**WINTER– 16 EXAMINATION**

**Model Answer**

Subject Code: 17213

**Important Instructions to examiners:**

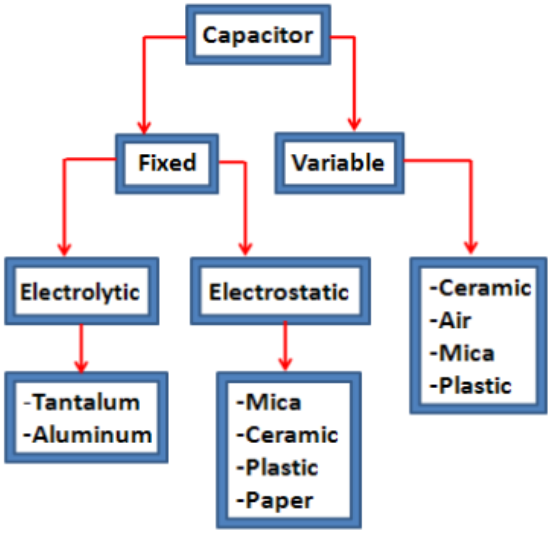
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

ModelAnswer

Q 1. Attempt any TEN of the following : 20

a) Give the classification of capacitor . State the unit of capacitor.

Ans: [Classification 1 ½ , Unit of capacitor ½ ]




The unit of capacitor is Farad (F)

b) Define amplification factor and transconductance of JFET.

Ans:[ Each definition for 1M , formula optional]

Amplification Factor : Amplification Factor is defined as the ratio of change in Drain to Source Voltage (ΔVDS) to

change in Gate to Source Voltage (ΔVGS) at a constant ID .

$$\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}} \quad I_D = \text{constant}$$

Transconductance : Transconductance is defined as the ratio of change in Drain current (ΔID) to change in Gate to Source Voltage (ΔVGS) at a constant VDS.

$$g_m = \frac{\Delta I_D}{\Delta V_{GS}} \quad \text{keeping } V_{DS} \text{ constant.}$$

c) Give the applications of Zener diode.

Ans:-Applications- ( any two)

1) Voltage regulator

2) Reference voltage generator

3) Waveshaping networks

4) Mosfet Protection Device

d) Define frequency and bandwidth of an amplifier.

Ans: [Each definition for 1M]

(Note : Instead of frequency , frequency response term more related to amplifier. )

Frequency response : It is the graph between various input frequency versus gain.

Bandwidth : The range of frequency over which the voltage gain of an amplifier is greater than or equal to 70.7% of maximum value is known as bandwidth of an amplifier.

e) State the typical values of knee voltage for silicon and germanium diode.

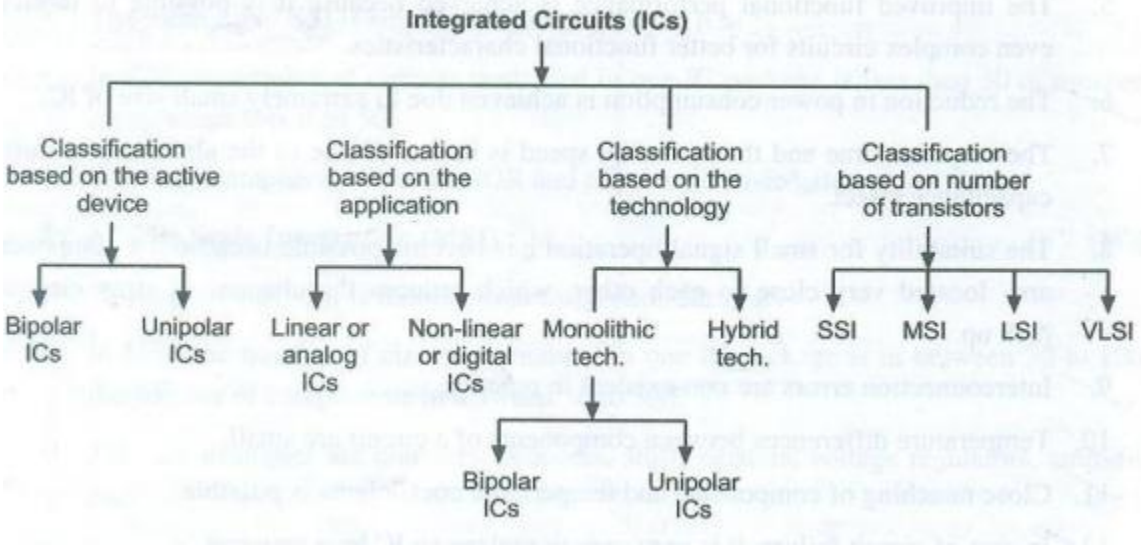
Ans:[Typical values of each 1M]

The knee voltage for a silicon diode is 0.6 V ( or 0.7 V) and that for a germanium diode is 0.2V ( or 0.3 V) .

f) Give the classification of ICs.

Ans :[Correct classification 2M]

The classification of ICs is as under :




g) State the need of filter. Define filter.

Ans. [Correct answer- 2 marks]

Need of the filter: The output of a rectifier contains ac and dc components. If such a dc is applied in an electronic circuit, it will produce noise and therefore to keep the ac components away from the load, filter circuits are used, which removes the ac components and allows only dc components to reach the load.

Definition of filter: It is a circuit which removes ac component from rectifier output.

h) State the types of JFET. Draw their symbol.

Ans :[Types ½ M, symbols 1 ½]

There are two types of JFET

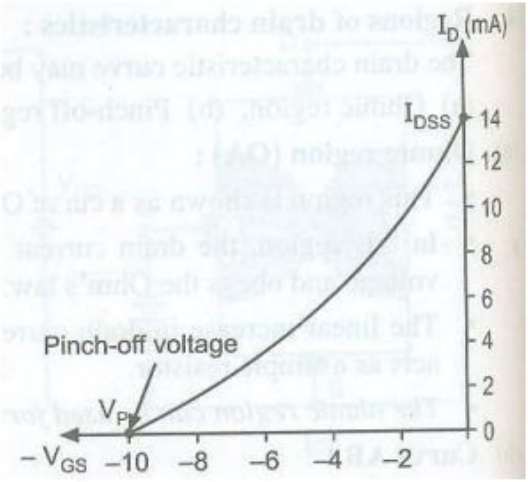
1 . N-channel JFET

2. P-channel JFET


i) Draw a transfer characteristics of JFET.

Ans: [ Correct characteristics 2M]

Transfer characteristics of JFET :




j) State the two advantages and disadvantages of Integrated circuits.

Ans. [Any 2 advantages 1M, any 2 disadvantages 1M]

Advantages of IC's are:

1. The physical size of an IC is extremely small (generally thousand times smaller) than that of discrete circuits.
2. The weight of an IC is very less as compared to that of equivalent discrete circuits.
3. The reduction in power consumption is achieved due to extremely small size of IC.
4. Interconnection errors are non-existent in practice.
5. Temperature differences between components of a circuit are small.
6. Close matching of components and temperature coefficients is possible.
7. In case of circuit failure, it is very easy to replace an IC by a new one.
8. Active devices can be generously used as they are cheaper than passive components.

Disadvantages of IC's are:

1. It is not possible to directly fabricate inductors.
2. The initial cost to be incurred is high
3. Power dissipation is limited.
4. ICs are very delicate and need extra care while handling

k) Draw the symbol of LED and varactor diode.

Ans :[ Each symbol 1M]

**Symbol of LED**

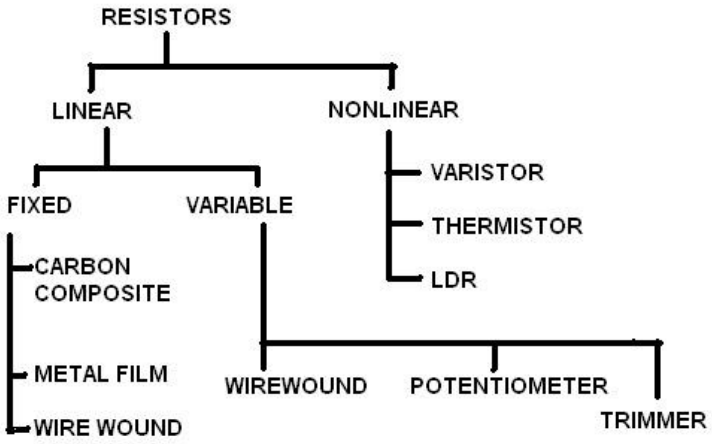

Symbol of Varactor diode

l) Define resistor . Give classification of resistor.

