.

15. What are stagger tuned amplifiers?

Stagger tuned amplifiers use a number of single tuned stages in cascade, the successive tuned circuits being tuned to slightly different frequencies.

(OR)

It is a circuit in which two single tuned cascaded amplifiers having certain bandwidth are taken and their resonant frequencies are adjusted that they are separated by an amount equal to the bandwidth of each stage. Since resonant frequencies are displaced it is called stagger tuned amplifier.

16. What is the effect of cascading single tuned amplifiers on bandwidth?

Bandwidth reduces due to cascading single tuned amplifiers.

17. List the advantages and disadvantages of tuned amplifiers.

Advantages:

1. They amplify defined frequencies.
2. Signal to Noise ratio at output is good.
3. They are well suited for radio transmitters and receivers.
4. The band of frequencies over which amplification is required can be varied.

Disadvantages:

1. Since they use inductors and capacitors as tuning elements, the circuit is bulky and costly.
2. If the band of frequency is increased, design becomes complex.
3. They are not suitable to amplify audio frequencies.

18. What are the advantages of double tuned amplifier over single tuned amplifier?

1. It provides larger 3 dB bandwidth than the single tuned amplifier and hence provides the larger gain-bandwidth product.
2. It provides gain versus frequency curve having steeper sides and flatter top.

19. What the advantages are of stagger tuned amplifier?

The advantage of stagger tuned amplifier is to have better flat, wideband characteristics.

20. Mention the applications of class C tuned amplifier.

1. Class C amplifiers are used primarily in high-power, high-frequency applications such as Radio-frequency transmitters.
2. In these applications, the high frequency pulses handled by the amplifier are not themselves the signal, but constitute what is called the Carrier for the signal.
3. Amplitude modulation is one such example.
4. The principal advantage of class-C amplifier is that it has a higher efficiency than the other amplifiers.

21. What is Neutralization?

The technique used for the elimination of potential oscillations is called neutralization. (OR) The effect of collector to base capacitance of the transistor is neutralized by introducing a signal that cancels the signal coupled through collector base capacitance. This process is called neutralization.

22. What is the use of Neutralization?

1. BJT and FET are potentially unstable over some frequency range due to the feedback parameter present in them.
2. If the feedback can be cancelled by an additional feedback signal that is equal in

amplitude and opposite in sign, the transistor becomes unilateral from input to output the oscillations completely stop.

3. This is achieved by Neutralization.

23. What are the different types of neutralization?
    1. Hazeltine neutralization
    2. Rice neutralization
    3. Neutrodyne neutralization.
24. What is rice neutralization?

    It uses center tapped coil in the base circuit. The signal voltages at the end of tuned base coil are equal and out of phase.

PART – B

1. Derive the Q factor for inductor.

2. Draw the circuit diagram and equivalent circuit of a capacitor coupled single tuned amplifier and derive the expression for 3 – dB bandwidth. Sketch also the frequency response of the amplifier.

3. With neat circuit diagram explain double tuned amplifier and derive the expression for 3 – dB bandwidth. Sketch also the frequency response of the amplifier.

4. Draw the circuit diagram of a two-stage synchronously tuned amplifier and also its equivalent circuit. Derive the expression for bandwidth.

5. A single tuned transistor amplifier is used to amplify modulated RF carrier of 600 KHz and a bandwidth of 15 KHz. The circuit has total output resistance R_t = 20 K_ and output capacitance C_o = 50 pF. Calculate the values of inductance and capacitance of tuned circuit.

6. Discuss the effect of bandwidth on cascading single tuned amplifiers.

7. Explain class C tuned amplifier and derive its efficiency. Also discuss about its frequency response.

8. Explain the following with neat circuit diagram:

    i. Hazeltine neutralization

    ii. Neutrodyne neutralization

9. Explain the Small signal tuned amplifier with necessary derivations.

10. Describe the principles involved in stagger tuned amplifier.

UNIT-IV
WAVE SHAPING AND MULTIVIBRATOR CIRCUITS

1. What is High pass RC circuit? Why it is called high-pass filter?

   1. A simple circuit consisting of a series capacitor and a shunt resistor is called high pass RC circuit.

   2. At very high frequencies the capacitor acts as a short circuit and all the higher frequency components appear at the output with less attenuation than the lower frequency components. Hence this circuit is called high-pass circuit.

2. Why high-pass RC circuit is called Differentiator?

   High-pass RC circuit gives an output waveform similar to the first derivative of the input waveform. Hence it is called Differentiator.

