DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

III SEMESTER

EC3301 - Electronic Devices and Circuits

Regulation – 2021

UNIT I PN JUNCTION DEVICES

PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance -Clipping and Clamping Circuits- Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes- Zener diode characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

LECTURE PLAN

Unit I

Course Contents:

UNIT I- PN JUNCTION DEVICES

PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance -Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes- Zener diode characteristics- Zener Reverse characteristics – Zener as regulator (CO1&CO2)

Course Outcomes:

CO1: Understand the basic structure of electronic devices such as diodes and display devices

Course Delivery Details :

Sl. No.	Course Content	CO Statement	Book Reference & Page No	Delivery method	No. of Hrs to be handled	Knowledge level
1	PN junction diode–structure	CO1		chalk and board / PPT	40m	U
2	operation and V-I characteristics	CO1		chalk and board / PPT	40m	U
3	Diffusion and transient	CO1,CO2		chalk and board / PPT	40m	U
4	Rectifiers – Half Wave Rectifier	CO1		chalk and board / PPT	40m	U
5	Rectifiers – Full Wave Rectifier	CO1		chalk and board / PPT	40m	U
6	Display devices- LED	CO1		chalk and board / PPT	40m	U
7	Laser diodes	CO1		chalk and board / PPT	40m	U
8	Zener diode characteristics	CO1		chalk and board / PPT	40m	U
9	Zener Reverse characteristics	CO1		chalk and board / PPT	40m	U
10	Zener as regulator	CO1		chalk and board / PPT	40m	U

Unit II

Course Outcomes:
CO1: Understand the basic structure of electronic devices such as diodes and display devices
CO2: Understand the operation of transistors

Course Content:
UNIT-II TRANSISTORS
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT -Structure and characteristics.

Course delivery details :

Sl. No.	Course Content	CO Statement	Book Reference & Page No	Delivery method	No. of Hrs to be handled	Knowledge level
1	BJT- structure	CO1,CO2		chalk and board / PPT	40m	B
2	BJT- operation, characteristics	CO1,CO2		chalk and board / PPT	40m	U
3	MOSFET - structure polymorphism	CO1,CO2		chalk and board / PPT	40m	U
4	MOSFET - operation, characteristics	CO1,CO2		chalk and board / PPT	40m	U
5	JFET- structure	CO1,CO2		chalk and	40m	U
6	JFET- operation, characteristics	CO1,CO2		chalk and board / PPT	40m	U
7	Biasing	CO1,CO2		chalk and board / PPT	40m	U
8	UJT-Structure and characteristics	CO1,CO2		chalk and board / PPT	40m	U
9	Thyristor -Structure and characteristics	CO1,CO2		chalk and board / PPT	40m	U
10	IGBT -Structure and characteristics	CO1,CO2		chalk and board / PPT	40m	U

Unit III

Course Outcomes:
CO3: Analysis various amplifiers and study their frequency and gain response

Course Content:
UNIT-III AMPLIFIERS
BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response-High frequency analysis. (CO1,CO3&CO4)

Course delivery details :

Sl. No.	Course Content	CO Statement	Book Reference & Page No	Delivery method	No. of Hrs to be handled	Knowledge level
1	BJT small signal model	CO3		chalk and board / PPT	40m	U
2	Analysis of CE	CO3		chalk and board / PPT	40m	U
3	Analysis of CB	CO3		chalk and board / PPT	40m	U
4	Gain and frequency response	CO3		chalk and board / PPT	40m	U
5	MOSFET small signal model	CO3		chalk and board / PPT	40m	U
6	Analysis of CS follower	CO3		chalk and board / PPT	40m	U
7	Analysis of CD follower	CO3		chalk and board / PPT	40m	U
8	Gain and frequency –CS	CO3		chalk and board / PPT	40m	U
9	Gain and frequency-CD	CO3		chalk and board / PPT	40m	U
10	High frequency analysis	CO3		chalk and board / PPT	40m	U

Unit IV

Course Outcomes:

CO4: Imparts knowledge on multistage amplifiers and differential amplifiers

Course Content:

UNIT-IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods,power amplifiers –Types (Qualitative analysis).

Course delivery details :

Sl. No.	Course Content	CO Statem e nt	Book Reference & Page No	Delivery method	No. of Hrs to be handled	Knowledge level
1.	BIMOS cascade	CO4		chalk and board	40m	U
2.	Differential amplifier - Introduction	CO4		chalk and board	40m	U
3.	Common mode analysis	CO4		chalk and board	40m	U
4.	Difference mode analysis	CO4		chalk and board	40m	U
5.	FET input stages	CO4		chalk and board	40m	U
6.	Single tuned amplifiers	CO4		chalk and board	40m	U
7.	Gain and frequency response	CO4		chalk and board	40m	U
8.	Neutralization methods	CO4		chalk and board	40m	U
9.	Power amplifiers-Introduction	CO4		chalk and board	40m	U
10.	Types – Class A,B,C	CO4		chalk and board	40m	U
11.	Types – Class D,AB	CO4		chalk and board	40m	U

Unit V

Course Outcomes:

CO4: Understand the advantages of feedback amplifiers and their applications

CO5: Understand the various oscillators

Course Content:

UNIT V - FEEDBACK AMPLIFIERS AND OSCILLATORS

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback –Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators

Course Delivery Details :

Sl. No.	Course Content	CO Statement	Book Reference & Page No	Delivery method	No. of Hrs to be handled	Knowledge level
1.	Advantages of negative feedback	CO4,CO5		chalk and board	40m	U
2.	Voltage series	CO4,CO5		chalk and board	40m	U
3.	Voltage Shunt	CO4,CO5		chalk and board	40m	U
4.	Current series	CO4,CO5		chalk and board	40m	U
5.	Current Shunt	CO4,CO5		chalk and board	40m	U
6.	Shunt feedback	CO4,CO5		chalk and board	40m	U
7.	positive feedback	CO4,CO5		chalk and board	40m	U
8.	Condition for	CO4,CO5		chalk and board	40m	U
9.	phase shift	CO4,CO5		chalk and board	40m	U
10.	Wien bridge	CO4,CO5		chalk and board	40m	U
11.	Hartley	CO4,CO5		chalk and board	40m	U
12.	Colpitts	CO4,CO5		chalk and board	40m	U
13.	Crystal oscillators	CO4,CO5		chalk and board	40m	U

R- Remember, U- Understand, A- Apply, An- Analyze, E- Evaluate & C- Create.

Books:Text/Reference:

S.NO		Title of The Book	Author	Publisher	Year
1.	**TB1**	Electronic Devices and Circuits	David A. Bell	Prentice Hall of India	2004
2.	**TB2**	Microelectronic Circuits	Sedra and smith	Oxford University Press	2004
3.	**RB1**	Micro Electronic Circuits	Rashid	Thomson publications	1999
4.	**RB2**	Electron Devices	Floyd	Pearson Asia 5th Edition	2001
5.	**RB3**	Electronic Circuit Analysis and Design	Donald A Neamen	Tata McGraw Hill, 3rd Edition	2003
6.	**RB4**	Electronic Devices and Circuit theory	Robert L.Boylestad		2002
7.	**RB5**	Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation	Robert B. Northrop	CRC Press	2004

UNIT I

PN JUNCTION DIODE

PART-A

1. **What are valence electrons?**
   Electron in the outer most shell of an atom is called valence electron.
2. **What is forbidden energy gap?**
   The space between the valence and conduction band is said to be forbidden energy gap.
3. **What are conductors? Give examples?**
   Conductors are materials in which the valence and conduction band overlap each other so there is a swift movement of electrons which leads to conduction. Ex. Copper, silver.
4. **What are insulators? Give examples?**
   Insulators are materials in which the valence and conduction band are far away from each other. So no movement of free electrons and thus no conduction. Ex glass, plastic.
5. **What are Semiconductors? Give examples?**
   The materials whose electrical property lies between those of conductors and insulators are known as Semiconductors. Ex germanium, silicon.
6. **What are the types of Semiconductor?**
   Intrinsic semiconductor
   Extrinsic semiconductor.
7. **What is Intrinsic Semiconductor?**
   Pure form of semiconductors are said to be intrinsic semiconductor. Ex germanium, silicon.
8. **What is Extrinsic Semiconductor?**
   If certain amount of impurity atom is added to intrinsic semiconductor the resulting semiconductor is Extrinsic or impure Semiconductor.
9. **What are the types of Extrinsic Semiconductor?**
   P-type Semiconductor
   N- Type Semiconductor.
10. **What is P-type Semiconductor?**
    The Semiconductor which are obtained by introducing pentavalent impurity atom (phosphorous, antimony) are known as P-type Semiconductor.
11. **What is N-type Semiconductor?**
    The Semiconductor which are obtained by introducing trivalent impurity atom (gallium, indium) are known as N-type Semiconductor.
12. **What is doping?**
    Process of adding impurity to an semiconductor atom is doping. The impurity is called dopant.
13. **Which is majority and minority carrier in N-type Semiconductor?**
    Majority carrier: electrons and minority carrier: holes.
14. **Which is majority and minority carrier in P-type Semiconductor?**
    Majority carrier: holes and minority carrier: electrons.
15. **What is a PN junction diode?**
    A PN junction diode is a two terminal device consisting of a PN junction formed either of Germanium or Silicon crystal. A PN junction is formed by diffusing P type material to one half side and N type material to other half side.

16. What is depletion region in PN junction? **(MAY/JUNE 2012)**

The diffusion of holes and electrons will result in difference in concentration across the junction which in turn results in the movement of the mobile charge carriers to the junction thus resulting in a region called depletion region.

17. What is barrier voltage?

Because of the oppositely charged ions present on both sides of PN junction an electric potential is established across the junction even without any external voltage source which is termed as barrier potential.

18. What is meant by biasing a PN junction?

Connecting a PN junction to an external voltage source is biasing a PN junction.

19. What are the types of biasing a PN junction?

Forward bias

Reverse bias.

20. Define Static resistance and Dynamic resistance? **(May 2013)**

The resistance offered by the diode to DC operating conditions is called "Static resistance" and the resistance offered by the diode to AC operating conditions is called "Dynamic resistance".

21. Explain the terms knee voltage and breakdown voltage? **(Nov 2010)**

Knee voltage: The forward voltage at which the current through the PN junction starts increasing rapidly is known as knee voltage. It is also called as cut-in voltage or threshold voltage. Breakdown voltage: It is the reverse voltage of a PN junction diode at which the junction breaks down with sudden rise in the reverse current.

22. Write down and explain junction diode equation.

The equation which explains the forward and reverse characteristics of a semiconductor diode is known diode equation. The diode current is given by

$$I = I_0 \left(e^{\frac{v}{\eta V_T}} - 1\right)$$

Where I_o = reverse saturation current

μ = 1 for Ge diodes , 2 for silicon diodes

V- External voltage

V_T = volt equivalent of temperature. = T/11,600

23. Define the term the drift current.

If a steady electric field is applied across a semiconductor, it causes the free electrons to move towards the positive terminal and the holes move towards the negative terminal of the battery. This combined effect causes a current flow in the semiconductor. The current produced in this manner is known as drift current.

Drift current density due to electr

a. $J_n = qn\mu_n E$

Drift current density due to holes

b. $J_p = qp\mu_p E$

J_n = Drift current density due to electrons

J_p = Drift current density due to holes

q = Charge of the carrier

μ_n = Mobility of electrons
μ_p = Mobility of holes
E = Applied electric field strength.

24. What is diffusion current? (APR/MAY 2015)

In a semiconductor it is possible to have a non uniform distribution of carriers. A concentration gradient exists if the number of either holes or electrons is greater in one region as compared to the rest of the region. The holes and electrons then tend to move from a region of higher concentration to lower concentration region.

This process is known as diffusion and the electric current produced due this process is known as diffusion current.

25. What is forward bias and reverse bias in a PN junction?

When positive of the supply is connected to P type and negative to N type then it is forward bias. When positive of the supply is connected to N type and negative to P type then it is reverse bias.

26. What is Reverse saturation current?

The current due to the minority carriers in reverse bias is said to be reverse saturation current.

27. What is reverse break down?

During reverse bias after certain reverse voltage the current through the junction increases abruptly thus breaking the crystal which is termed as reverse break down.

28. Give the diode current equation? (APRIL/MAY 2011)

$$I = I_0\left(e^{V/\eta V_T} - 1\right)$$

I – Total diode current
I_0 - reverse saturation current
V – Applied voltage

- – Constant which is 1 for Germanium and 2 for Silicon

V_T - voltage equivalent of temperature (V_T = T/11600)

29. Give two applications of PN junction diode.

As rectifier in power supplies.
As switch in logic circuits

30. Why contact differences of potential exist in PN junction?

When a PN junction is formed by placing a p-type and n-type material in intimate contact, the Fermi level throughout the newly formed specimen is not constant at equilibrium. There will be transfer of electron and energy until Fermi levels in the two side did line up. But the valence and conduction band in P - side cannot be at the at the same level as in N side. This shift in energy level results in contact difference of potential .