Ans: [Definition 1M, classification 1M]

Definition of resistor: A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit.

Classification of resistor:




Q2. Attempt any FOUR of the following : 16

a) Define electronics and explain its applications in atleast three fields .

Ans a.[ Electronics Definition 1M ,Any three applications 3M]

Definition of electronics: Electronics is the branch of science that deals with the study of flow and control of electrons and the study of their behavior and effects in vacuums, gases, and semiconductors devices using electrons.

Applications of electronics in different fields:

1. Communication and Entertainment: a) Wire communication or Line communication. b) Wireless communication. The examples of wire communication are Telegraphy, Telephony, Telex and Teleprinter. The examples of wireless communication are radio broadcasting, TV broadcasting, and satellite communication.

2. Defense: The most important application is RADAR.

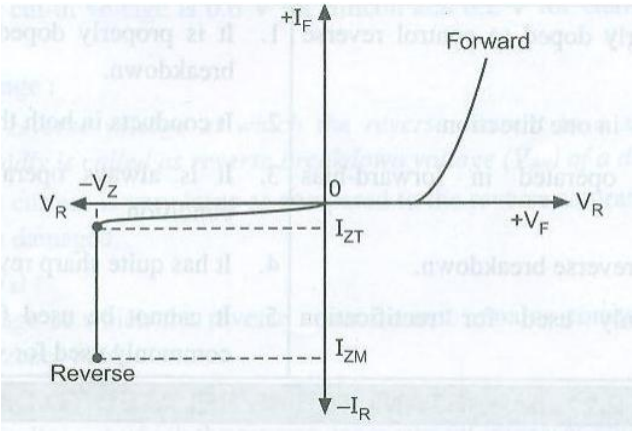
3. Industrial Applications: Electronic circuits are used to control thickness, quality, weight and moisture. They are also used to amplify weak signals.

4. Medical sciences: Electronics helps doctors and scientists in the diagnosis and treatment of various diseases. E.g. X-rays, ECG , Oscillography and Short-wave diathermy units.

5. Instrumentation: Instrumentation plays very vital role in research field and industry. E.g. Cathode Ray Oscilloscope (CRO), Frequency counter, Signal generator and Strain gauges

b) Draw and explain VI characteristics of Zener diode .

Ans [ Characteristics 2M , Explanation 2M]




The characteristics are similar to that of an ordinary silicon PN junction diode.

- It indicates that the forward current is very small for voltages below knee voltage and large for voltages above knee (i.e. cut in) voltage.

- The reverse characteristics curve indicates that negligible reverse saturation current flows until we reach the breakdown (i.e. Zener) voltage Vz .

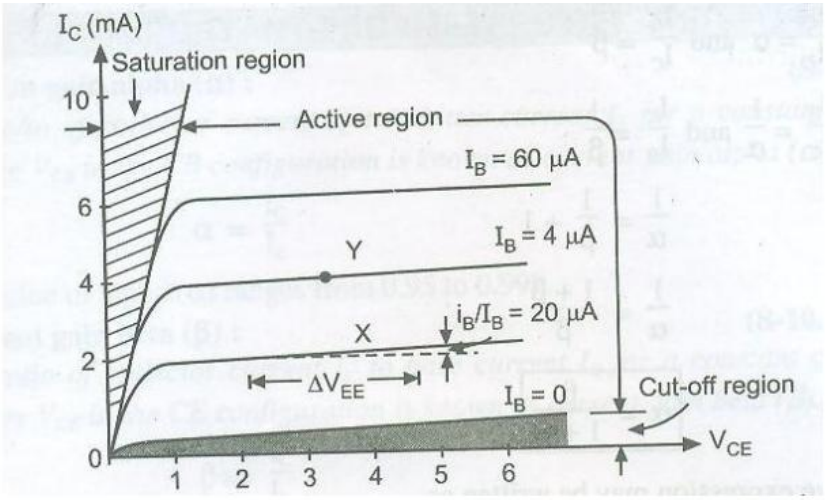
- The breakdown has a very sharp knee, followed by an almost vertical increase in reverse current.

- The voltage across the zener diode is approximately constant and equal to Zener voltage VZ over most of the zener breakdown region.

- It will come out of the breakdown region, when the applied reverse voltage is reduced below the Zener breakdown voltage

c) Draw output characteristics of CE configuration of BJT and show all three region.

Ans: [Correct characteristics with three regions - 4M]

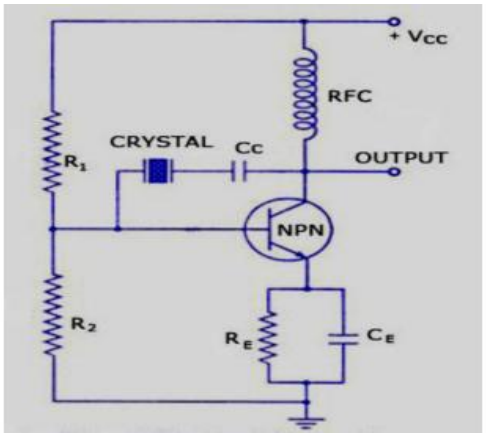



Output characteristics of CE configuration

d) Draw and explain working of crystal oscillator .

Ans.[ Circuit Diagram 2M ,working 2M]

Circuit Diagram :




Working : When the D.C power is switched on, the noise voltage of small amplitude appearing at the base gets amplified and appears at the output. This amplified noise now drives the feedback network consisting of a quartz crystal and a capacitor C. Thus the crystal is excited by a fraction of energy feedback from the output to the input. The crystal is made to operate as an inductor L so that the feedback network consists of series resonant LC circuit.

- This is possible only, if the frequency of oscillations fo is in between the series resonant frequency fs and the parallel resonant frequency fp of an electrical equivalent circuit of a crystal, Thus, the frequency of oscillations is

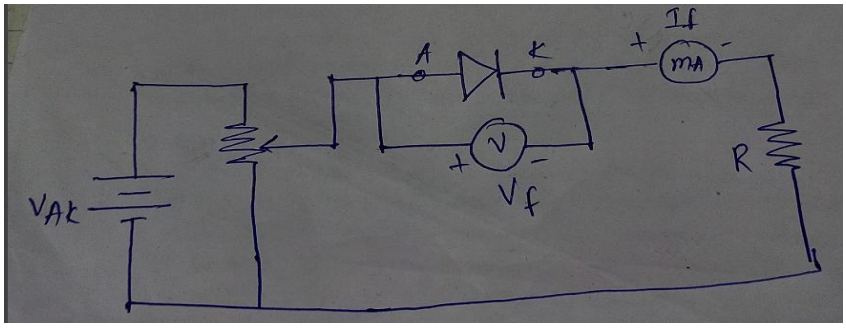
set by the series resonant frequency fs of the crystal. This produces the undamped oscillations of stable frequency fo.

e) Draw a setup for operation of p-n junction diode in forward and reverse bias mode . Describe its operation with the characteristics.

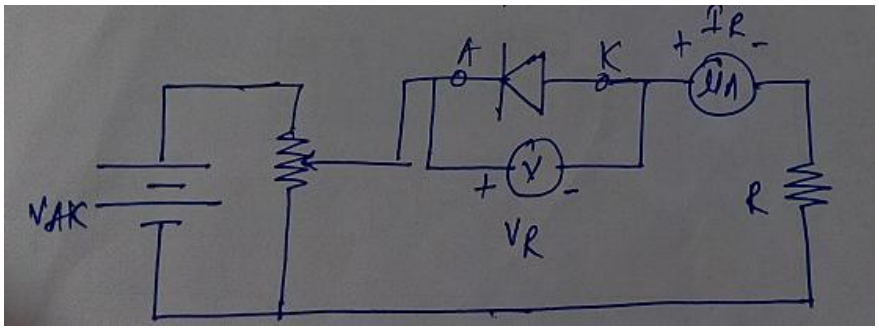
Ans: [Setup diagram – 1M each , characteristics 1M , operation 1M]

Note : Any relevant diagram can be consider.
Setup for operation of p-n junction diode in forward and reverse bias mode .