3. What is Low pass RC circuit? Why it is called low-pass filter?

   1. A simple circuit consisting of a series resistor and a shunt capacitor is called Low pass RC circuit.

   2. At very high frequencies the capacitor acts as a virtual short circuit and output falls to zero. Hence this circuit is called low-pass filter

4. Why low-pass RC circuit is called Integrator?

   Low pass RC circuit gives an output waveform similar to the time integral of the input waveform. Hence it is called Integrator.

5. What is High pass RL circuit? Why it is called high-pass filter?

   1. A simple circuit consisting of a series resistor and a shunt inductor is called high-pass RL circuit.

   2. At very high frequencies, the inductor acts as an open circuit and all the higher frequency components appear at the output. Hence this circuit is called high-pass filter.

6. What is Low pass RL circuit? Why it is called low-pass filter?

   1. A simple circuit consisting of a series inductor and a shunt resistor is called low pass RL circuit.

   2. At very high frequencies, the inductor acts as a virtual open circuit and the output falls to zero. Hence this circuit is called low pass filter.

7. What is Delay time (t_d) in transistor?

   The time needed for the collector current to rise to 10% of its maximum (saturation) value i.e. $i_{C(Sat)} = V_{CC}/R_C$ is called the delay time.

8. What is Rise time (t_r) in transistor?

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

9. What is Turn-ON time (t_{ON}) in transistor?

   The sum of the delay time (t_d) and the rise time (t_r) is called the turn-ON time (t_{ON}).

   $$t_{ON} = t_d + t_r$$

10. What is storage time (t_s) in transistor?

    The time when collector current (i_C) dropped to 90% of its maximum value is called the storage time.

11. What is fall time (t_f) in transistor?

    The time required for the collector current to fall from 90% to 10% of its maximum value is called fall time (t_f).

12. What is Turn-off time (t_{OFF}) in transistor?

    The sum of the storage time (t_s) and the fall time (t_f) is called the turn-OFF time (t_{OFF}).

    $$(t_{OFF}) = (t_s) + (t_f)$$

13. What is clipper?

The circuit with which the waveform is shaped by removing (or clipping) a portion of the input signal without distorting the remaining part of the alternating waveform is called a clipper.

14. What are the four categories of clippers?

1. Positive clipper
2. Negative clipper
3. Biased clipper
4. Combination clipper

15. What is comparator?

1. The nonlinear circuit which was used to perform the operation of clipping may also be used to perform the operation of comparison is called the comparator.
2. The comparator circuit compares an input signal with a reference voltage.

16. What is clamper?

A circuit which shifts (clamps) a signal to a different dc level, i.e. which introduces a dc level to an ac signal is called clamper. It is also called dc restorer.

17. Which circuits are called multivibrators?

1. The electronic circuits which are used to generate nonsinusoidal waveforms are called multivibrators.
2. They are two stage switching circuits in which the output of the first stage is fed to the input of the second stage and vice-versa.

18. Which are the various types of multivibrators?

1. Astable multivibrator
2. Bistable multivibrator
3. Monostable multivibrator

19. What is astable multivibrator?

1. A multivibrator which generates square wave without any external triggering pulse is called astable multivibrator.
2. It has both the states as quasi-stable states. None of the states is stable.
3. Due to this, the multivibrator automatically makes the successive transitions from one quasi-stable state to other, without any external triggering pulse. So it called Free-running multivibrator.
4. The rate of transition from one quasi-stable state to other is determined by the discharging of a capacitive circuit.

20. List the applications of Astable multivibrator?

1. Used as square wave generator, voltage to frequency convertor and in pulse synchronization, as clock for binary logic signals, and so on.
2. Since it produces square waves, it is a source of production of harmonic frequencies of higher order.
3. It is used in the construction of digital voltmeter and SMPS.
4. It can be operated as an oscillator over a wide range of audio and radio frequencies.

21. State the basic action of monostable multivibrator.

1. It has only one stable state. The other state is unstable referred as quasi-stable state.
2. It is also known as one-short multivibrator or univibrator.
3. When an external trigger pulse is applied to the circuit, the circuit goes into the quasi-stable state from its normal stable state.
4. After some time interval, the circuit automatically returns to its stable state.
5. The circuit does not require any external pulse to change from quasi-stable state.
6. The time interval for which the circuit remains in the quasi-stable state is determined by the circuit components and can be designed as per the requirement.

22. Mention the applications of one short multivibrator?

1. It is used to function as an adjustable pulse width generator.
2. It is used to generate uniform width pulses from a variable width pulse train.
3. It is used to generate clean and sharp pulses from the distorted pulses.
4. It is used as a time delay unit since it produces a transition at a fixed time after the trigger signal.