31. Give the expression of contact difference of potential?

$$E_0 = \frac{kT \ln N_D N_A}{n_i^2}$$

E_0 - contact difference of potential
K – Boltzmann constant
T – Temperature
N_D - concentration of donor atoms
N_A - concentration of acceptor atoms
n_i - intrinsic concentration

32. What is the total current at the junction of PN junction diode?

The total in the junction is due to the hole current entering the n material and the electron current entering the p material. Total current is given by

$$I = I_{pn}(0) + I_{np}(0)$$

I – Total current
$I_{pn}(0)$ - hole current entering the n material
$I_{np}(0)$ - electron current entering the p material.

33. What is the diffusion length for holes (L_p)?

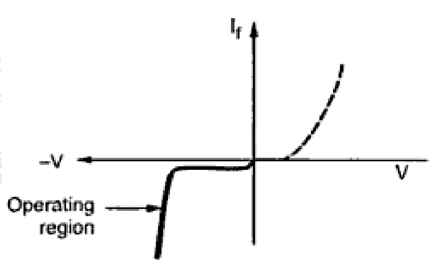
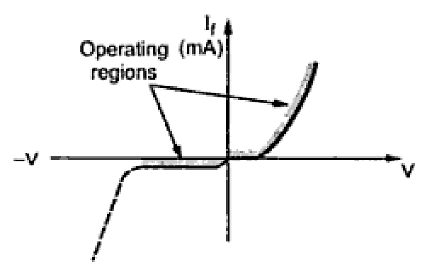
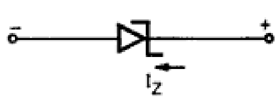
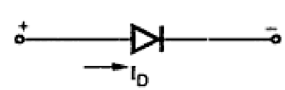
Diffusion length of holes can be said as the mean distance of travel of hole before recombination.

$$L_p = (D_p \tau_p)^{1/2}$$

34. State the law of junction relating the boundary value of injected minority carrier concentration with applied voltage?

The law of junction gives the density of minority carriers injected into a material across the junction. In a PN junction diode, concentration of holes injected in to the n region is given by $P_n(0) = p_{no} e^{V/V_T}$

35. Compare PN diode ad Zener Diode

No.	Zener diode	P-N junction diode
1.	Operated in reverse breakdown condition.	Operated in forward biased condition and never operated in reverse breakdown condition.
2.	The characteristics lies in third quadrant. 	The characteristics lies in first quadrant. 
3.	Dynamic zener resistance is very small in reverse breakdown condition.	The diode resistance in reverse biased condition is very high.
4.	Zener diode symbol is, 	The p-n junction diode symbol is, 

5.	The conduction in zener is opposite to that of arrow in the symbol, as operated in breakdown region.	The conduction when forward biased is in same direction as that of arrow in the symbol, when forward biased.
6.	The power dissipation capability is very high.	The power dissipation capability is very low compared to zener diodes.
7.	Applications of zener diode are voltage regulator, protection circuits, voltage limiters etc.	Applications of p-n junction diode are rectifiers, voltage multipliers, clippers, clampers and many electronic devices.

36. What is Zener breakdown? may 2017

Zener break down takes place when both sides of the junction are very heavily doped and consequently the depletion layer is thin and consequently the depletion layer is tin. When a small value of reverse bias voltage is applied, a very strong electric field is set up across the thin depletion layer. This electric field is enough to break the covalent bonds. Now extremely large number of free charge carriers are produced which constitute the zener current. This process is known as Zener break down.

37. What is avalanche break down? (APRIL/MAY 2011), (NOV/DEC 2011) may2017

When bias is applied, thermally generated carriers which are already present in the diode acquire sufficient energy from the applied potential to produce new carriers by removing valence electron from their bonds. These newly generated additional carriers acquire more energy from the potential and they strike the lattice and create more number of free electrons and holes. This process goes on as long as bias is increased and the number of free carriers gets multiplied. This process is termed as avalanche multiplication. Thus the break down which occurs in the junction resulting in heavy flow of current is termed as avalanche break down.

38. How does the avalanche breakdown voltage vary with temperature?

In lightly doped diode an increase in temperature increases the probability of collision of electrons and thus increases the depletion width. Thus the electrons and holes needs a high voltage to cross the junction. Thus the avalanche voltage is increased with increased temperature.

39. How does the Zener breakdown voltage vary with temperature?

In heavily doped diodes, an increase in temperature increases the energies of valence electrons, and hence makes it easier for these electrons to escape from covalent bonds. Thus less voltage is sufficient to knock or pull these electrons from their position in the crystal and convert them in to conduction electrons. Thus Zener break down voltage decreases with temperature.

40. Mention the types of junction capacitance. (MAY/JUNE 2013)

- Depletion layer capacitance or transition capacitance
- Diffusion capacitance

41. Define the term transition capacitance C_T of a PN diode. (NOV/DEC 2009)

Transition capacitance is formed during the reverse bias of the PN junction diode,

$$C_T = \frac{k}{(V_B - V)^n}$$

Where, k = constant depending on the nature of the semiconductor

- V_B = barrier voltage
- V = applied reverse voltage
- = a constant depending on the nature of the junction

42. Define the term diffusion capacitance or storage capacitance. (Nov 14) (Nov 17)

The diffusion capacitance effect is found when the diode is forward biased and it is defined as the rate of change of injected charge with voltage and given by

$$C_d = \frac{\tau I}{\eta V_T}$$

I = diode current, V_T = volt equivalent temperature.

$V_T = T / 11{,}600$

- = constant η= 1 for Ge diodes 2 for silicon diodes

  τ = mean life time

43. Define rectifier

A rectifier is an electrical device that converts alternating current to direct current. Typically this is done with a diode because they have the ability to conduct current one way & block current from going in the other way.

44. What is a rectifier and list its types? (Nov 2014) (APR/MAY 2015)

Rectifier is a circuit which converts a.c. to d.c. signal.

Half-wave rectifier: It is the simplest type of rectifier, which is made with just one diode.

Full-wave rectifier: This rectifier is essentially made of two half-wave rectifiers, and can be made with two diodes and an earthed centre tap on the transformer. The centre tap allows the circuit to be completed because current cannot flow through the other diode.

Bridge rectifier: A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.

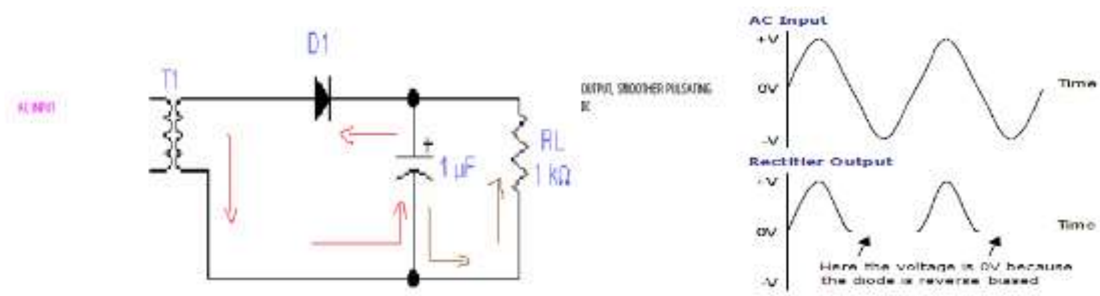
45. Define: Ripple factor.

It is the ratio of a.c voltage to d.c voltage or a.c. current to d.c. current

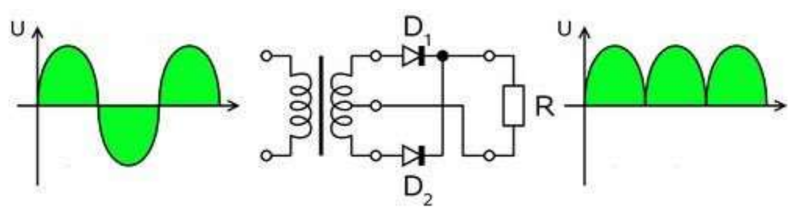
46. Define filter and its need. (NOV/DEC 2009)

A filter is a component that is used to reduce the ripple voltage. Generally the component used is a capacitor.

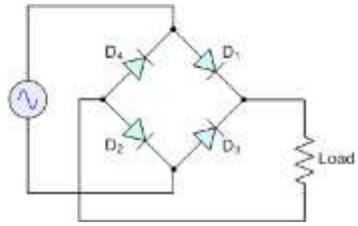
47. Draw the circuit diagram and output wave form for half wave rectifier



48. Draw the circuit diagram and output wave form for full wave rectifier



49. Draw the circuit diagram for a full wave rectifier using bridge rectifier



50. Define PIV, what is the value of PIV for bridge wave rectifier? (NOV/DEC 2011)

PIV is the peak voltage across the diode in the reverse direction.

PIV for HWR = $E_{sm} = \pi E_{DC}$ | $I_{DC} = 0$

PIV for FWR = $2E_{sm} = \pi E_{DC}$ | $I_{DC} = 0$

PIV for bridge wave FWR = E_{sm}

51. Define and explain peak inverse voltage (PIV) (Nov 2010)

Peak inverse voltage is the maximum reverse voltage that can be applied to the PN junction without damage to the junction. If the reverse voltage across the junction exceeds to its peak inverse voltage, the junction may be destroyed due to excessive heat.

52. What is meant by transformer utilization factor?

It is the ratio of power delivered to the load to the volt ampere rating of transformer.

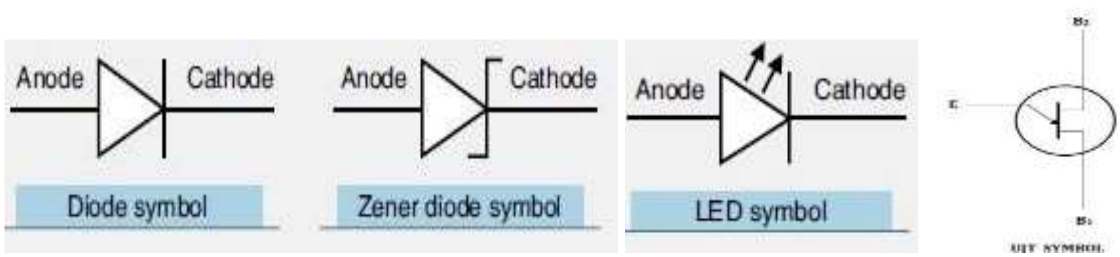
53. Mention some characteristics of LASER diode.

It is coherent i.e. there is no path difference between the waves comprising the beam.
It is monochromatic i.e. it consists of one wavelength and hence one colour only.
It is collimated i.e. emitted light waves travel parallel to each other.

54. Mention some applications of LASER diode. may/June 2016 may 2017

Laser diodes used in variety of applications ranging from medical equipment used in surgery to consumer products like optical disk equipment, laser printers, hologram scanners, etc. Laser diodes emitting visible light are used as pointers. Those emitting visible and infrared light are used to measure the distance.