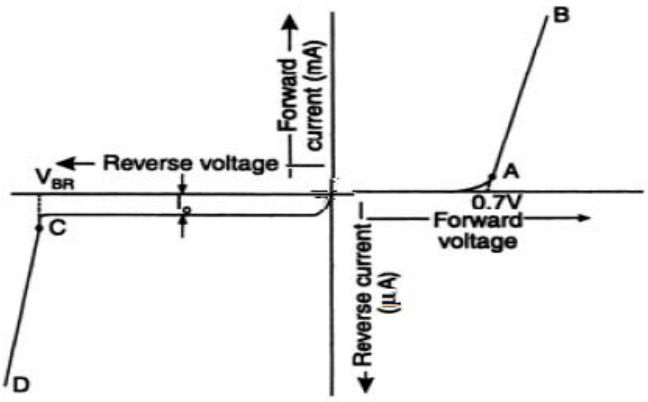
- In forward bias mode




- In reverse bias mode




- VI Characteristics of PN junction diode




Forward Characteristics:

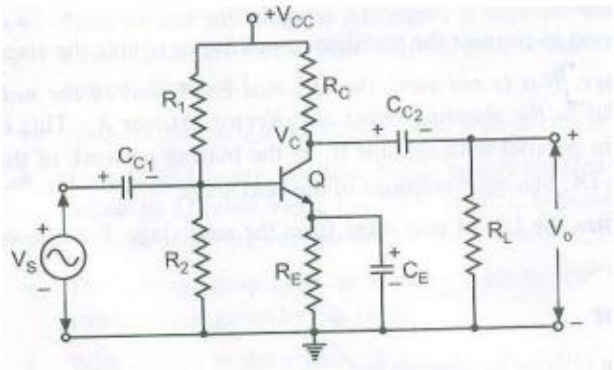
There is no diode current till the point A is reached. It is because of the fact, that the external applied voltage is being opposed by the barrier potential, which is 0.7 V for silicon and 0.3 V for germanium. However, as the applied voltage is increased above this A, the diode current increases rapidly.

Reverse Characteristics:
When the applied reverse voltage is below the breakdown voltage , the diode current is small and remains constant. This value of current is called reverse saturation current When the reverse voltage is increased to a sufficiently large value, the diode reverse current increases as rapidly The applied reverse voltage, at which this happens, is known as break down voltage of a diode.

f) Draw a single stage common emitter amplifier . Draw its DC equivalent circuit and state the function of each component .

Ans: [Circuit diagram 1 1/2 M , Dc equivalent 1M , Function of components 1 1/2M]

Circuit Diagram:




Function of components:

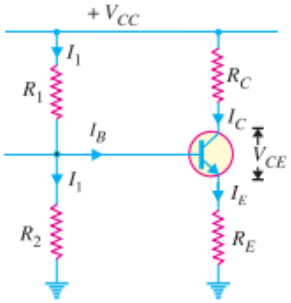
- $R_1$, $R_2$ and $R_E$ : The potential divider biasing is provided by resistors R1, R2 . It $R_1$, $R_2$ and $R_E$ provides good stabilization of the operating point against temperature and transistor parameter variations .

- $C_{C1}$ and $C_{C2}$ : The capacitors $C_{C1}$ and $C_{C2}$ are called the coupling capacitors used to block the AC voltage signals . $C_{C1}$ connects AC input from source to the transistor base while $C_{C2}$ connect

- $C_E$ : The capacitor $C_E$ works as a bypass capacitor. It bypasses all the AC currents from the emitter to the ground and avoids the negative current feedback. It increases the output AC voltage.

- $R_L$ : The resistance $R_L$ represents the resistance of whatever is connected at the output. It may be load resistance or input resistance of the next stage.

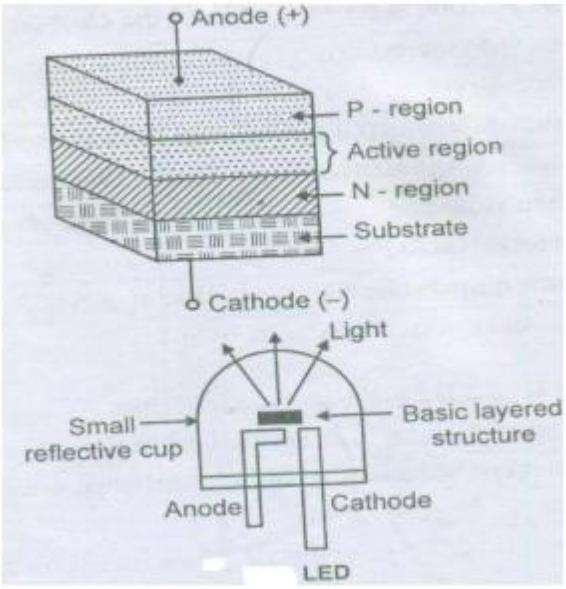
DC equivalent circuit of Single stage CE amplifier :



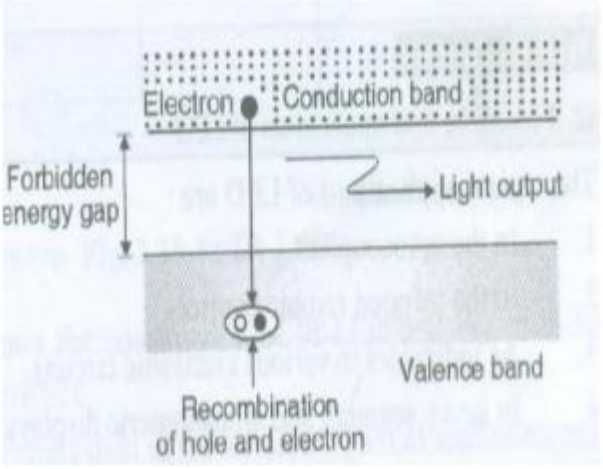

3. Attempt any four of the following 16

a) Describe construction and working of LED.

Ans: ( Construction fig. – 1 mark, working fig. – 1 mark, Explanation – 2 marks)




Construction Diagram




Working Diagram

Working

When the junction is forward – biased the electron in the n-region combines with the holes.

- These free electrons reside in the conduction band and at the higher energy level from the holes in the valence band. When the recombination takes place, these electrons return back to the valence band which is at a lower energy level than the conduction band.
- While returning back, the recombining electrons give away the excess energy in the form of light.

b) Define inductance. State the unit of inductor and give specifications of inductor.

Ans:( Definition- 1 mks, unit- 1 mks, specifications ( any four)- 2 mks)

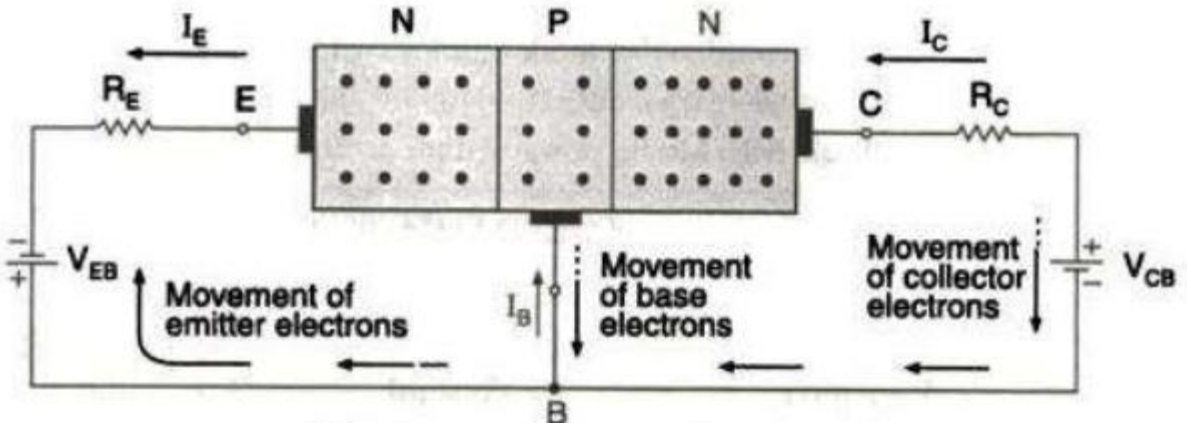
**Inductance**: In electronics inductance is the property of a coil by which a change in current through it induces an electromotive force in the conductor, the unit of inductance is Henry .