23. Which multivibrator would function as a time delay unit? Why?

Monostable multivibrator would function as a time delay unit since it produces a transition at a fixed time after the trigger signal.

24. What is Bistable multivibrator?

1. The Bistable multivibrator has two stable states.
2. The multivibrator can exist indefinitely in either of the two stable states.
3. It requires an external trigger pulse to change from one stable state to another.
4. The circuit remains in one stable state unless an external trigger pulse is applied.

25. List the applications of bistable multivibrator?

1. It is used as memory elements in shift registers, counters, and so on.
2. It is used to generate square waves of symmetrical shape by sending regular triggering pulse to the input. By adjusting the frequency of the trigger pulse, the width of the square wave can be altered.
3. It can also be used as a frequency divider.

26. What are the two methods of triggering for bistable multivibrators?

1. Unsymmetrical triggering
2. Symmetrical triggering

27. How many stable states do bistable Multivibrator have?

Two stable states.

28. When will the circuit change from stable state in bistable Multivibrator?

When an external trigger pulse is applied, the circuit changes from one stable state to another.

29. What are the different names of bistable Multivibrator?

Eccles Jordan circuit, trigger circuit, scale-of-2 toggle circuit, flip-flop and binary.

30. What are the other names of monostable Multivibrator?

One-shot, Single-shot, a single-cycle, a single swing, a single step Multivibrator, Univibrator.

31. Why is monostable Multivibrator called gating circuit?

The circuit is used to generate the rectangular waveform and hence can be used to gate other Circuits hence called gating circuit.

32. What are the main characteristics of Astable Multivibrator?

The Astable Multivibrator automatically makes the successive transitions from one quasi- stable State to other without any external triggering pulse.

33. What is the other name of Astable Multivibrator- why is it called so?

As it does not require any external pulse for transition, it is called free running Multivibrator.

34. What are the two types of transistor bistable Multivibrator?

i. Fixed bias transistor circuit
ii. Self bias transistor circuit.

35. Why does one of the transistor start conducting ahead of other?

The characteristic of both the transistors are never identical hence after giving supplies one of the Transistors start conducting ahead of the other.

36. What are the two stable states of bistable Multivibrator? i.
Q1 OFF (cut off) and Q2 ON (Saturation)
ii. Q2 OFF (Cut off) and Q1 On (Saturation)

37. What finally decides the shape of the waveform for bistable multivibrator?
The spacing of the triggering pulses.

38. How are the values R1, R2 and VBB chosen in bistable Multivibrator?
It is chosen in such a way that in one state the base current is large enough to drive the transistor into saturation while in other state the emitter junctions is well below off.

39. What is the self biased Multivibrator?
The need for the negative power supply in fixed bias bistable Multivibrator can be eliminated by raising a common emitter resistance R_E. The resistance provides the necessary bias to keep one transistor ON and the other OFF in the stable state. Such type of biasing is called self biasing and the circuit is called self biased bistable Multivibrator.

40. What are the other names of speed up capacitors?
i. Commutating Capacitors
ii. Transpose capacitors

41. Define transition time?
It is defined as the time interval during which conduction transfers from one transistor to other.

42. What is the value of commutating capacitor?
It lies in the range of tens to some hundreds of Pico farads.

43. Define resolving time.
The smallest allowable interval between triggers is called resolving time.

44. Give the expression of fmax with respect to resolving time
Fmax = 1/resolving time.

45. Define gate width
The pulse width is the time for which the circuit remains in the quasi stable state. It is also called gate width.

46. What is UTP of the Schmitt Trigger?
The level of Vi at which Q1 becomes ON and Q2 OFF is called Upper Threshold Point.

47. What is the other name for UTP?
It is also called input turn on threshold level.

48. What is LTP of the Schmitt trigger?
The level of Vi at which Q1 becomes OFF and Q2 on is called Lower Threshold Point.

49. Define transfer Characteristics
The graph of output voltage against input voltage is called transfer characteristics of Schmitt trigger.

50. What is the important application of Schmitt trigger?
1. It is used as an amplitude comparator
2. It is used as a squaring circuit.

51. What is Schmitt trigger?
1. It is a wave shaping circuit, used for generation of a square wave from a sine wave input.
2. It is a bistable circuit in which two transistor switches are connected regeneratively.

52. What is meant by Hysteresis voltage in a Schmitt trigger?
1. The difference between UTP (Upper Threshold Point) and LTP (Lower Threshold Point) is called Hysteresis voltage (V_H).
2. It is also known as Dead Zone of the Schmitt trigger.