55. Draw the symbol of the following device (i)PN diode (ii)Zener diode (iii)LED (iv)UJT (NOV/DEC 2015)



56. Applications of Zener Diode . (Nov 2016)

Clamping, voltage reference and voltage regulator

57. A silicon diode has a saturation current of 7.5µA @ room temperature 300K. Find the saturation current @ 400k.

Ŋ=2,IO=7.5µA,T=300K

Sub in this equation I=IO(e^V/ŋ VT-1) (nov 2016)

58. Define diode resistance **may/June 2016**

PART – B

1. With neat sketch explain the construction, operation and its characteristics of PN junction diode. Also list its Advantages, disadvantages and its applications. **NOV/DEC 2014, NOV/DEC 2015** may 2016
2. Draw the circuit diagram of a half wave rectifier for producing a positive output voltage. Explain the circuit operation and sketch the waveforms.(**NOV/DEC 2015,16)**
3. (i) Explain the action of a full wave rectifier using diodes and give waveforms of input and output voltages. **APR/MAY 2015** may/June 2017
   (ii) Derive an expression for a ripple factor in a full wave rectifier with resistive load. **APR/MAY 2015**
4. Explain the working of bridge rectifier. Give the Expression for RMS current, PIV, Ripple factor and efficiency. **NOV/DEC 2014**
5. With neat diagram, explain the operation of Zener diode and its forward and reverse characteristics .Also distinguishes between Avalanche and Zener breakdowns. **NOV/DEC 2015** may 2016
6. Briefly discuss about the following: **APR/MAY 2015**
   i LED & Laser diodes.
   ii Zener diode as a voltage regulator.
7. Derive the expression of Space Charge Capacitance of PN Junction diode under Reverse Bias Condition. **NOV/DEC 2016**
8. An AC supply of 220V, 50 Hz is applied to a HWR through a transformer of turn ratio 10:1. Find (i) Maximum RMS load Voltage (ii) Maximum RMS load current iii) Power delivered to the load (iv) AC power input (v) Efficiency and ripple factor (vi) PIV, ripple frequency, ripple voltage and ripple current
9. A 230 V, 50 Hz voltage is applied to the primary of a 5:1 stepdown center-tapped transformer used in a FWR having a load of 900Ω. If the diode resistance and the secondary coil resistance together has a resistance of 100Ω determine, (i)DC voltage across the load (ii) DC current flowing through the load (iii) DC power delivered to the load (iv) PIV across each diode (v) Ripple voltage and its frequency
10. A germanium diode has a contact potential of .2volt while the concentration of accepted impurity atoms is 3x10^20/m^3. Calculate for a reverse bias of 0.1V the width of the depletion region. If the reverse bias is increased to 10V calculate the new width of the depletion region. Assuming cross sectional area of the junction as 1mm^2 , Analyse the transition capacitance values for both the cases. Assume Ɛr=16 for germanium
11. Estimate the ideal reverse saturation current density in a silicon PN junction at T=300K, Consider the following parameters in the silicon pn junction. Nd=Na= 10^16cm^-3, ni= 1.5×10^10 cm^-3, Dn =25 cm2/s, Tp0= Tn0=5×10^-7s. Dp=10cm2/s, Ɛr =11.7 .Comment on the result.
12. A bridge rectifier is supplied with 230V, 50Hz supply with step down ratio of 3:1 to a resistive load of 10kΩ. If the diode forward resistance is 75Ω while the transformer secondary resistance is 10Ω. Calculate the maximum and average values of current, dc output voltage and rms voltage, efficiency, ripple factor, peak factor, form factor, PIV and TUF.

13. **(i)** The reverse saturation of a silicon PN junction diode is 10μA. Infer the diode current for the forward bias voltage of 0.6V at 25
(ii) Brief about the terms Diffusion capacitance and transient capacitance with respect to the diode **may/June 2017 may 2016**
14. **(i)** A FW diode rectifier has V1=100sinωt , RL=900Ω and Rf=100Ω. Come up with the peak and dc load current, DC load voltage, the peak instantaneous diode current, the PIV on the diode, AC input power, output power, Rectification efficiency of the FW rectifier.
(ii) Determine the minimum and maximum values of the load resistance of the zener shut regulator to meet the following specifications VS=24V, VZ=10V, iZMIN=3mA, IZMAX=50mA and RL=250Ω.
15. There is an application which needs the output voltage to be regulated. Choose an appropriate diode/device, thatwould ensure this operationwith appropriate circuit, describe how it regulates voltage. Consider a specific example, design the circuit with appropriate values of components involved. State the important constraints that need to be considered. **(Dec 2017)**

UNIT II
TRANSISTORS
PART-A

1. **What is a transistor (BJT)?**
   Transistor is a three terminal device whose output current, voltage and /or power is controlled by input current.
2. **What are the terminals present in a transistor?**
   Three terminals: emitter, base, collector.
3. **Why do we choose Q point at the center of the load line?**
   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.
4. **List out the different types of biasing.**
   Voltage divider bias
   Base bias
   Emitter feedback bias
   Collector feedback bias
   Emitter 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.
8. **What is Q-point or operating point? (MAY/JUNE 2012)**
   We set a fixed level of certain currents and voltages in a transistor. These values define a point called as the Q-point or the operating point
9. **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.
10. **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
11. **What is biasing? (MAY/JUNE 2012)**

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

12. What is meant by biasing a transistor? **(Nov 2014)**

Transistor biasing is the process of maintaining proper flow of zero signal collector current and collector-emitter voltage during the passage of signal. Biasing keeps emitter-base junction forward biased and collector-base junction reverse biased during the passage of signal.

13. 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.

14. Explain about the various regions in a transistor?

The three regions are active region saturation region cutoff region.

15. 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.

16. What are the three types of configurations?

Common base configuration, Common emitter configuration Common collector configuration

17. Which transistor configuration is widely used?(NOV/DEC 2011)

CE is widely used because,
Both the voltage gain and current gain is greater than unity
The ratio of the output impedance to the input impedance is small which makes it ideal for coupling between various transistor stages
Higher power gain

18. Which configuration is known as emitter follower and why it is named so?

CC configuration is known as emitter follower, whatever may be the signal applied at the input, may produce same signal at the output. In other words, the gain of the circuit is unity. So that the common collector circuit - the so called emitter follower is named as emitter follower. (Output follows the input)

19. What are the disadvantages of collector feedback bias?

The disadvantages of the collector feedback bias are
The collector current is high.
If the AC signal voltage gain feedback into the resistor R_e , it will reduce the gain of the amplifier.

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

The voltage divider bias has the following advantages.
The operating point will be in stable position.
The stability will be considerably improved.
I_C can be reduce to the collector leakage current I_{CO}.

21. Define the stability factor S for the fixed bias circuit.

The stability factor for the fixed bias circuit is ,

1. $S = 1 + \beta$

β – Current gain of the transistor.

22. Why fixed bias circuit is not used in practice?

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

23. What is thermal run away? (NOV/DEC 2009), (MAY/JUNE 2013)

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

24. The reverse saturation current in a silicon diode is 100nA at 27^0 C. find the current through the diode if the applied forward voltage is 1V.

$$V_T = \frac{273+27}{11600} = 25.8mV$$

$$I = I_0\left[e^{\frac{V}{\eta V_T}} - 1\right]$$

$$= 100 \text{ x } 10^{-9}\left[e^{\frac{1}{2 \text{ x } 25.8\text{x}10^{-3}}} - 1\right] = 26 \text{ A}$$

25. What is the difference between the AC and the DC load line in a CE amplifier having voltage divider bias and external load resistor R_L?

<u>DC load line:</u>

The load resistance is not considered here,

Applying KVL in the CE junction,

$$V_{CC} = I_C R_C + V_{CE} + I_E R_E$$

$$Put\ V_{CE} = 0, \quad I_C = I_E$$

$$I_{CQ} = \frac{V_{CC}}{R_C + R_E}$$

Put $I_C = I_E = 0$, $V_{CC} = V_{CEQ}$. Hence the DC load line co – ordinates are (V_{CEQ}, I_{CQ})

<u>AC load line:</u>

The load resistance is considered here,

The co- ordinates of the AC load line is determined by,

$$R_{ac} = R_C \parallel R_L$$

$$\max V_{CE} = I_{CQ} R_{ac} + V_{CEQ}$$

$$\max I_C = I_{CQ} + \frac{V_{CEQ}}{R_{ac}}$$

26. Compare the performance of CE, CB, CC(MAY 2017)

Parameters	CB	CE	CC
Current gain (A_i)	Low	High	High
Voltage gain (V_i)	High	High	Low
Input resistance (R_i)	Low	Medium	High

Output resistance (R_o)	High	Medium	Low

27. Give the Shockley's equation for FET.

The Shockley's equation give the relation between drain current (I_d) in the pinch of region and the gate to source voltage V_{gs}

$$I_d = I_{dss}\left(1 - \frac{V_{gs}}{V_p}\right)$$

Where I_{dss} = maximum value of drain current when $V_{gs} = 0$, V_p = Pinch off voltage.

28. What is FET?

FET is abbreviated for field effect transistor. It is a three terminal device with its output characteristics controlled by input voltage.

29. Why FET is called voltage controlled device? (NOV/DEC 2010)

The output characteristics of FET is controlled by its input voltage thus it is voltage controlled.

30. Why do you call FET as field effect transistor?(NOV/DEC 2011)

As it is a voltage controlled device as the output characteristics of FET is controlled by its input voltage it is called as field effect transistor

31. What are the two main types of FET?

1.JFET 2. MOSFET.

32. What are the terminals available in FET?

Drain 2. Source 3. Gate

33. What is JFET?

JFET- Junction field effect transistor.

34. What are the types of JFET?

N- channel JFET and P- Channel JFET

35. What are the two important characteristics of JFET?

1.Drain characteristics 2. Transfer characteristics.

36. What is Transconductance in JFET?

It is the ratio of small change in drain current to the corresponding change in drain to source voltage.

37. What is amplification factor in JFET?

It is the ratio of small change in drain to source voltage to the corresponding change in Gate to source voltage.

38. What is the disadvantage of FET over BJT? (APR/MAY 2011)

Its relative small gain-bandwidth product in comparison with that of a conventional transistor.

Greater susceptibility to damage in its handling.

JFET has low voltage gains because of small transconductance .

Costlier when compared to BJT’s.

39. What are the consideration factors that are used for the selection of an FET amplifier?

The consideration factors are

- Output voltage swing
- Distortion
- Power dissipation
- Voltage gain
- Drift drain current

40. Write the difference types of FET biasing circuits?

The FET biasing circuits are classified as,

- Gate bias,Self bias,Voltage divider bias,Current source bias ,Zero bias

41. Write the use of JFET as a voltage variable resistor?

One of the applications of voltage resistor (JFET) is to vary the gain of a multistage amplifier, as the signal level is increased. This action is called automatic gain control (AGC).

42. Mention the advantages of FET over BJT? (Nov 2013) (Nov 2017)

- The noise level is very low in FET since there are no junctions.
- FET has very high power gain
- Offers perfect isolation between input and output since it has very high input impedance.
- FET is a negative temperature coefficient device hence avoids thermal runaway.

43. Define amplification factor of JFET?(May 2010)

Amplification factor (μ) is defined as the ratio of small change in drain to source voltage (ΔV_{ds}) to the corresponding change in gate to source voltage (ΔV_{gs}) at a constant drain current Id.

$$\mu = \frac{\Delta V_{ds}}{\Delta V_{gs}} \text{ at constant } I_d$$

44. What is a MOSFET? Mention its types.(NOV/DEC 2009)

Metal Oxide Semiconductor Field effect transistor. Its types are

Enhancement type

- N- channel
- P- channel

Depletion type

- N- channel
- P- channel

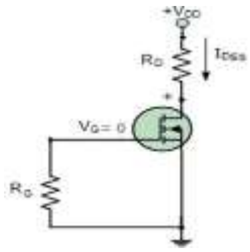
45. Why self-bias technique is not used in enhancement of type MOSFET?

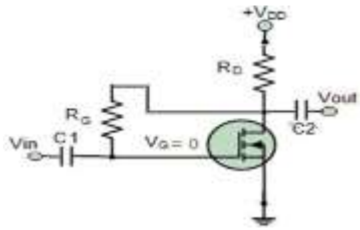
The self bias technique cannot be used to establish an operating point for the enhancement type MOSFET because the voltage across R_S is in a direction to reverse the gate and a forward gate bias is required.

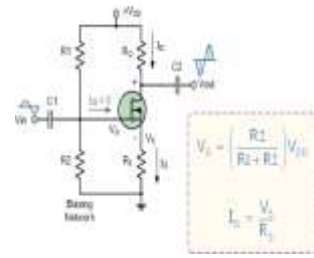
46. What is MOSFET? (May 2013)

The MOSFET is an abbreviation of Metal Oxide Semiconductor Field Effect Transistor. It is a three terminal semiconductor device similar to a FET with gate insulated from the channel. Therefore it is a also known as insulated Gate (IGFET)

47. Draw one biasing circuit for an enhancement type MOSFET (MAY/JUNE 2013)







ZERO BIASING **DRAIN FEEDBACK BIAS** **VOLTAGE DIVIDER**
BIAS

48. Differentiate JFET and MOSFET? may 2016

JFET	MOSFET
Reverse bias for gate	Positive or negative gate voltage
Gate is formed as a diode	Gate is made as a capacitor
Operated only in depletion mode	Can be operated either in depletion mode or in enhancement mode
High input impedance	Very high input impedance due to capacitive effect

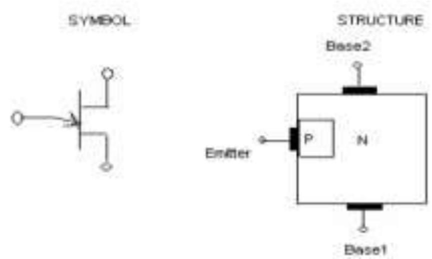
49. Differentiate Enhancement MOSFET and Depletion MOSFET

Enhancement MOSFET	Depletion MOSFET
Positive voltage at the gate	Negative voltage at the gate
Inversion layer is made	Depletion of majority carries happens
Negative charges are formed	Positive charges are formed

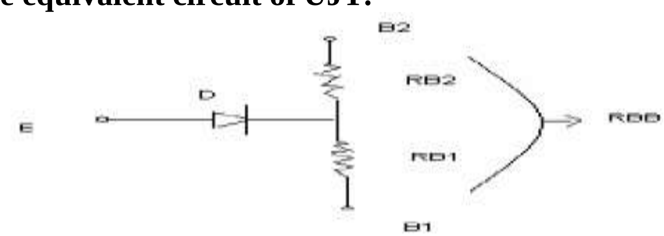
50. What does UJT stands for? Justify the name UJT.