Specifications of inductor:

1) Inductance value
2) Q factor
3) Operating frequency range
4) Power dissipation
5) Core
6) Size and mounting requirements
7) Stary capacitance

c) Draw and explain construction of NPN transistor.

Ans: ( Diagram – 2 marks, construction explanation – 2 marks)




Working principle- Above fig shows NPN transistor with forward biased emitter-base junction and reverse biased collector-base junction. The forward bias causes the electrons in the N-type emitter to flow towards the base. This constitutes the emitter current IE.As these electrons flow through the P-type they tend to combined with holes. As the base is likely doped and very thin therefore only a few electrons (2%) combine with holes to constitute base current IB. The remaining electrons (98%) cross over in to the collector region to constitute collector current IC. In this way almost the entire emitter current flows in the collector circuit. It is clear that emitter current is sum of collector and base current.

**IE = IB + IC**

d) Compare CB, CE and CC configurations of BJT.

Ans: (any four points – 4 marks)

| Sr. No | Parameter | CB | CE | CC |
|---|---|---|---|---|
| 1 | Input impedance | Low **(OR)** 50Ω | Medium **(OR)** 600Ω to 4KΩ | High **(OR)** 1MΩ |
| 2 | Current gain | less than or equal to 1 **(OR)** $\alpha = \frac{I_C}{I_E}$ | High **(OR)** $\beta = \frac{I_C}{I_B}$ | Very high **(OR)** $\gamma = \frac{I_E}{I_B}$ |
| 3 | Output impedance | High **(OR)** 50KΩ | Medium **(OR)** 10KΩ to 50KΩ | Low **(OR)** 50Ω |
| 4 | Voltage gain | High **(OR)** $\frac{V_{CB}}{V_{EB}}$ | High **(OR)** $\frac{V_{CE}}{V_{BE}}$ | Less than or equal to 1 **(OR)** $\frac{V_{EC}}{V_{BC}}$ |

e) Derive the relation between α and β.

Ans:- ( Proper relevant derivation- 4

**α :**

- The ratio of collector current $I_C$ to emitter current $I_E$ for a constant collector to base voltage $V_{CB}$ in the CB configuration is called current gain alpha (α).

**β :**

- The ratio of collector current $I_C$ to base current $I_B$ for a constant collector to emitter voltage $V_{CE}$ in the CE configuration is called current gain beta (β) .

Relationship :

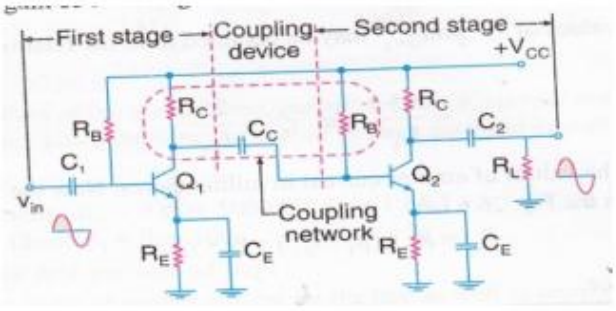
- We know, $I_E = I_B + I_C$
- Dividing the above equation on both sides by $I_C$,
  $I_E/I_C = I_B/I_C + 1$
- Since $I_C/I_E = \alpha$ and $I_B/I_C = \beta$
  So, $I_E/I_C = 1/\alpha$ and $I_C/I_B = 1/\beta$

  Therefore, $1/\alpha = 1/\beta + 1$
  Or $1/\alpha = 1+\beta/\beta$
  **Therefore, $\alpha = \beta/(1+\beta)$**
- **The above expression may be written as**
  $\alpha(1+\beta) = \beta$
  $\alpha + \alpha\beta = \beta$
  $\alpha = \beta - \alpha\beta = \beta(1-\alpha)$
  **Therefore, $\beta = \alpha/(1-\alpha)$**

f) Describe the operation of two stage RC coupled amplifier with the help of neat circuit diagram and frequency response.

Ans: ( circuit diagram – 2 marks, frequency response- 1 mks, description- 1 mks)

**Circuit diagram RC coupled amplifier : -**

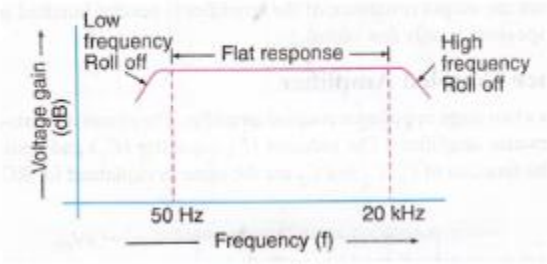


- This is the popular type of coupling method. It is usually employed for voltage amplification following fig shows two stage of an RC coupled amplifier.
- A coupling capacitor $C_c$ is used to connect the output of first stage to the base of the second stage and so on.
- The resistance $R_1$, $R_2$ and $R_E$ form the biasing and stabilization network. The emitter bypass capacitor offers low reactance path to the signal. The coupling capacitor $C_E$ transmits ac signal but blocks dc. This prevents dc interference between various stages and the shifting of Q-operating point.

**Operation: -**

- When ac signal is applied to the base of the first transistor, it appears in the amplified form across its collector load $R_C$ is given to base of next stage through coupling capacitor Cc.
- The second stage does further amplification of the signal. In this way the cascaded (in series) stage will amplify the signal further and overall gain is considerably increased.

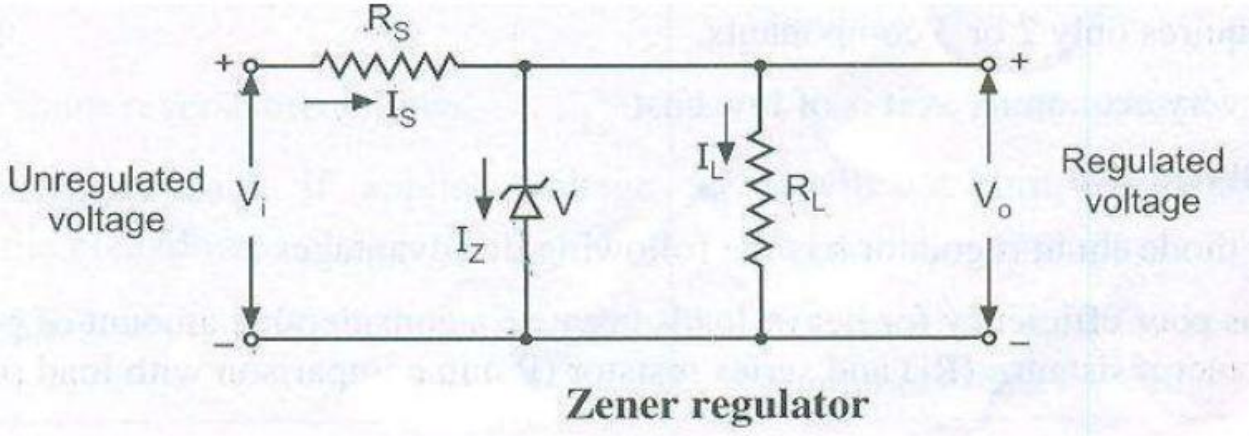
Following fig. shows frequency response of typical RC coupled amplifier.