53. List the applications of Schmitt trigger.

1. It is used for wave shaping circuits.
2. It can be used for generation of rectangular waveforms with sharp edges from a sine wave or any other waveform.
3. It can be used as a voltage comparator.
4. The Hysteresis in Schmitt trigger is valuable when conditioning noisy signals for using digital circuits. The noise does not cause false triggering and so the output will be free from noise.

54. How a Schmitt trigger is different from a multivibrator?

A Schmitt trigger has an input and an output; the output is a squared-up version of the input. As long as the input is constant, the output of the Schmitt trigger is also constant.

A multivibrator typically has no inputs (other than power), only an output: an oscillating signal.

PART – B

1. Derive and draw the response of low pass RC circuit to the following input waveforms:

   a. Step b. Pulse c. Square

33. Explain the operation of positive and negative diode clippers with waveforms.

34. Draw a transistor switching circuit and its response waveform for a pulse input. For such a circuit, explain the following terms:

   1. Delay time
   2. Turn on time
   3. Storage time
   iv. Fall time and
   v. Turn-off time

4. With neat circuit diagram and waveforms, explain the operation of collector coupled astable multivibrator which uses transistors. Derive the expression for pulse width.

5. Briefly discuss about the one shot multivibrator with neat circuit diagrams and waveforms. Derive the expression and mention its advantages and disadvantages.

6. Explain the working principle of Bistable multivibrator with neat diagrams and illustrate how Schmitt trigger circuit can be evolved from a bistable circuit?

7. Explain the different types of triggering used for bistable multivibrator.

8. With circuit diagrams explain Schmitt trigger operation. Obtain the expression for UTP and LTP.

9. Design a Schmitt trigger circuit for the data given: V_{cc} = 20, UTP = 5V and LTP= 3 V. $I_{c\ sat}$ = 2 mA and $h_{fe\ (min)}$ = 100. Draw the designed circuit.

10. Explain the working principle of Monostable multivibrator with neat diagrams

UNIT-V-POWER AMPLIFIERS AND DC CONVERTERS

1. List out the classification of large signal amplifiers?

The large signal amplifiers are classified as follows. a. Based on the input
i. small signal amplifiers
ii. large signal amplifiers b. Based on the output
I. Voltage amplifier
II. Power amplifier
III. Current amplifier
c. Based on the transistor configuration
I. CE amplifier
II. CB amplifier
III. CC amplifier
d. Based on the number of stages
I. Single stage amplifier
II. Multistage amplifier e. Based on the Bandwidth
I. Untuned amplifier (wide band amplifier) II. Tuned amplifier (narrow band amplifier)
f. Based on the frequency response
I. AF (Audio frequency) amplifier
II. IF (Intermediate frequency) amplifier
III. RF (Radio Frequency) amplifier g. Based on the Biasing condition
I. Class A amplifier
II. Class B amplifier
III. Class C amplifier IV. Class AB amplifier V. Class D amplifier VI. Class S amplifier

2. How do you bias the class A operation?

In class A mode, the output current flows through out the entire period of input cycle and the Q point is chosen at the midpoint of AC load line and biased.

3. Which amplifier gives minimum distortion?

Class S amplifier gives minimum distortion.

4. Give the applications of class C power amplifier.

The applications of class C power amplifier are, a. Used in radio and TV transmitters.
b. Used to amplify the high frequency signals. c. Tuned amplifiers

5. Give the two draw backs of class C amplifier.

The drawbacks of class C amplifier are, a. Distortion is high.
b. Figure of merit is low.

6. Define the following modes of operation (a) Class AB (b) Class C. a. Clas=s AB

In this mode of operation, the output current flows for more

than one half cycle but less than full cycle. b. Class C
In this mode, the level current flows for less than one half cycled i.e., ¼ th of the input cycle.

7. Define Class B mode of operation and its advantages and disadvantages.
Class B mode of operation
The Biasing signal and input signal flow through the circuit for half cycle i.e., 180o.
Advantages
a. Efficiency is increased from 25% to 78.5%
b. Due to push pull configuration all even harmonics are reduced. So harmonic distortions are reduced.
c. Due to centre-tapped transformer at input and output, the core
saturation loss is reduced. Disadvantages
a. Transistor is biased above the cut off region
b. Due to the centre-tapped transformer at both input and output, the circuit becomes complex

8. What is Class D amplifier?
In order to increase the conversion efficiency, it would be desirable to make the device to operate as a switch. So that its voltage drop remains almost at minimum value over the half cycle of output
current flow. Such a system is called class D amplifier.

9. Why RC coupling is popular?
RC coupling is popular because it is simple, less expensive, less distortion and it provides uniform bandwidth.