UJT stands for uni junction transistor. The UJT is a three terminal semiconductor device having two doped regions. It has one emitter terminal (E) and two base terminals (B1and B2). It has only one junction, moreover from the outlook; it resembles to a transistor hence the name uni junction transistor.

51. Give the symbol and structure of UJT. (Dec 2017)



52. Give the equivalent circuit of UJT.



53. What is intrinsic stand- off ratio of an UJT? (MAY 2017)

If a voltage VBB is applied between the bases with emitter open the circuit will behave as a potential divider. Thus the voltage VBB will be divided across RB1 and RB2 Voltage across resistance RB1,

$$V_1 = \frac{R_{B1}}{R_{B1} + R_{B2}} V_{BB} = \frac{R_{B1}}{R_{BB}} V_{BB} = \eta V_{BB}$$

Where $\eta = \frac{R_{B1}}{R_{BB}}$ is called as intrinsic stand -off ratio.

54. What is interbase resistance of UJT?

The resistance between the two bases (B1and B2) of UJT is called as interbase resistance.

Interbase resistance = $R_{B1} + R_{B2}$

R_{B1}- resistance of silicon bar between B_1 and emitter junction.

R_{B2} - resistance of silicon bar between B_2 and emitter junction

55. Give the expression for peak point voltage for UJT?

$$V_P = \eta V_{BB} + V_D$$

Where

V_P - peak point voltage

η - intrinsic stand -off ratio

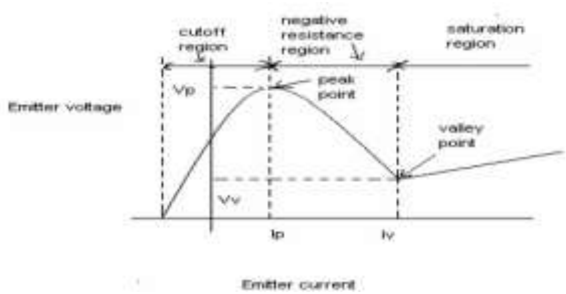
V_{BB} - voltage applied between the bases

V_D – barrier potential of UJT

56. What are the regions in the VI characteristics of UJT?

- Cut-off region
- Negative resistance region.
- Saturation region

57. Give the VI characteristics of UJT.



58. What is meant by negative resistance region of UJT? (APR/MAY 2011)

In a UJT when the emitter voltage reaches the peak point voltage, emitter current starts flowing. After the peak point any effort to increase in emitter voltage further leads to sudden increase in the emitter current with corresponding decrease in emitter voltage, exhibiting negative resistance. This takes place until the valley point is reached. This region between the peak point and valley point is called negative resistance region.

59. Mention the applications of UJT. (MAY 2017)

- It is used in timing circuits
- It is used in switching circuits
- It is used in phase control circuits
- It can be used as trigger device for SCR and TRIAC.
- It is used in saw tooth generator.

- It is used for pulse generation.

60. What is intrinsic stand off ratio of a UJT? may 2017**(NoV2013)**

The ratio of voltage between emitter and base 1 to V_{BB} is called as intrinsic stand of ratio. The value lies between 0.51 to 0.82.

$$\eta = \frac{R_{B1}}{R_{B1} + R_{B2}}$$

61. Compare UJT and FET. (NOV/DEC 2011)

S.No	UJT	FET
1	Terminals – emitter, base1, base 2	Terminals – gate, source, drain
2	It is a triggering device	It is an amplifier
3	It has negative resistance region	It does not

62. Differentiate BJT and UJT. (MAY/JUNE 2012)

S.No	BJT	UJT
1	It has two PN junctions	It has only one PN junctions
2	three terminals present are emitter, base, collector	three terminals present are emitter, base1,base2
3	basically a amplifying device	basically a switching device
4	Gate surface is smaller	Gate surface is larger
5	It has two PN junctions	It has one junctions

63. Compare BJT and JFET (MAY 2010, NOV 2014,MAY 2015)

BJT	JFET
Low input impedance	High input impedance
High Output impedance	Low output impedance
Bipolar device	Unipolar device
Noise is more	Less noise
Cheaper	Costlier
Gain is more	Gain is less
Current controlled device	Voltage controlled device

64. What is a thyristor? Mention two of them.(APR/MAY 2015)

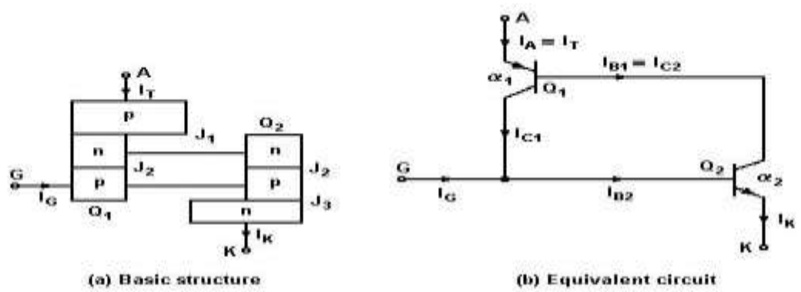
A thyristor is a four-layer semiconductor device, consisting of alternating P type and N type materials (PNPN). The four layers act as bistable switches. As long as the voltage across the device has not reversed (that is, they are forward biased), thyristors continue to conduct electric current.

The most common type of thyristor is the (i) silicon-controlled rectifier (SCR) (ii) DIAC **(iii)** TRIAC

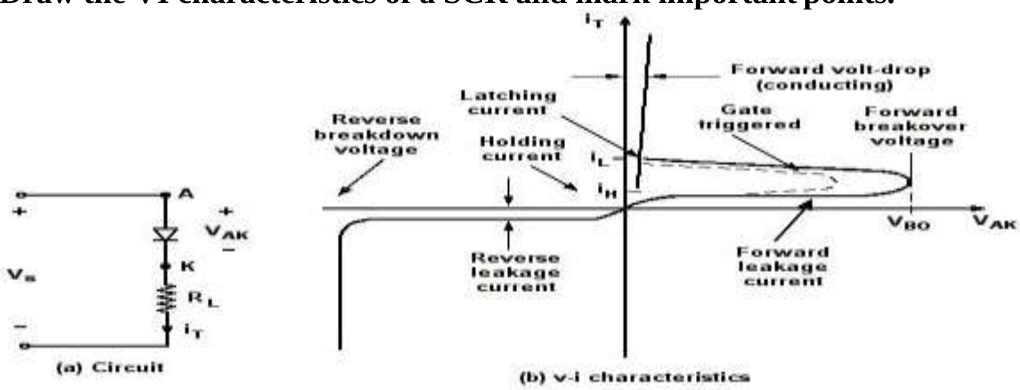
65. Compare the transistor and thyristors. (MAY 2017)

S.NO	TRANSISTOR	THYRISTOR
1.	Transistor is a three layer , two junction device	Thyristor is a four layer, three junction device
2.	Commutation circuitry which is costly and bulky, is not required	Commutation circuit is required
3.	To keep a transistor in the conducting state, a continuous base current is required.	Thyristors require a pulse to make it conducting and thereafter it remain conducting.

66. Draw the two transistor model of SCR.(Jan 2011) may 2017



67. Draw the VI characteristics of a SCR and mark important points.



68. What is meant by latching current & holding current?(Jan 2012)

Latching current is the minimum anode current required to maintain the thyristor in the on
State immediately after a thyristor has been turned on and gate signal has been removed.
Holding current is the minimum anode current to maintain the thyristor in the on state.

69. What is an IGBT? List its types.

Insulated gate bipolar transistor (IGBT) combines the advantages of BJT and MOSFET. Therefore it has low switching times as well as low power losses.

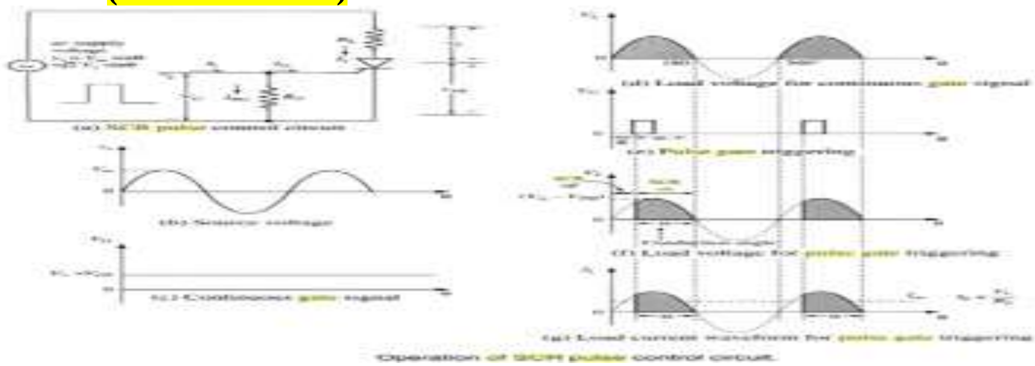
1. Punch through IGBT 2. Non punch IGBT.

70. What are the advantages of IGBTs?

They have high input gate impedance.

They have low conduction loss.
They have fast switching characteristics.
They have very high operating frequency.

71. Show how an SCR can be triggered on by the application of the pulse to the gate terminal.(NOV/DEC 2015)



72. List the applications of IGBTs.

i)They are used in low noise, high performance power supplies.
ii)They are used in inverters.
iii)They are used in motor speed controls.

73. What is Early effect? (NOV-DEC 2016)

Early effect is very important phenomenon used in drawing input characterstics(graphical relation between input current and input voltage for different values of output voltage) of Common Base Configuration which is similar to characterstics of forward biased diode. *Early effect* is also known as Base Width Modulation.

74. Determine base current for CE transisitor circuit IC=80Ma &β=170 (NOV-DEC-2016)

IE=IC/β , Using these relations problems can be solved.

75. draw the transfer and drain characteristics of JFET **may 2016**

PART – B

1. (i)Explain the construction and operation of NPN transistors with neat sketch. Also comment on the characteristics of NPN transistor **NOV/DEC 2014**
(ii) Explain the input/output characteristics of BJT in common base configuration.**MAY/JUN 2014**
(iii)Explain the operation of NPN transistor in CE configuration with its input and output characteristics. Also define Active, saturation and cut-off region. **MAY/JUN 2012**
(iv) Compare the performance of a transistor in different configuration.**MAY/JUN 2012**
2. (i)Explain the selection of Q point for a transistor bias circuit and discuss the limitations on the output voltage swing. **NOV/DEC 2015**
(ii) Explain in detail, different biasing methods for a transistor circuit with neat circuit diagram and obtain respective stability factors.**APR/MAY 2011, DEC 2017**

(iii) Draw a self bias circuit using BJT and derive an expression for the stability factor. **APR/MAY 2015**

(iv) Draw the collector to base bias circuit of a transistor and derive the expression for the stability factor. **NOV/DEC 2009, NOV/DEC 2013**

(v) Distinguish between d.c and a.c load lines with suitable diagram. **APR/MAY 2015**

(vi) Explain how potential divider bias is obtained **NOV/DEC 2011**

3. (i)Explain the construction and operation of N-channel JFET with neat sketches and characteristics curve.**MAY/JUN 2012**

4. With the help of suitable diagram, explain the working of enhancement MOSFET. Draw and explain its VI Characteristics. **APR/MAY 2015, DEC 2015, DEC 2013, DEC 2017 may 2017**

5. Describe the construction and working of UJT with its equivalent circuit and V-I characteristics. **APR/MAY 2015, NOV/DEC 2015, NOV/DEC 2013 , NOV/DEC 2016 may 2016**

6. In an transistor amplifier using voltage divider bias, the operating point is chosen such that I-q = 2rnA, VCE = 3V. If Rc=2.2Kohm, VCC = 9V, β= 50, find the values of bias resistois and RE. Assume VBE = 0.3V and current through the bias resistors is $10I_B$". **DEC 2017**

7. The reverse leakage current of the transistor when connected in CB configuration is 0.2 mA and it is 18 μA when the same transistor is connected in CE configuration. Determine αdc &βdc of the transistor. Assume IB =30mA

8. (i) For an n-channel silicon FET with $a=3x10^{-4}$ cm and $Nd=10^{15}$ electrons/cm^{-3}. Evaluate (a) pinch off voltage (b) the channel half width for VGS= 0.5Vp.

(ii) In biasing with feedback resistor method, a silicon transistor with feedback resistor is used. The operating point is 7V, 1mA and VCC=12V. Assume β=100. Determine the value of RB, Stability factor and the new operation point if β=50 and all other circuit values the same.