4. Attempt any four of the following 16

a) Draw and explain Zener diode as a voltage regulator.

Ans: ( circuit diagram – 2 marks, explanation – 2 marks)




**Zener regulator**

**Operating Principle**

For proper operation, the input voltage Vimust be greater than the Zener voltage Vz. This ensures that the Zener diode operates in the reverse breakdown condition. The unregulated input voltage Vi is applied to the Zener diode.
Suppose this input voltage exceeds the Zener voltage. This voltage operates the Zener diode in reverse breakdown region and maintains a constant voltage, i.e. Vz = Vo across the load inspite of input AC voltage fluctuations or load current variations. The input current is given by,

IS = Vi– Vz/ Rs= Vi – Vo / Rs
We know that the input current IS is the sum of Zener current Izand load current IL.

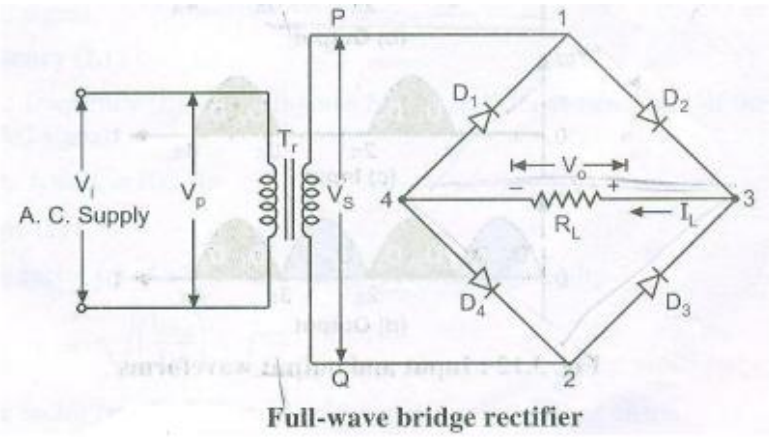
Therefore, IS = Iz+ IL
orIz= Is - IL
As the load current increase, the Zener current decreases so that the input current remains constant.
According to Kirchhoff's voltage law, the output voltage is given by,

Vo = Vi – Is .Rs

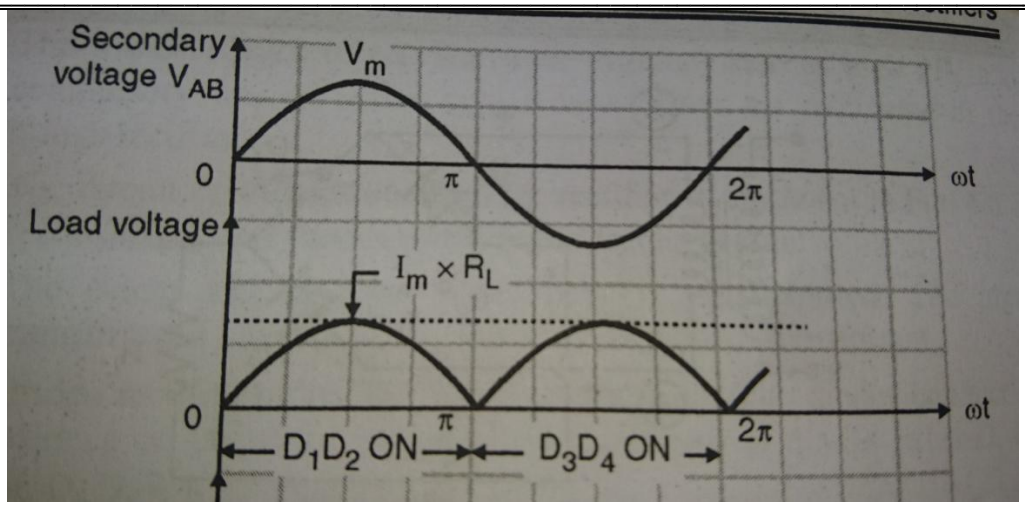
As the input current is constant, the output voltage remains constant (i.e. unaltered or unchanged). The reverse would be true, if the load current decreases. This circuit is also correct for the changes in input voltage.
As the input voltage increases, more Zener current will flow through the Zener diode. This increases the input voltage Is, and also the voltage drop across the resistor Rs, but the
load voltage Vo would remain constant. The reverse would be true, if the decrease in input voltage is not below Zener voltage.
Thus, a Zener diode acts as a voltage regulator and the fixed voltage is maintained across the load resistor RL.

b) Describe the operation of bridge rectifier with the help of neat circuit diagram and waveforms.

Ans: ( circuit diagram- 2 mks, waveform- 1 mks, description- 1 mks)



Full-wave bridge rectifier




**1. Operation in the positive half cycle ($0 \leq \omega t \leq \pi$) :**

- In the positive half cycle of the ac supply the secondary voltage $V_{AB}$ is positive. Therefore diodes $D_1$ and $D_2$ are forward biased whereas $D_3$ and $D_4$ are reverse biased.
- The equivalent circuit for this interval is as shown in Fig. 4.6.2(a). Note that the reverse biased diodes $D_2$ and $D_4$ act as open switches.
- The load current and load voltage both are positive as shown in the waveforms in Fig. 4.6.3.

**2. Operation in the negative half cycle ($\pi \leq \omega t \leq 2\pi$) :**

- In the negative half cycle of the ac supply the secondary voltage $V_{AB}$ becomes negative. Diodes $D_3$ and $D_4$ are forward biased and start conducting.
- $D_1$ and $D_2$ are reverse biased hence do not conduct. The equivalent circuit for this interval is as shown in Fig. 4.6.2(b).
- The waveforms of the bridge circuit are as shown in Fig. 4.6.3.

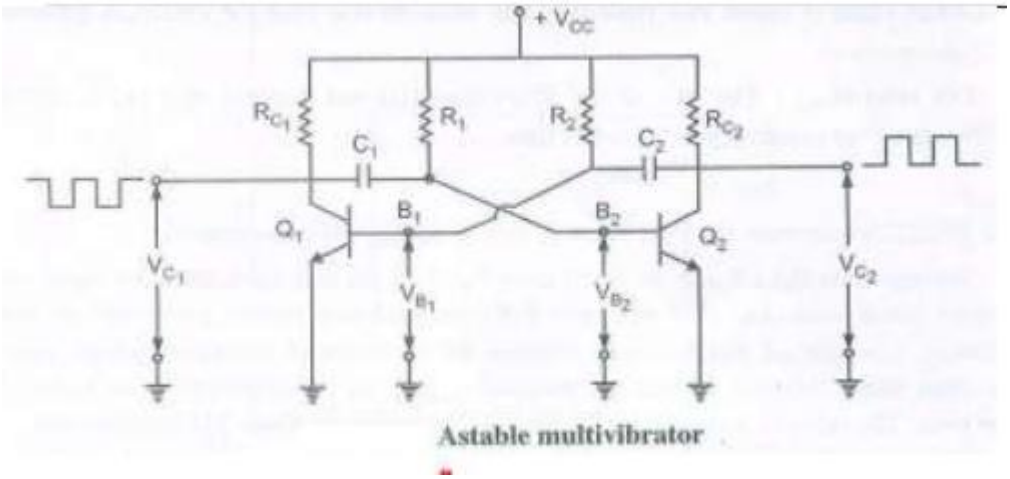
c) Compare JFET and BJT.