10.List the advantages of transformer coupled amplifier.
The advantages of transformer coupled amplifier are,
a. it is more efficient because the low DC resistance of the primary is connected to the collector circuit.
b. It provides excellence impedance matching, thus voltage and power gains are improved.

11.What is the use of transformer coupling in the output stage of multistage amplifier?
The transformer coupling provides impedance matching between input and output. As a result the power gain is improved.

12.State the reason for fall in gain at low frequencies in the RC coupled amplifier.
a. The coupling capacitance (input) has very reactance at low
frequency. Therefore it will allow only a small part signal from one stage to next stage.
b. The bypass capacitor cannot bypass or shunt the emitter resistor
effectively.

As a result of these factors, the voltage gain rolls off at low frequency.

13.State the reason for fall in gain at high frequencies.
At high frequency, the reactance of coupling capacitor (output) is very low. Therefore it provides like a short circuit. As a result of this, the loading effect of the next stage increase which reduces the voltage gain. Hence the voltage gain falls off at high frequencies.

14.What is amplitude or non linear distortion?
In case of large signal amplifier, the input signals are large in amplitude. So the operation extends to non linear region of its transfers characteristics. Of the signal excursion enters the non-linear region then distortion occurs in the output. Such a distortion is called non-linear distortion.

15.Define figure of merit.
Figure of merit is defined as the ratio of maximum collector current dissipation power to the maximum AC power developed across the load.

16.Where S amplifiers are used?
The class S power amplifier can be used to amplify either the constant amplitude or varying amplitude signal such as FM or AM signal.

17. Define inter modulation distortion?
Inter modulation distortion is a type of non-linear distortion. Which generate frequency components not harmonically related to the signal frequencies. It occurs when the input signal contains more than the one frequency.

18.What is the use of heat sink?
The heat sink is used to observe the heat produce in the transistor junctions while its operation. Usually power amplifiers are provided with heat sinks. The heat sink is a large, black metallic heat-conductingdevice placed in close contact with the transistor.

19.What is the maximum power dissipation hyperbola?
Maximum power dissipation hyperbola represents focus of all the points at which the collector dissipation is exactly Pc Max . The Q point must lie on or below the hyperbola for safe operation.

20. Define thermal resistance.
The resistance offered by the bipolar junction transistor to the flow of heat is called thermal resistance.
The thermal resistance Q = QjA = QjC+QCS+QSAo C/W
QjA = Total junction to ambient thermal resistance
QjC= Junction to case thermal resistance. QCS= Case to heat sink resistance.
QSA=Heat sink to ambient resistance.

21.Write the maximum power handling of the class C power amplifier?

The maximum power in class C power amplifier is, Pc max = 5/12 (T/To)(Vcc2/RL)

22.Write the advantages of heat sink?

The advantages of heat sink are,

a. The temperature of the case gets lowered.

b. The power handling capacity of the transistors can approach the rapid maximum value.

23.Write the derivating factor expression of a power transistor?

Pd(T1) = Pd(To) – (T1 - To)

Where Pd(To) = Rated power handling capacity at To

Pd(T1) = Power handling capacity at T1

The derating factor is expressed in the units of watts / degree of temperature or milliwatts /degree of temperature.

24.What is meant by thermal analogy of power transistors?

The heat dissipation problem is very much analogous to a simple electric circuit and the ohm's law. An electric current flows when there exists a potential difference while the heat flows when there exists a temperature difference (T2-T1).

25.Write the Thermal-electric analogy parameters.

The following are the thermal-electric analogy parameters.

Tj = Junction temperature

TC = Case temperature

TA = Ambient temperature

QjA = Total thermal resistance

QjC= Transistor thermal resistance. QCS= Insulator thermal resistance. QSA=Heat sink thermal resistance.

PART- B

1.Derive the theoretical max conversion efficiency of class B power amplifier. ii) Write short notes on power MOSFET amplifier.

2.Describe the distortion in power amplifier and the methods to eliminate the same

3.(i) Explain the operation of the transformer coupled class A audio power amplifier. (ii) Explain the terms conversion efficiency and maximum value of efficiency used in audio power amplifiers

4.Explain the operation of the class-B push pull power amplifier with neat diagram and list its advantages.

5.Explain class A power amplifier with circuit diagram and derive for its efficiency.

6.(i) Explain complementary – Symmetry class B power amplifier and derive for its efficiency. (ii) Explain class D power amplifier with necessary sketches

7.Draw the circuit diagram of class B push pull amplifier and discuss its merits.

8.Compare class A, class B and class C power amplifier in their performance and efficiency

9.What is the difference between a voltage amplifier and a power amplifier?

10.Describe the operation of class c amplifier and derive the efficiency

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