9. Design a voltage divider bias circuit for transistor to establish the quiescent point at VCE=12V, IC=1.5mA, stability factor S≤3, β = 50, VBE=0.7V, VCC=22.5V and RC=5.6kΩ

10. (i)With neat sketch, explain the construction, operation and characteristics of SCR. **NOV/DEC 2014, NOV/DEC 2015, NOV/DEC 2013 , NOV/DEC 2016**

11. (ii) Explain the construction and working principles of DIAC and TRIAC with neat sketches**. APR/MAY 2015**

(iii) With neat sketch, explain the construction, operation and characteristics of IGBT **may 2016 may 2017**

12. (i) Take part in discussion of the two transistor model of a thyristor in detail **may 2017**

(ii) Sketch and explain the typical shape of drain characteristics of JFET for VGS=0 with indication of four region clearly

UNIT III

AMPLIFIERS

PART-A

1. **What is an amplifier?(APR/MAY 2015)**
   An amplifier is a circuit which can be used to increase the magnitude of the input current or voltage at the output by means of energy drawn from an external source.
2. **Based on the transistor configuration how amplifiers are classified? (APR/MAY 2015)**
   Based on transistor configuration, the amplifiers are classified as
   - Common emitter amplifier
   - Common base amplifier
   - Common collector amplifier.
3. **List out the classification of large signal amplifiers? (NOV/DEC 2009), (MAY/JUNE 2013)**
   The large signal amplifiers are classified as follows.
   Based on the input
   Small signal amplifier
   Large scale amplifier
   Based on the output
   Voltage amplifier
   Power amplifier
   Current amplifier
   Based on the transistor configuration
   CE amplifier
   CB amplifier
   CC amplifier
   Based on the number of stages
   Single stage amplifier
   Multi stage amplifier
   Based on band width
   Untunned amplifier (wide band amplifier)
   Tuned amplifier (narrow band amplifier)
   Based on the frequency response

AF(Audio Frequency) amplifier
IF (Intermidiate Frequency) amplifier
RF(Radio Frequency) amplifier

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

4. Compare input impedance and voltage gain of CE and CC amplifiers (NOV/DEC 2010), (NOV/DEC 2013)

S.No	Characteristics	CE	CC
1	Input Impedance	Low	High
2	Voltage Gain	Medium	Low

5. Define hybrid parameters. (MAY 2011,NOV2014)

Any linear circuit having input and output terminals can be analyzed by four parameters are input impedance, output impedance, current gain and voltage gain.(one measured on ohm, one in mho and two dimensionless) called hybrid or h-parameters.

6. What are the use of h - Parameters? (NOV/DEC 2009, APR/MAY 2011)

It perfectly isolates the input and output circuits. Its source and load currents are taken into account.

7. Write the procedure to draw the a.c. equivalent of a network.

- Setting all the dc sources to zero and replacing them by a short circuit equivalent.
- Replacing all capacitors by a short circuit.
- Removing all elements bypassed by the short circuit equivalents introduced by step 1 & step 2.
- Redrawing the n/w in a more convenient & logical form.

8. What is the effect of coupling capacitors at low frequency?

At low frequency the coupling capacitors acts as open circuit.

9. What is the effect of coupling capacitors at high frequency

At high frequency the coupling capacitors acts as short circuit

10. Which is the most commonly used transistor configuration? Why?

The CE Configuration is most commonly used. The reasons are High Current gain High voltage gain High power gain Moderate input to output ratio.

11. What are the values of input resistance in CB, CE & CC Configuration

CB - Low about 75 CE - Medium About 750 CC - Very high about 750

12. Write the voltage and current equation for hybrid parameters.

$$V_1 = h_{11}\, i_1 + h_{12}\, V_2$$
$$I_2 = h_{21}\, i_1 + h_{22}\, V_2$$

13. What are the values of h-parameters?

$h_{11} = V_1 / i_1$
$h_{12} = V_1 / V_2$
$h_{21} = i_2 / i_1$
$h_{22} = i_2 / V_2$

14. Write the hybrid equations of CE amplifier.

$$V_b = h_{ie} i_b + h_{re} V_c$$
$$I_c = h_{fe} i_b + h_{oe} V_c$$

15. Write the hybrid equations of CB amplifier.

$$V_e = h_{ib} i_e + h_{rb} V_c$$
$$I_c = h_{fb} i_e + h_{ob} V_c$$

16. Write the hybrid equations of CCamplifier.

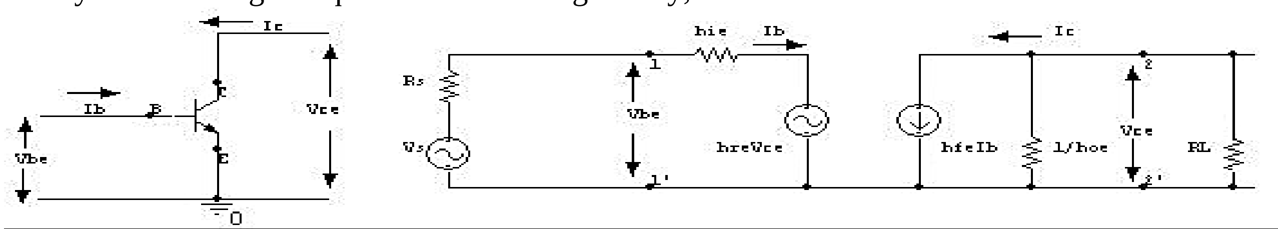
$$V_b = h_{ic} i_b + h_{rc} V_e$$
$$I_c = h_{fe} i_b + h_{oc} V_e$$

17. What is an amplifier? Compare BJT and FET amplifiers.

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

18. Draw a small signal equivalent circuit of CE amplifiers(APR/MAY 2015)

The hybrid small signal equivalent circuit is given by,



19. Compare gain characteristics of CB, CC transistor circuits

	Common Emitter	*Emitter Follower*	*Common Base*
A_v	Midrange	Less than 1	Midrange
A_i	Midrange	Midrange	Less than 1
A_p	High	Midrange[2]	Midrange[3]
Z_{in}	Midrange	High	Low
Z_{out}	Midrange	Low	High

CB and CC are nearly opposite in terms of gain and impedance characteristics.

20. Give the significance of coupling and bypass capacitor on BW of amplifiers.

At low frequency the bypass capacitor makes gain to lower value and at higher frequency the coupling capacitor decreases the gain so at low and high frequencies response curves is varied and mid range of frequencies the gain is nearly constant.

21. State the reason for fall in gain at low and high frequencies.

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

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

22. Write short note on effects of coupling capacitor.

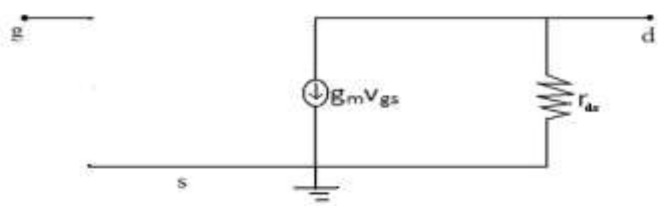
The coupling capacitor transmits a.c. signal but blocks d.c. This prevents d.c. interference between various stages and the shifting of operating point. It prevents the loading effect between adjacent stages.

23. Define the frequencies fT & fβ

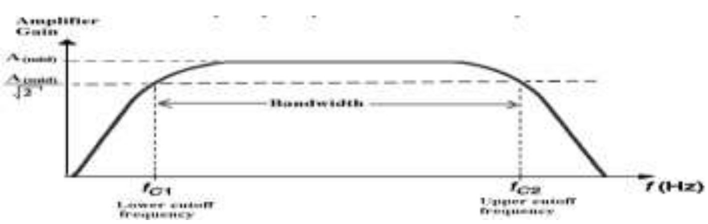
f_T – It is the frequency at which short circuit gain becomes unity.

f_β - It is the frequency at which short circuit gain becomes unity.

24. Draw the low frequency incremental model of FET.



25. Draw the frequency response curve of an amplifier.



26. Define transconductance with respect to a JFET DEC 2017

In amplifier terminology, the gain is known as transconductance and is denoted by the symbol 'g_m'.

The gain is given by:

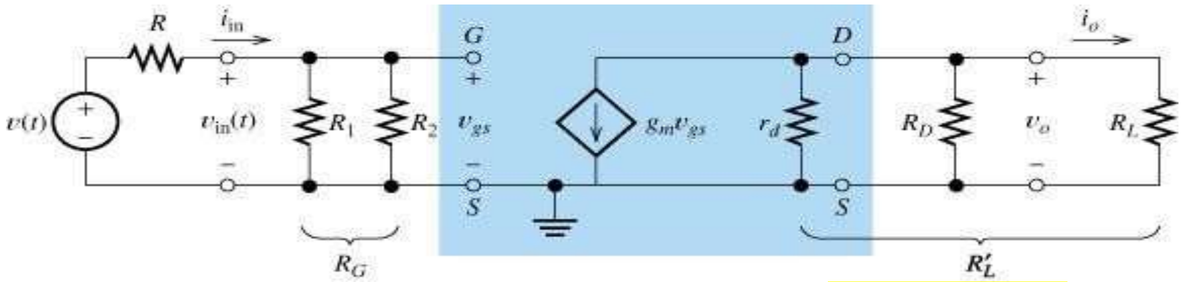
$$g_m = \frac{\Delta I_D}{\Delta V_{GS}}$$

27. Give the drain current expressions in triode region and in saturation region of MOSFET

In saturation region:

$$i_D = \mu_n C_{ox} (W/2L) (v_{GS} - V_{Tn})^2 (1 + \lambda_n v_{DS}) = i_D(v_{GS}, v_{DS}, v_{BS})$$

28. Draw the small signal equivalent circuit of CS JFET(NOV/DEC 2015)



29. What is the need of coupling capacitors in amplifier design? (NOV/DEC 2015)

A coupling capacitor is a capacitor which is used to couple or link together only the AC signal from one circuit element to another. The capacitor blocks the DC signal from entering the second element and, thus, only passes the AC signal.

30. What are 3 db frequencies?

The frequency at which we have 70.7% of fall from the maximum gain is called 3db frequency

20. In an amplifier the maximum voltage gain is 2000, occurs at 2KHz. It falls to 1414 at 10Hz and 50Hz.Find i) B.W ii) Lower and upper cut off frequency.

$$\mathrm{BW} = 50\ \mathrm{Hz} - 10\ \mathrm{Hz} = 40\ \ \mathrm{Hz}$$

$$F_1\ = 10\ Hz \& F_2 = 50\ Hz$$

31. Define upper and lower cut off frequencies of an amplifier.

The frequency at which the voltage gain of the amplifier is exactly 70.7% of the maximum gain is known as lower cut off frequency.

The frequency at which the voltage gain of the amplifier, is exactly 70.7% o0f the maximum gain is known as upper cutoff frequency.

32. Define the term bandwidth and gain bandwidth product.

Bandwidth is defined as the range of frequency over which the gain remains constant.

The product of midland gain and bandwidth is called gain bandwidth product.

33. What are the causes of occurrence of upper cutoff frequency in BJT?

The internal capacitors are the main element for decrease of gain as well as occurrence of upper cut off frequency.

34. List out the application and characteristics of CE amplifier.

It is used as voltage amplifier, among the three basic transistor amplifiers.

Characteristics of CE amplifier:

- It has good voltage gain with phase inversions. i.e. the output voltage is 180°out of phase with input
- It also has good current, power gain and relatively high input and output impedance.

35. Mention some application of CC amplifier.

- It is used as buffer amplifier as it has unity voltage gain.
- It is used as impedance matching network.

36. What is millers theorem?(NOV-DEC 2016)

Millers theorem states that the capacitor connected between the input and output can be split in to two net works such that one network appears as the mirror image of the other one.The impedance of such network can be taken by open circuiting or short circuiting the common connections exist between the two net works.

37. Define frequency response.

Frequency response can be defined as measure of output parameter variation with respect to variation of input frequency.

38. State the reason for choosing 3 db point to determine the bandwidth.

The reason for choosing 3 db point to determine the bandwidth is that, above this level, larger the frequency variation (i.e. output delivers the constant output below this level even for lower frequency variation), the gain variation is large i.e. the output is not constant. Thus 3 db point is selected as reference to find the bandwidth.