Ans: (1 mark for each point. Consider any four points)

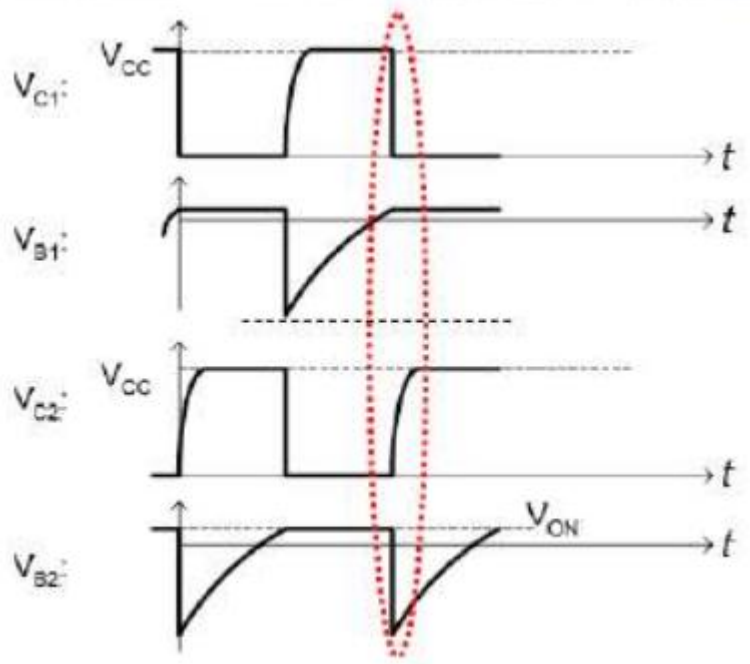
| SR. NO. | FET | BJT |
|---|---|---|
| 1 | It is unipolar device i.e. current in the device is carried either by electrons or holes | It is bipolar device i.e. current in the device is carried either by both electrons & holes |
| 2 | It is a voltage controlled device i.e. voltage at the gate (or drain) terminal controls amount of current flowing through the device. | It is a current controlled device i.e. the base current controls the amount of collector current. |
| 3 | Its input resistance is very high & is of order of several megaohms. | Its input resistance is very low compared to FET. |
| 4 | It has a negative temperature co-efficient at high current levels. It means that current decreases as temperature increases. | It has a positive temperature co-efficient at high current levels. It means that current increases as temperature increases. |
| 5 | It is less noisy. | It is comparatively more noisy. |
| 6 | It has relatively lower gain bandwidth product as compared to BJT. | It has relatively higher gain bandwidth product as compared to FET. |
| 7 | It is simpler to fabricate as IC & occupies less space on chip compared to BJT. | It is comparatively difficult to fabricate on IC & occupies more space on chip compared to FET. |
| 8 | It is relatively immune to radiation. | It is susceptible to radiation |
| 9 | It does not suffer from minority- carrier storage effects & therefore has higher switching speeds & cut-off frequencies. | It suffers from minority- carrier storage effects & therefore has lower switching speeds & cut-off frequencies. |

d) Draw and explain astable multivibrator using transistor.

Ans:- ( Diagram-1 ½ mks, waveforms- 1 ½ mks , explanation- 1 mks)



Astable multivibrator




The astable circuit has no stable state. With no external signal applied, the transistors alternately switch from cutoff to saturation at a frequency determined by the RC time constants of the coupling circuits. Astable multivibrator circuit consist of two cross coupled RC amplifiers. 3 Consists of two amplifying devices cross-coupled by resistors and capacitors. Typically, R2 = R3, R1 = R4, C1 = C2 and R2 >> R1. The circuit has two states

State 1: VC1 LOW, VC2 HIGH, Q1 ON (saturation) and Q2 OFF.

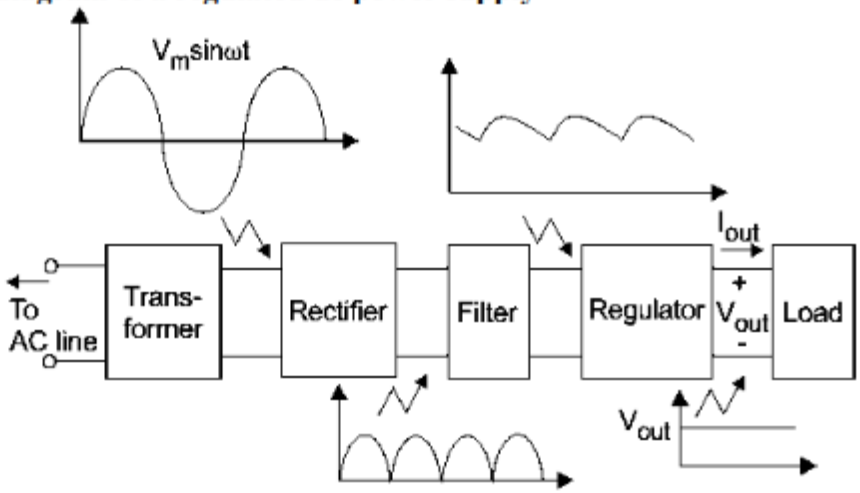
State 2: VC1 HIGH, VC2 LOW, Q1 OFF and Q2 ON (saturation).

It continuously oscillates from one state to the other. Astable Multivibrators When the circuit is first powered up, neither transistor is ON. Both VB1 and VB2 rise via base resistor R 3 and R 2 respectively.. Since Q1 conducts and Q2 off hence Vc1 = 0V and Vc2 = VCC. - state1.4Since Q1 conducts and Q2 off hence Vc1 = 0V and Vc2 = VCC. Due to higher voltage at Vc2, capacitor C 2 will be charged via R 4 (low resistance path because R 4 R1). Time taken to discharge C1(T1 = R 2 C1) > time taken to charge C 2 (T 2 =R 4 C 2 ) When C 2 is fully charged then left plate of C 2 will be at –Vcc which switch off the Q1. When C1 is fully discharged then left plate of C1 will be at +Vcc which switch on the Q2. – State 2 When VB2 reaches Von, the circuit enters in state 1 again, and the process repeats.

e) Draw a block diagram of regulated power supply. State the need of each block.

Ans: -( Block diagram- 2 mks, need of each block- 2 mks)

**Functional block diagram of a regulated dc power supply**




02 M

**Functions of each block:** **02M**

**Step Down Transformer**

A step down transformer will step down the voltage from the ac mains to the required voltage level. The output of the transformer is given as an input to the rectifier circuit.

**Rectification**

Rectifier converts an alternating voltage or current into corresponding pulsating dc .Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the ac supply.

**DC Filter**

The rectified voltage from the rectifier is a pulsating dc voltage having very high ripple content. Hence a filter is used. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, π type filter.

**Regulator**

The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur.

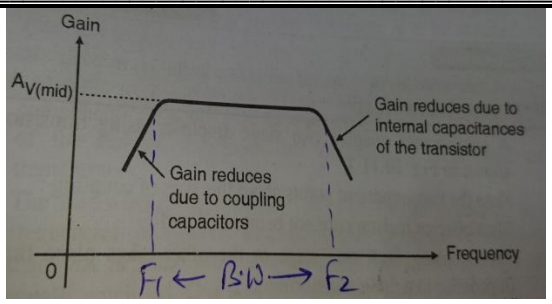
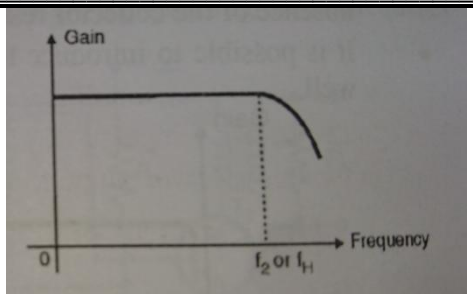
f) State the need of multistage amplifier. Compare RC and direct couple amplifiers with its frequency response and applications.

Ans: ( Need of multistage amplifier – 2 marks, any two comparision – 2 marks)

**Need for multistage amplifiers :**

- Gain should be sufficiently high.
- Input impedance should match with the source impedance.
- Output impedance should match with the load resistance.
- Bandwidth should be large.

| | RC couple amplifier | Direct couple amplifiers |
|---|---|---|
| Frequency | | |

| | | |
|---|---|---|
| response |  |  |
| Application | 1. In public address (P.A.) amplifier system.<br>2. Tape recorders<br>3. TV, VCR and CD player<br>4. Stereo amplifiers | 1. In the operational amlifiers<br>2. In the analog computation<br>3. In the linear power supplies. |

5. Attempt any four of the following 16

a) Define the following for P-N junction diode.

i) Knee voltage

ii) Peak inverse voltage

iii) Reverse saturation current

iv) Maximum forward current

Ans: (Each point – 1 mark)

**Knee Voltage**

- The applied forward voltage at which the PN junctions starts conducting is called the cut-in (Vr) voltage. It is also known as knee voltage (Vk or Vz)
- The value of cut-in voltage is 0.6 V for Silicon and 0.2 V for Germanium PN junction diodes.

**PIV**

- The maximum value of reverse voltage that a diode can withstand without destroying its PN junction during the non-conduction period is called peak inverse voltage.
- The diode should be so chosen as to withstand this reverse voltage.

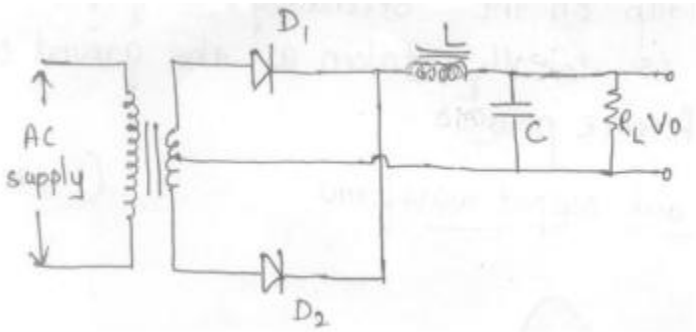
**Reverse saturation current**: In reverse bias condition there will be negligible amount of current that will flow through the device due to minority carrier which is called as reverse saturation current.

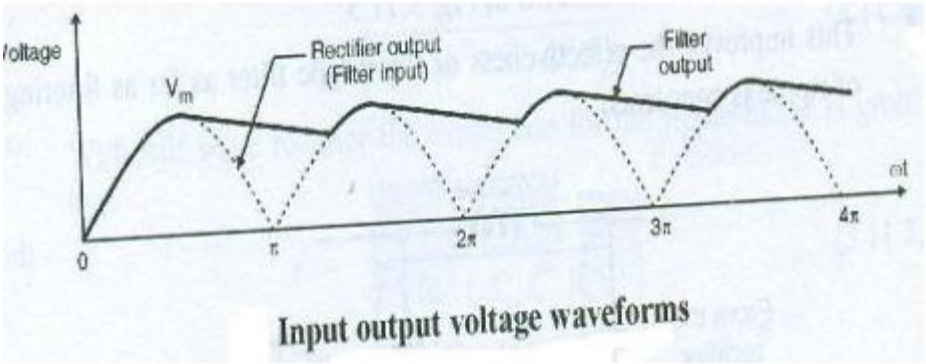
**Maximum forward current ($I_o$) :**

- It is defined as the maximum value of forward current that can be allowed to pass through a forward biased diode without damaging it.
- This rating is also called as peak surge current rating and it is specified only for 1 cycle of input ac waveform.
- It is nonrepetitive current rating.

b) Draw a circuit diagram Centre tap full wave rectifier with LC filter and explain the operation with waveforms.

Ans: ( Diagram- 2 mks, waveforms- 1 mks, operation- 1 ks)



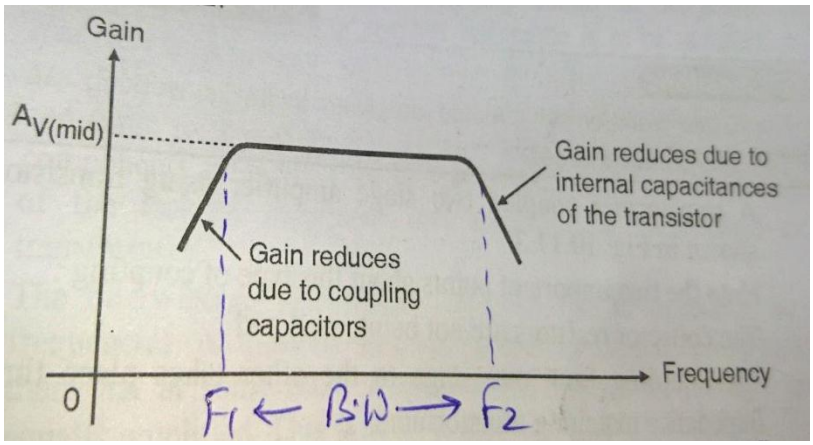

Input output voltage waveforms

Working:-

- The combination of series inductor (L) filter on shunt capacitor (C) filter is known as LC filter.
- This filter is also known as the rectifier is applied across the input terminals of the choke input filter.
- The pulsating output of the rectifier contains AC as well as DC component of current. The choke L passes the DC component from the rectifier because its DC resistance R is very small.
- It opposes the AC component capacitor C bypasses AC component that presents at the output of inductor L but prevents DC component to flow through it.
- Therefore only DC component reaches to the load resistor $R_L$.

c) Draw a frequency response of single stage common emitter amplifier. Explain the effect of coupling capacitor and junction capacitor.

Ans: - ( Frequency response- 2 mks, effect of capacitor- 2 mks)




<u>Effect of coupling capacitor and junction capacitor</u>:

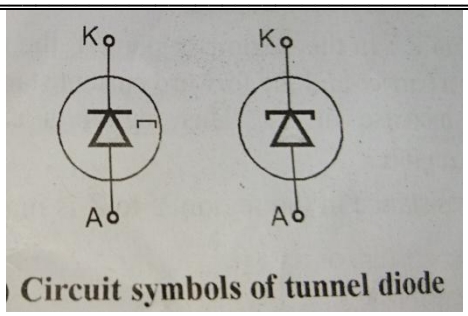
Due to coupling capacitor and junction capacitor voltage gain reduces.

1) Amplifier gain reduces due to coupling capacitor C1, C2 at low frequencies. Because coupling capacitors will offer high reactance and hence they will act as a open circuited.

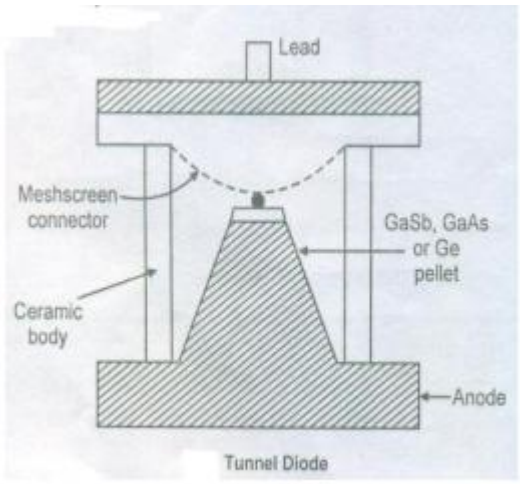
2) At high frequency voltage gain reduces due to internal junction capacitance of transistor. Because these capacitor offers very low reactance at high frequencies which will provide shunting effect across transistor junctions and hence votage gain decrease due to shunting effect.

d) Explain Tunnel diode with its symbol, construction and working.

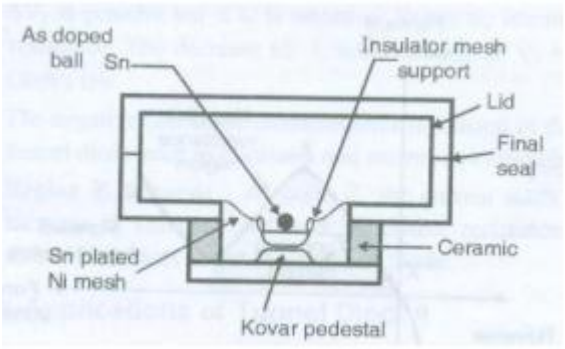
Ans: ( Symbol- 1 mks, construction- 1 ½ mks, working- 1 ½ mks)



Circuit symbols of tunnel diode (any one symbol)




**OR**




Working

The operation of tunnel diode is based on special characteristics known as negative resistance.

The width of the depletion region is inversely proportional to the square root of impurity concentration.

So increase in the impurity concentration, the depletion region width will reduce. The thickness of depletion region of this diode is so small. That indicates there is large probability of an electron can penetrate through this barrier.