39. Define voltage gain for a JFET CG configuration.

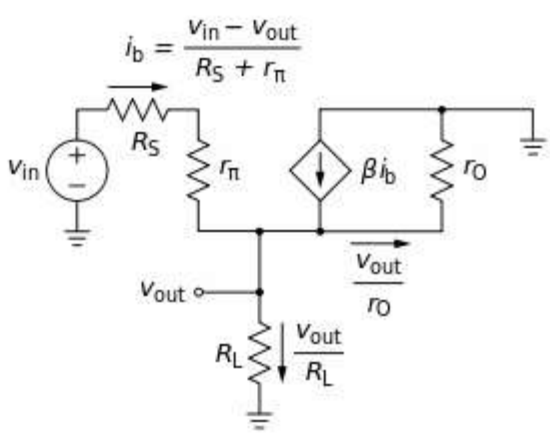
The small-signal voltage gain is found to be

$$A_v = \frac{V_o}{V_i} = \frac{g_m(R_D \| R_L)}{1 + g_m R_{Si}}$$

40. Distinguish between CE, CB, and CC amplifiers DEC 2017

	CE Amplifier	CC Amplifier	CB Amplifier
Voltage Gain (A_V)	moderate ($-R_c/R_E$)	low (about 1)	high
Current Gain (A_I)	moderate (β)	moderate ($\beta+1$)	low (about 1)
Input Resistance	high	high (VCVS)	low (CCCS)
Output Resistance	high	low (VCVS)	high (CCCS)

41. Draw the hybrid small signal model of CB configuration? (NOV-DEC 2016)



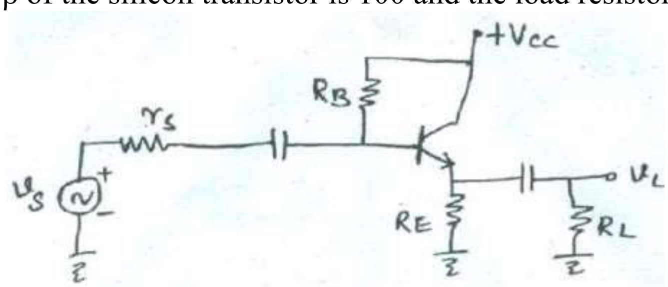
42. In a common base connection, current amplification factor is 0.9. If the emitter current is 1mA, find the value of base current. DEC 2017

43. The data sheet of an enhancement MOSFET gives $I_{D(on)}$ = 800 mA at V_{gs} = 10 V and $V_{gs(th)}$ = lV. Find the drain current of V_{gs}= 5V. DEC 2017

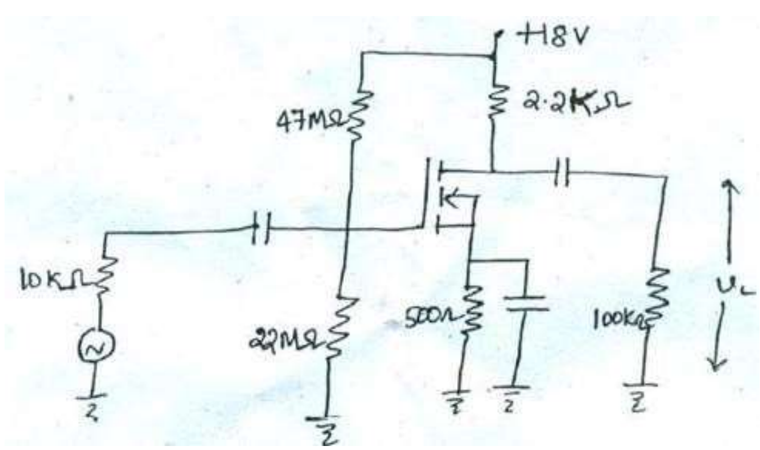
PART - B

1. Draw the h-parameter model of a BJT-CE amplifier and derive the equations for voltage gain, current gain, input impedance and output impedance. **NOV/DEC 2014, APR/MAY 2015, NOV/DEC 2016**

2. Draw the a.c equivalent circuit of a C.B/CE amplifier using h-parameter model and derive the equation for Zi,Zo,Av and Ai. **APR/MAY 2015 DEC 2017**
3. Discuss the factors involved in the selection of Ic, Rc and Re for a single stage common emitter BJT amplifier circuit ,using voltage divider bias**. NOV/DEC 2015 NOV/DEC 2016**
4. Compare and contrast all the parameters of CC,CB and CC amplifiers. **APR/MAY 2015, NOV/DEC 2013**
5. With neat circuit diagram, perform ac analysis for common source and common drain using equivalent circuit NMOSFET amplifier. **NOV/DEC 2014, NOV/DEC 2015, NOV/DEC 2016(MAY 2017)**
6. Describe about small signal MOSFET amplifiers (NMOS) and obtain the expression for its transconductance. **APR/MAY 2015**
7. **(i)** Derive the expression for the voltage gain of CS amplifier
   (ii) For CS amplifier, the operating point is defined by VGSQ=-2.5V,Vp= -6V and IdQ=2.5mA with IDSS=8mA. Also RG=1MΩ, RS=1 KΩ, RD=2.2KΩ and VDD=15V.Calculate gm, rd, Zi, Zo and Av **(MAY 2017)**
8. (i) Discuss the factors involved in Ic, Rc and Re for a single stage common emitter BJT amplifier circuit, using voltage divider bias**(MAY 2017)**
   (ii) A CC amplifier shown in below figure has VCC=15 V, RB=75kΩ and RE=910Ω The β of the silicon transistor is 100 and the load resistor is 600Ω. Estimate rin and Av



9. (i) The MOSFET shown in below figure has the following parameters. VT=2V, β=0.5×10 -3, rD=75kΩ. It is biased at ID=1.93 mA. Determine the impedance and voltage gain
   (ii) With neat circuit diagram, evaluate the ac analysis for common source using equivalent circuit NMOSFET amplifier **DEC 2017**



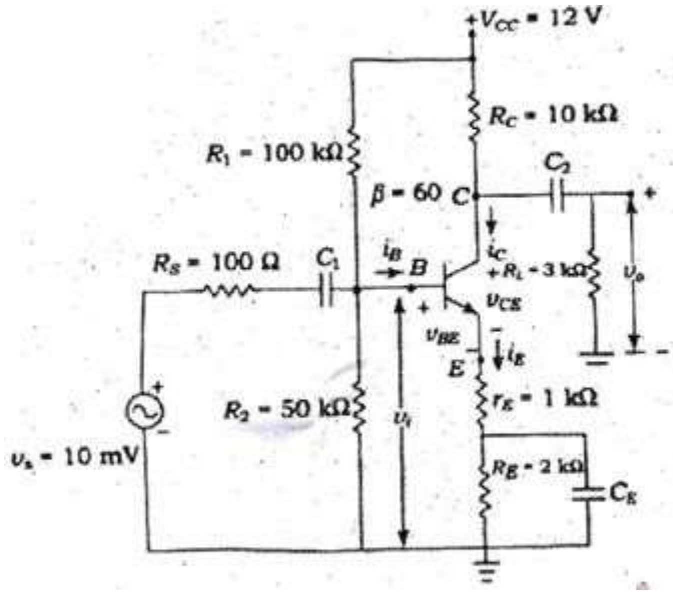
10. The hybrid parameters of a transistor used as an amplifier in the CE configuration are hie = 800Ω, hfe = 46, hoe = 80 x 10^{-6} and hre = 5.4x 10^{-4}. If RL = 5K and Rs=500Ω. Find Ai, Ri , Av, Pi

11. For a CB amplifier driven by voltage source of internal resistance Rs=1200Ω. The load impedance is resistor RL=1000Ω. The H parameters are Hin=22Ω Hcb=3x10-4, Hfb= -0.98 and Hinf=0.5A/V. Estimate the current gain A, Input impedance Ri, voltage gain Av, overall gain Ais, overall voltage gain Avs and output impedance Zo.

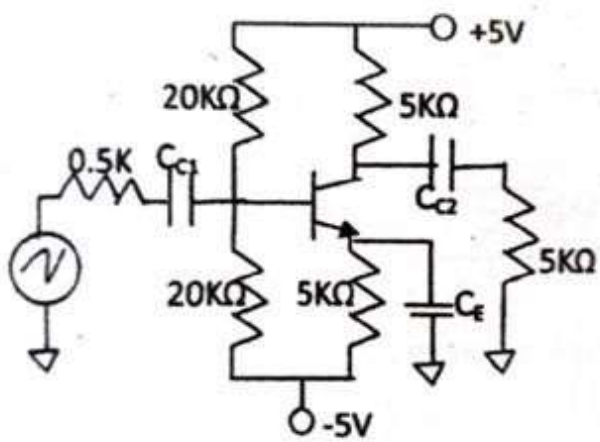
12. The figure shows a common-emitter amplifier. Determine the input resistance, ac load resistance, voltage gain and output voltage

13. (i)Explain the working of Common emitter Amplifier **DEC 2017**

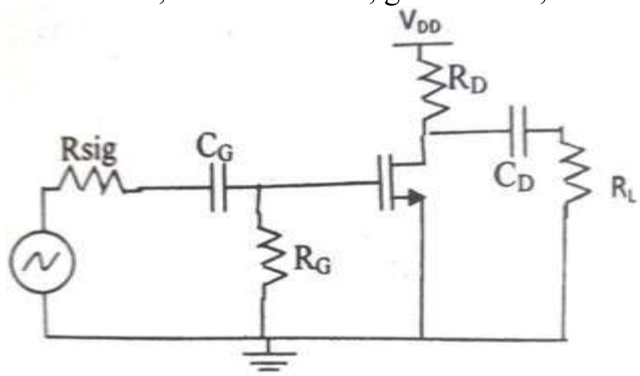
(ii)The data sheet of an enhancement MOSFET gives ID(on) = 500 mA at VGs = 10 V and VGs TH = lV. Find the drain currrent for VGS=5V **DEC 2017**



1. Examine the midband gain and bandwidth of a CE amplifier. Assume lower cutoff frequency is 100Hz. Let Hfe=β=100, Cbe=4pF, Cbc=0.2pF and VA=∞



2. **(i)** Determine the mid band gain, upper cutoff frequency of a common-source amplifier fed with the signal having internal resistance Rsig=100kΩ. The amplifier has RG=4.7MΩ, RD=RL=15kΩ, gm=1mA/V, ro=150kΩ, Cgs=1 pF and Cgd=0.4pF



(ii) For CS amplifier, the operating point is defined by VGSQ=-2.5V, VP=-6V and IdQ=2.5mA with IDSS=8mA. Also RG=1MΩ, RS=1KΩ,RD=2.2kΩ and VDD=15V. Calculate gm, rd, Zi, ZO and AV

UNIT IV
MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER
PART-A

1. **What is a differential amplifier? What are its advantages? DEC 2017**
An amplifier that has two inputs and produces an output signal that is a function of the difference between the two inputs. Advantages:
(i) It can compare any two signals and detect any difference. (ii).It gives higher gain than two cascaded stages of ordinary direct coupling. (iii).It provides very uniform amplification of signal from dc up to very high frequencies.

2. **What are the applications of differential amplifier? DEC 2017(Nov 2011)**
    - In the medial electronics field
    - As a input stage in the measuring instruments
    - In analog computation
    - In linear integrated circuits
3. **What is the need of constant current circuit in differentia amplifier?**
The necessary for constant current source for differential amplifier to increase the CMRR without changing quiescent current and without lowering the forward current gain.
4. **Define CMRR.what is its ideal value? (NOV/DEC 2015) (May 2010 / Nov 2014) &NOV-DEC 2016**(MAY 2017)**
It is defined as the ratio of the differential voltage gain (A_d) to the common mode voltage gain (A_{cm}) .
CMRR = 20 log (Ad/Acm)
For a perfect differential amplifier, the CMRR is equal to infinity as Acm is zero.
5. **State the different methods of biasing of difference amplifier.**
    a. The different methods of biasing of difference amplifier are,
    b. i) Emitter bias ii) Constant current bias
6. **Explain the need for constant current source for difference amplifier.**
The necessity for constant current source for differential amplifier is to increase the common mode rejection ratio without changing the quiescent current (operating point)

and without lowering the forward current gain.

7. **Why R_E is replaced by a constant current bias in a differential amplifier?**
The emitter supply V_{EE} used for biasing purpose must become larger as R_E is increased in order to maintain the quiescent current at its proper value. If the operating currents of the transistors are allowed to decrease, this will lead to higher H_{ie} values and lower values of H_{fe}. Both these effects will tend to decrease CMRR. To overcome this practical limitations R_E is replaced by a constant current bias.

8. **What is the input impedance of a differential amplifier with RE at its emitter junction?**
The input impedance of a differential amplifier with RE at its emitter junction is :

$$R_i = 2 ?_{ie} + (1 + ?_{fe})R_E$$

9. **What should be the value of AC, the common mode gain and Ad the difference mode gain for an ideal differential amplifier?**
The common mode gain of an ideal differential amplifier is 0. The difference mode gain of an ideal differential amplifier is very high (α) .

10. **Explain why constant current source biasing is preferred for differential amplifier.**
The constant current source biasing is preferred for differential amplifier inorder to increase the input resistance and to make the common mode gain zero.

11. **Distinguish between common mod signal and differential mode signal.**
If the same input is applied to both the inputs, the operation is called common mode signal. It is the average value of the input signals.

$$V_c = \frac{V_1 + V_2}{2}$$

If the two opposite polarity input signals are applied, the operation is referred to as difference mode. The difference between the input voltages in called difference mode signal.

12. **What is the classification of power amplifier?**
Class A ,class B, class C, class AB & class D.
13. **Explain the difference between voltage and power amplifier.**
Voltage Amplifier: The input given to the transistor is in millivolts. The transistor used is a small signal transistor. Power Amplifier: The input given to the transistor is in volts. The transistor used is a power transistor.
14. **Explain why power amplifier is also known as large signal amplifier.**
Since the output obtained from the power amplifier is very large, it is known as large signal amplifier.
15. **How do you bias the class A amplifier? List the advantage of class A amplifiers. (NOV/DEC 2013)**
In class A mode, the output current flows through the entire period of input cycle and the Q point is chosen at the midpoint of AC load line and biased. An amplifier is a circuit which can be used to increase the magnitude of the input current or voltage at the output by means of energy drawn from an external source.
ADVANTAGES OF CLASS A POWER AMPLIFIER.
    - Lower distortion
    - Higher suppression of ripple and noise from the power supply
    - Lower output impedance
    - Better DC stability
    - Suppression of interference from the loudspeaker connection
16. **Which power amplifier gives minimum distortion**?
Class C power amplifier gives minimum distortion.
17. **Define class A power amplifier**.
It is an amplifier in which the input signals and the biasing is such that the output current flows for full cycle of the input signal.
18. **Define class B power amplifier.**
It is an amplifier in which the input signal and the biasing is such that the output current flows for half cycle of the input signal
19. **Define class C power amplifier. DEC 2017**
It is an amplifier in which the input signal and the biasing is such that the output current flows for less than half cycle of the input signal
20. **Define class AB power amplifier.**
It is an amplifier in which the input signal and the biasing is such that the output Current flows for more than half cycle but less than full cycle of the input signal
21. **Define class D power amplifier.**
It is an amplifier which is used in digital circuits and also the input signals are pulses.
22. **Give two applications of class C power amplifier**.
It is used to generate pulses.
It is used to trigger other devices.
23. **Write any two characteristics of class A amplifier**.
The Q point is placed at the center of the DC load line.
The overall efficiency is 25%.

24. Write any two characteristics of class B amplifier.

The Q point is placed at the cutoff region.

The overall efficiency is 78.5%

25. What is a push pull amplifier?

Class B amplifier is used as a push pull amplifier which uses two transistors. Both the transistors work as a push pull arrangement.. i.e. one transistor will be on at a time.

26. What are the features of class – C power amplifier? (APR/MAY 2011)

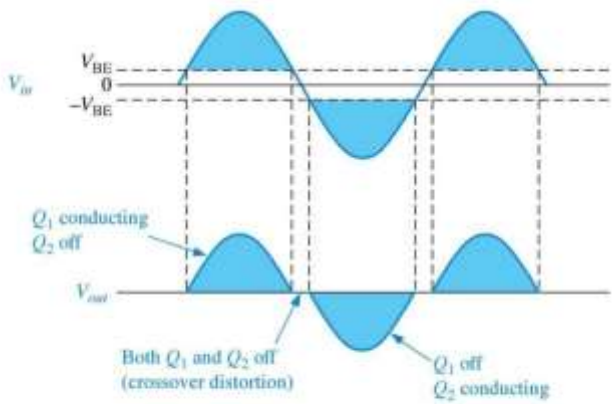
The output current flows only during a part of the positive half cycle of the input signal. This condition is achieved by biasing the transistor below cut off.

The output signal does not Resemble the input Signal because it consists of narrow pulses

The class – C amplifiers is the most efficient power amplifier and its overall efficiency, under certain conditions, may approach even 100%

27. What is meant by cross over distortion? (NOV/DEC 2010), (NOV/DEC 2011), (MAY/JUNE 2012), (MAY/JUNE 2013)

In Class – B amplifier, both the transistors are at cut off region that is bias voltage is zero. So input signal voltage should exceed the barrier voltage to make the transistor conduct until the input signal exceeds 0.7V for Si and 0.3V for Ge, otherwise the transistor cannot conduct. So there is a time interval between the positive and the negative alterations of the input signal when neither transistor is conducting. The resulting distortion in the output signal is cross over distortion.



28. How crossover distortion is eliminated? (MAY/JUNE 2013)

To avoid crossover distortion, a slight forward bias (0.3V for germanium, 0.6V for silicon) voltage is applied to the base emitter junction of the transistors. It causes transistor to conduct immediately when the input signal is applied. So Q point is fixed above the cut-off.

29. State the merits of using push pull configuration.

- The merits of push pull configuration are,
- Efficiency is high (78.5%)
- Figure of merit is high
- Distortion is less
- Ripple present in the output due to power supply is multified.

30. What are the advantages of using complementary symmetry configuration?

The advantages of using complementary symmetry are,

- It does not use center taped transformer either at input or output.
- It uses one PNP transistor and one NPN transistor, hence it provides proper impedance matching. Hence its voltage gain is unity (i.e., it acts as voltage follower)

31. Define conversion efficiency of a power stage.(NOV-DEC 2016)

The ratio of the AC output power delivered to the load DC input power applied is referred to as conversion efficiency. It is also called as collector circuit efficiency in case of transistor amplifier

$$\eta = \frac{Signal\ power\ delivered\ to\ the\ load}{DC\ power\ supplied\ at\ input\ circuit} X\ 100$$

32. Write down the values of maximum possible power conversion efficiency for

- **Class A direct coupled**
- **Class A transformer coupled**
- For class A direct coupled η = 25%
- For class A transformer coupled η = 50%

33. State Bisection theorem

This is called Bisection theorem can be applied to any symmetrical network. Emitter coupled differential amplifier is symmetrical network.

34. 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.

35. What are the various types of tuned amplifiers?

- Small signal tuned amplifiers
- Single tuned amplifiers
- Capacitive coupled
- Inductively coupled (or) Transformer coupled
- Double tuned amplifiers
- Stagger tuned amplifiers
- Large signal tuned amplifiers

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

$f = 1 / 2\pi\sqrt{LC}$ & $Z R = L/C_R$

37. 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.

38. When tuned circuit is like resistive, capacitive and inductive?

- At resonance, circuit is like resistive.
- For frequencies above resonance, circuit is like capacitive.
- For frequencies below resonance, circuit is like inductive.

39. What are the various components of coil losses?

- Copper loss
- Eddy current loss
- Hysteresis loss

40. Define Q factor of resonant circuit.

- It is the ratio of reactance to resistance.
- 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)

41. What is dissipation factor?

- It is defined as 1/Q.
- It can be referred to as the total loss within a component.

42. Define unloaded and loaded Q of tuned circuit.

- The unloaded Q or QU is the ratio of stored energy to dissipated energy in a reactor or resonator.
- The loaded Q or QL of a resonator is determined by how tightly the resonator is coupled to its terminations.

43. Why quality factor is kept as high as possible in tuned circuits?

When Q is high, bandwidth is low and we get better selectivity. Hence Q is kept as high as possible in tuned circuits. When Q is high inductor losses are less.

44. List various types of cascaded Small signal tuned amplifiers.

Single tuned amplifiers.
Double tuned amplifiers.
Stagger tuned amplifiers.

45. How single tuned amplifiers are classified?

Capacitance coupled single tuned amplifier.
Transformer coupled or inductively coupled single tuned amplifier.

46. 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.

47. 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.

48. 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.

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

Bandwidth reduces due to cascading single tuned amplifiers.

50. List the advantages and disadvantages of tuned amplifiers.

Advantages:

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

Disadvantages:

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

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

It provides larger 3 dB bandwidth than the single tuned amplifier and hence provides the larger gain-bandwidth product.

It provides gain versus frequency curve having steeper sides and flatter top.

52. What the advantages are of stagger tuned amplifier?

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

53. Mention the applications of class C tuned amplifier.

Class C amplifiers are used primarily in high-power, high-frequency applications such as Radio-frequency transmitters.

- 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.
- Amplitude modulation is one such example.
- The principal advantage of class-C amplifier is that it has a higher efficiency than the other amplifiers.

54. What is Neutralization? (MAY 2017)

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.

55. What is the use of Neutralization? (NOV/DEC 2015) (MAY 2016)

BJT and FET are potentially unstable over some frequency range due to the feedback parameter present in them.

- 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.
- This is achieved by Neutralization.

56. What are the different types of neutralization?

- Hazeltine neutralization **(MAY 2016)**
- Rice neutralization
- Neutrodyne neutralization.

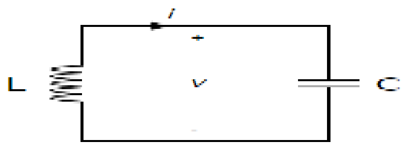
57. What is rice neutralization?

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.

58. Write down the need of cascading the amplifiers.(Nov2014)(APR/MAY 2015)

Cascading means connecting the output of one amplifier to the input of another to form a multistage amplifier. The overall gain of cascaded amplifiers depends on that of each stage and the total number of stages. The purpose of cascading amplifiers is to reach the desired signal power with a minimum amount of distortion, by providing equal overall gain characteristics to all frequencies in the signal.

59. Draw the ideal tuned circuit and write the expression for its resonant frequency.(APR/MAY 2015)



Resonance occurs when an LC circuit is driven from an external source at an angular frequency ω_0 at which the inductive and capacitive reactances are equal in magnitude. The frequency at which this equality holds for the particular circuit is called the resonant frequency. The resonant frequency of the LC circuit is

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

where L is the inductance in henries, and C is the capacitance in farads. The angular frequency ω_0 has units of radians per second.

The equivalent frequency in units of hertz is

$$f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi\sqrt{LC}}.$$

PART-B

1. With neat sketch explain two stage cascaded amplifier and derive its overall Av,Ai,Ri and Ro **NOV/DEC 2014**
2. Draw the circuit of emitter coupled BJT differential amplifier, and derive expressions for differential gain, common mode gain and CMRR. **NOV/DEC 2014, APR/MAY 2015, NOV/DEC 2015, APR/MAY 2016 DEC 2017**
3. What is Neutralization? Explain any one method in brief **APR/MAY 2015, APR/MAY 2016**
4. (i)Draw the circuit diagram of a push pull amplifier and explain its working in detail. **APR/MAY 2015**
   (ii) Derive the equation for efficiency of a class B power amplifier. **APR/MAY 2015, NOV/DEC 2015, NOV/DEC 2013**
5. **(i)**Explain the operation of complementary symmetry push pull amplifiers state its advantages and disadvantages.
   (ii) Explain the working of Class A Power amplifier and derive the expression for the power output, efficiency, **NOV/DEC 2013 DEC 2017(MAY 2017)**
   (iii) Explain the working of Class C Power amplifier and derive the expression for the power output, efficiency **DEC 2017(MAY 2017)**
6. With the neat circuit, explain and derive the gain and bandwidth of a single tuned amplifier with its frequency response. **NOV/DEC 2015**
7. Draw the circuit of FET input stages, and derive expressions for differential gain, common mode gain and CMRR**(MAY 2017)**
8. The dual input balanced output differential amplifier having Rs=100Ω, R_C=4.7KΩ, RE =6.8KΩ,hfe=100,VCC=+15V, VEE=-15V. Find operating point values, differential &common mode gain, CMRR and output if Vs1=70mV(p-p) at 1 kHz and Vs2=40mV(p-p)
9. A Class C amplifier with VCC=25V has RL=680Ω,Cp=4300pF,Lp=20μH and Rw=0.06Ω.The transistor has VCE(sat)=0.6V.Calculate the appropriate signal frequency, the output power and circuit efficiency

10. The differential amplifier has the following values RC = 50 K, Re = 100K and Rs = 10K. The transistor parameters are rπ = 50K= hie, hfe = Vo = 2 x10^3, ro=400K.Determine Ad, Ac and CMRR in db.
11. Construct BiMOS cascade amplifier.
12. Explain the different types of neutralization technique used in tuning amplifier**(MAY 2016)**
13. Interpret the qualitative analysis for power amplifiers

UNIT V

FEEDBACK AMPLIFIERS AND OSCILLATORS

PART-A

1. **Define positive feedback?**
   If the feedback signal is in phase with input signal, then the net effect of the feedback will increase the input signal given to the amplifier. This type of feedback is said to be positive or regenerative feedback.
2. **Define negative feedback? DEC 2017**

If the feedback signal is out of phase with the input signal then the input voltage applied to the basic amplifier is decreased and correspondingly the output is decreased. This type of feedback is known as negative or degenerative feedback.

3. Define sensitivity?

Sensitivity is defined as the ratio of percentage change in voltage gain with feedback to the percentage change in voltage gain without feedback.

4. Define Desensitivity D? DEC 2017

Desensitivity is defined as the reciprocal of sensitivity. It indicates the factor by which the voltage gain has been reduced due to feedback network.

Desensitivity factor (D) = $1+A\beta$.

Where

A = Amplifier gain.

β = Feedback factor.

5. What are the types of feedback?(NOV/DEC-2013) DEC 2017

i. Voltage-series feedback
ii. Voltage-shunt feedback
iii. Current-series feedback
iv. Current-shunt feedback

6. Define 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.

7. Give an example for voltage-series feedback.

The Common collector or Emitter follower amplifier is an example for voltage series feedback.

8. Give the properties of negative feedback. DEC 2017

i. Negative feedback reduces the gain
ii. Distortion is very much reduced

9. Distinguish between series and shunt feedback.

S.No	Series Feedback	Shunt Feedback
(i)	In series feedback amplifier, the feedback signal is connected in series with the input signal.	In shunt feedback amplifiers, the feedback signal is connected in parallel with the input signal.
(ii)	It increases the input resistance	It decreases the input resistance.

10. Give the effect of negative feedback on amplifier characteristics.

CHARACTERISTICS				
Type of feedback	**Voltage gain**	**Bandwidth**	**Input resistance**	**Output resistance**
Current-series	Decreases	Increases	Increases	Increases
Voltage-series	Decreases	Increases	Increases	Decreases
Voltage-shunt	Decreases	Increases	Increases	Decreases
Current-shunt	Decreases	Increases	Increases	Increases

11. What is current-series feedback amplifier. (or) What is Transconductance amplifier?

In a current series feedback amplifier the sampled signal is a current and the feedback signal (Which is fed in series) is a voltage.

$$G_m = \frac{I_o}{V_i}$$

Where

G_m = Amplifier gain.
I_o = Output current.
I_i = Input current.

12. What is Voltage shunt feedback? (or) What is transresistance amplifier?

In voltage shunt feedback amplifier the sampled signal is a voltage and the feedback signal(Which is fed in shunt)is a current.

$$R_m = \frac{V_o}{V_i} \quad \text{(or)} \quad V_o = R_m . I_i$$

Where

R_m = Amplifier gain.
V_o = Output voltage.
I_i = Input current.

13. What is voltage series feedback amplifier? (or)What is voltage amplifier?

In a voltage series feedback amplifier the sampled signal is a voltage and feedback signal(Which is fed in series) is also a voltage.

$$A = \frac{V_o}{V_i}$$

Where

A = Amplifier gain.
V_o = Output voltage.
V_i = Input voltage.

14. What is current -shunt feedback amplifier? (or) What is current amplifier?

In a current shunt feedback amplifier, the sampled signal is a current and the feedback signal(Which is fed in shunt) is a current.

$$A = \frac{I_o}{I_i} \quad \text{(or)} \quad I_o = A.I_i$$

Where

A = Amplifier gain.
I_o = Output current.
I_i = Input current.

15. Write the expression for gain with feedback for positive and negative feedback.

For positive feedback:

$$A_f = \frac{A}{1 - A\beta}$$

For negative feedback:

$$A_f = \frac{A}{1 + A\beta}$$

Where,

A_f = Amplifier gain with feedback.

A = Amplifier gain without feedback.

β = Feedback factor.

16. Give an example for current-series feedback amplifier. (or) Give an example for Transconductance amplifier.

The common emitter amplifier with Re in the emitter lead and FET common source amplifier stage with source resistor R are the best expel for current series feedback circuit.

17. Give an example for Voltage shunt feedback? (or) Give an example for transresistance amplifier?

The collector feedback biased common emitter amplifier is an example of voltage – shunt feedback circuit.

18. Give an example for voltage series feedback. (or) Give an example for voltage amplifier.

The common collector (or) emitter follower is an example of voltage series feedback.

19. Distinguish between series and shunt feedback amplifiers.

Series feedback:

(i). In series feedback amplifier the feedback signal is connected in series with the input signal.

(ii). It increases the input resistance.

Shunt feedback:

(i). In shunt feedback amplifier the feedback signal is connected in shunt with the input signal.

(ii). It decreases the input resistance.

20. What are the drawbacks of negative feedback?(NOV/DEC2009), (NOV/DEC 2011)(APR/ MAY 2015) DEC 2017

There are two disadvantages of negative feedback (i)the overall gain is reduced almost in direct proportion to the benefits, and it is often necessary to compensate for the decrease in gain by adding an extra amplifier stage;(ii)the circuit may tend to oscillate, in which case careful design is required to overcome this problem. Negative feedback is also known as degenerative feedback because it degenerates (or reduces)the output signal.

21. What are the advantages of negative feedback? (NOV/DEC2010), (MAY/JUNE 2012),(NOV/DEC 2015) DEC 2017

- Gain stability
- Noise reduction
- Reduction in nonlinear distortion
- Bandwidth can be increased
- Increase in input impedence
- Decrease in output impedence

22. What is the nature of input and output resistance in negative feedback.

(1) Voltage series feedback:

Input impedance:

$$Z_{if} = Z_i / (1+A\beta)$$

Output impedance:

$$Z_{of} = Z_o / (1+A\beta)$$

(2) Voltage shunt feedback:

Input impedance:

$$R_{if} = R_i * (1+A\beta)$$

Output impedance:

$$Zo_f = Zo * (1+ A\beta)$$

(3) Current series feedback:

Input impedance:

$$R_{if} = Z_i / (1+A\beta)$$

Output impedance:

$$Z_{of} = Z_o / (1+A\beta)$$

(4) Current shunt feedback:

Input impedance:

$$R_{if} = R_i / (1+A\beta)$$

Output impedance:

$$R_{of} = R_o / (1+A\beta)$$

23. What is Oscillator circuit?

A circuit with an active device is used to produce an alternating current is called an oscillator circuit.

24. What are the classifications of Oscillators?(NOV/DEC-2013)

*Based on wave generated:

i. Sinusoidal Oscillator,

ii. Non-sinusoidal Oscillator or Relaxation Oscillator

Ex: Square wave, Triangular wave, Rectangular wave etc.

*According to principle involved:

i. Negative resistance Oscillator

ii. Feedback Oscillator.

*According to frequency generated:

i. Audio frequency oscillator 20 Hz – 20 kHz

ii. Radio frequency Oscillator 30 kHz – 30 MHz

iii. Ultrahigh frequency Oscillator 30 MHz – 3 GHz

iv. Microwave Oscillator 3GHz – above.

* Crystal Oscillators.

25. What are the types of feedback oscillators?

* RC-Phase shift Oscillator,

* LC-Oscillators

i. Tuned collector Oscillator

ii. Tuned emitter Oscillator

iii. Tuned collector base Oscillator

iv. Hartley Oscillator

v. Colpits Oscillator

vi. Clap Oscillator

26. Define Barkhausen Criterion. (NOV 2009,APR 2011,NOV 2011,MAY 2012,NOV 2014)(NOV-2016). (MAY 2017) (MAY 2016)

Condition for sustained oscillation,

a. Magnitude condition $|A_v\beta| = 1$

b. Phase condition $\angle A_v\beta = 0°$

These conditions are called as Barkhausen criterion.

27. Write the expression for gain and oscillation frequency for wein bridge oscillator. (NOV/DEC 2010)(APR/MAY 2015) DEC 2017

Oscillating frequency, $f = \frac{1}{2\pi RC}$ and gain, $\beta = \frac{1}{3}$

28. What are the advantages and drawbacks of RC phase shift oscillator? (APR/MAY 2011)

Advantage

1. f_o is independent of active device parameters and elements of amplifier does not affect frequency stability.

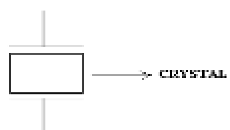
Disadvantages

1. Condition for sustaining oscillation is dependent of parameters of active device.
2. f_o is very difficult to vary.
3. f_o depends on discrete components.
4. $|A| \geq 29$ is not possible by single stage FET.

29. Define Piezoelectric effect. (MAY 2013)

When applying mechanical energy to some type of crystals called piezoelectric crystals the mechanical energy is converted into electrical energy is called piezoelectric effect.

$F \propto 1/T$.



30. What is Miller crystal oscillator? Explain its operation.

It is nothing but a Hartley oscillator its feedback Network is replaced by a crystal. Crystal normally generate higher frequency reactance due to the miller capacitance are in effect between the transistor terminal.

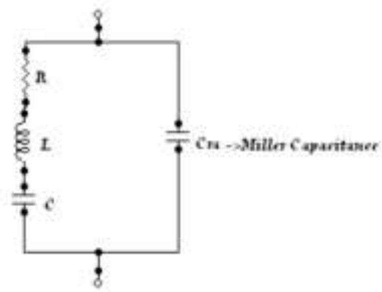
31. State the frequency for RC phase shift oscillator.

The frequency of oscillation of RC-phase shift oscillator is

$F = 1/2\pi RC\sqrt{(4k+6)}$

Where k=2.639.

32. Draw the equivalent circuit of crystal oscillator.



33. **.Name two high frequency oscillators. (Nov 2010)**
 (i) Hartley oscillator (ii) Colpitts oscillator
34. **What are the advantages of crystal oscillator?(Nov 2012)**
 Simple circuit since no tuned circuit is needed other than the crystal it self.
 Different frequencies of oscillations can be obtained by simply replacing one crystal by another. Hence it makes it easy for a radio transistor to work at different frequencies.
 Since the frequency of oscillation is set by the crystal, changes in the supply and transistor parameters does not affect the frequency of oscillation.
35. **Mention the types of feedback amplifiers. (Nov 2013)**
 i) Voltage Series ii) Voltage Shunt iii) Current Series iv) Current Shunt
36. **What is the advantage of colpitts oscillator compared to phase shift oscillator? (NOV/DEC 2015)**
 Colpitts 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
 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. 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.
37. **Differentiate oscillator and amplifier? (NOV-DEC 2016).**
 Oscillator producuce an alternating current
 Amplifier will provide a stable output which is an amplified version of input signal.

PART –B

1. i) Explain in detail the advantages of negative feedback. **DEC 2017**
 ii) Explain with circuit diagram, a negative feedback amplifier and obtain expression for its closed loop gain. **APR/MAY 2015 DEC 2017**
2. Determine Rif,Rof,Av and Avf for the Voltage shunt feedback amplifier **NOV/DEC 2014, APR/MAY 2015**
3. Determine Rif,Rof,Av and Avf for the Voltage series feedback amplifier **NOV/DEC 2014, APR/MAY 2015, NOV/DEC 2016(MAY 2017)**
4. Sketch the circuit diagram of a two-stage capacitor coupled BJT amplifier that uses series voltage negative feedback. Briefly explain how the feedback operates. **NOV/DEC 2015**
5. Draw circuit of CE amplifier with current series feedback and obtain the expression for feedback ratio, voltage gain, input and output resistances. **NOV/DEC 2014, APR/MAY 2015**
6. Discuss in detail the characteristics of current shunt feedback amplifier. **NOV/DEC 2013(MAY 2017)**
7. Explain the following with neat diagram. **NOV/DEC 2014**
 (i) RC phase shift oscillator **NOV/DEC 2014 DEC 2017**
 (ii) Hartley oscillator. **NOV/DEC 2014**
 (iii) Colpitts oscillator **APR/MAY 2015**

(iv) Wein bridge oscillator **APR/MAY 2015, NOV/DEC 2015, NOV/DEC 2013, NOV/DEC 2016**

(v) Crystal oscillator **NOV/DEC 2015**

8. Take part in the discussion of the four types of topology for feedback of an amplifier. Derive the expression for gain with feedback. Mention the advantages of negative feedback amplifier.

9. A Hartley oscillator is designed with L1 = 2mH, L2 = 20μH and a variable capacitance. Find the range of capacitance value if the frequency of oscillation is varied between 950 to 2050 KHZ

10. Two identical amplifier stages , each with voltage gain of 20dB and B.W of 25kHz are cascaded. To improve gain stability the cascade is provided with negative feedback to the extent of 10%. Estimate the effective gain and bandwidth

11. Design a Colpitts oscillator with C1 = 100pf and C2 = 7500pf. The inductance is variable. Determine the range of inductance values, if the frequency of oscillation is to vary between 950 KHz and 2050 KHz **(MAY 2017)**

12. When negative voltage feedback is applied to an amplifier of gain 100, the overall gain falls to 50. Find the fraction of the output voltage feedback. If this fraction is maintained, find the value ofthe amplifier gain required if the overall stage gain is to be 75. **DEC 2017**

13. A 1 mH inductor is available. Choose the capacitor values in a colpitts oscillator so that f = l MHz and feedback fraction is 0.28 **DEC 2017**

14. When a portion of the output signal is fed to input, as you are aware, feedback is generated. Distinguish between negative feedback and positive feedback and elaborate on their individual advantages. How different parameters of an amplifier (say) will be affected by these two types of feedback ? **DEC 2017**