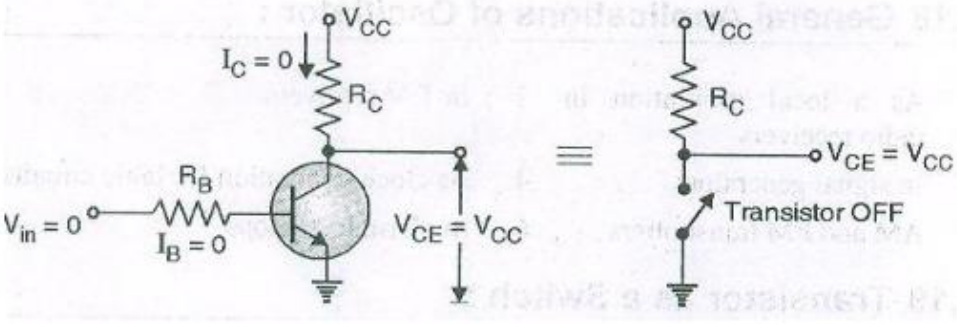
This behavior is called is tunneling & hence the name of the high impurity density PN junction is called as tunnel diode.

e) Draw a circuit diagram of transistor as a switch and explain how transistor acts as a closed switch and open switch.

Ans: ( Each switch mode with neat diagram-2 mks)

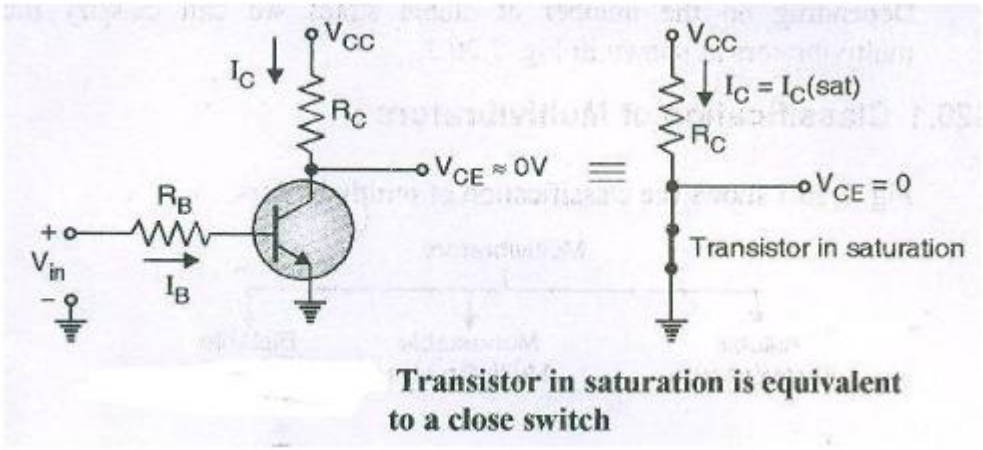
**1. Transistor in cutoff region (open switch)**

- In the cutoff region both the junctions of a transistor are reverse biased and a very small reverse current flows through the transistor.
- The voltage drop across the transistor (VCE) is high. Thus in the cutoff region the transistor is equivalent to an open switch as shown in figure.




**2. Transistor in the saturation region :**

- When Vin is positive, a large base current flows and the transistor saturates.
- In the saturation region both the junctions of a transistor are forward biased. The voltage drop across the transistor (VCE) is very small of the order of 0.2V to 1 V depending on the type of transistor and collector current is very large.
- In saturation the transistor is equivalent to a closed switch as shown in figure.




**Transistor in saturation is equivalent to a close switch**

f) Differentiate between P-N junction diode and Zener diode.

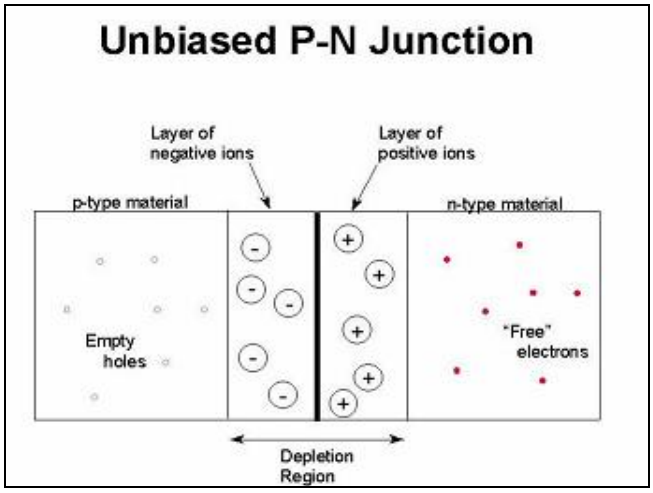
Ans: (Any four points – 4 marks)

| Sr. No. | PN junction Diode | Zener Diode |
|---|---|---|
| 1 | It is not properly doped to control reverse breakdown. | It is properly doped to control reverse breakdown. |
| 2 | It conducts only in one direction. | It conducts in both directions. |
| 3 | It is always operated in forward-bias condition. | It is always operated in reverse-bias condition. |
| 4 | It has no sharp reverse breakdown. | It has quite sharp reverse breakdown. |
| 5 | It burns immediately, if applied voltage exceeds the breakdown voltage. | It will not burn, but functions properly in breakdown region. |
| 6 | It is commonly used for rectification purpose. | It cannot be used for rectification, but commonly used for voltage regulation. |

6. Attempt any four of the following 16

a) Describe the formation of unbiased P-N junction diode with suitable diagram.

Ans: ( Diagram – 2 marks, description – 2 marks)




Description :

1. Joining n-type material with p-type material causes excess electrons in the n-type material to diffuse to the p-type side and excess holes from the p-type material to diffuse to the n-type side.
2. Movement of electrons to the p-type side exposes positive ion cores in the n-type side while movement of holes to the n-type side exposes negative ion cores in the p-type side, resulting in an electron field at the junction and forming the depletion region.
3. A voltage results from the electric field formed at the junction is called barrier potential.

b) Compare half wave, centre tap and bridge type full wave rectifier on the basis of

i) Ripple factor

ii) Rectification efficiency

iii) TUF

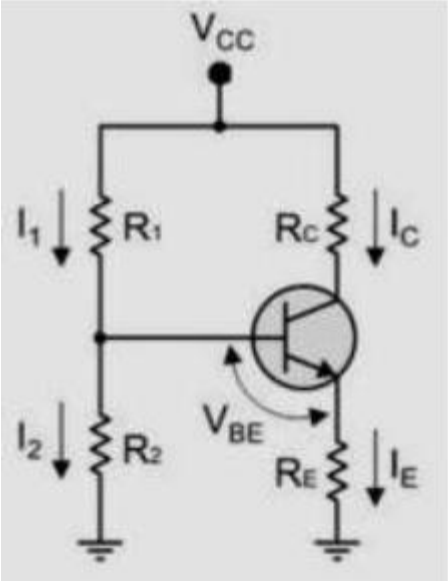
iv) PIV

Ans: (Each point 1 mark)

| | Half wave | Centre tap | Bridge type full wave |
|---|---|---|---|
| Ripple factor | 1.21 | 0.482 | 0.482 |
| Rectification efficiency | 40% | 81.2% | 81.2% |
| TUF | 0.287 | 0.693 | 0.812 |
| PIV | Vm | 2 Vm | Vm |

c) Draw and explain voltage divider bias network.

Ans: ( Diagram – 2 marks, explanation – 2 marks)




Applying kvl and thevenin's theorem in input and output side we get,
VTH = IB RTH + VBE + IE RE
IC = βIB
Ic = VTH / RE
It is evident from the above equations that the increase in collector current (due to rise in temperature or current gain) will cause voltage drop across the emitter resistor RE to increase.
This in turn decreases the voltage VBE which causes the decrease in base current and hence the collector current decreases to restore its original value.
Thus good stabilization of operating point is ensured for D.C bias.

d) An amplifier has signal input voltage of 0.25 V and draws 1 mA from the source. The amplifier delivers 8 V to load at 10 mA. Determine

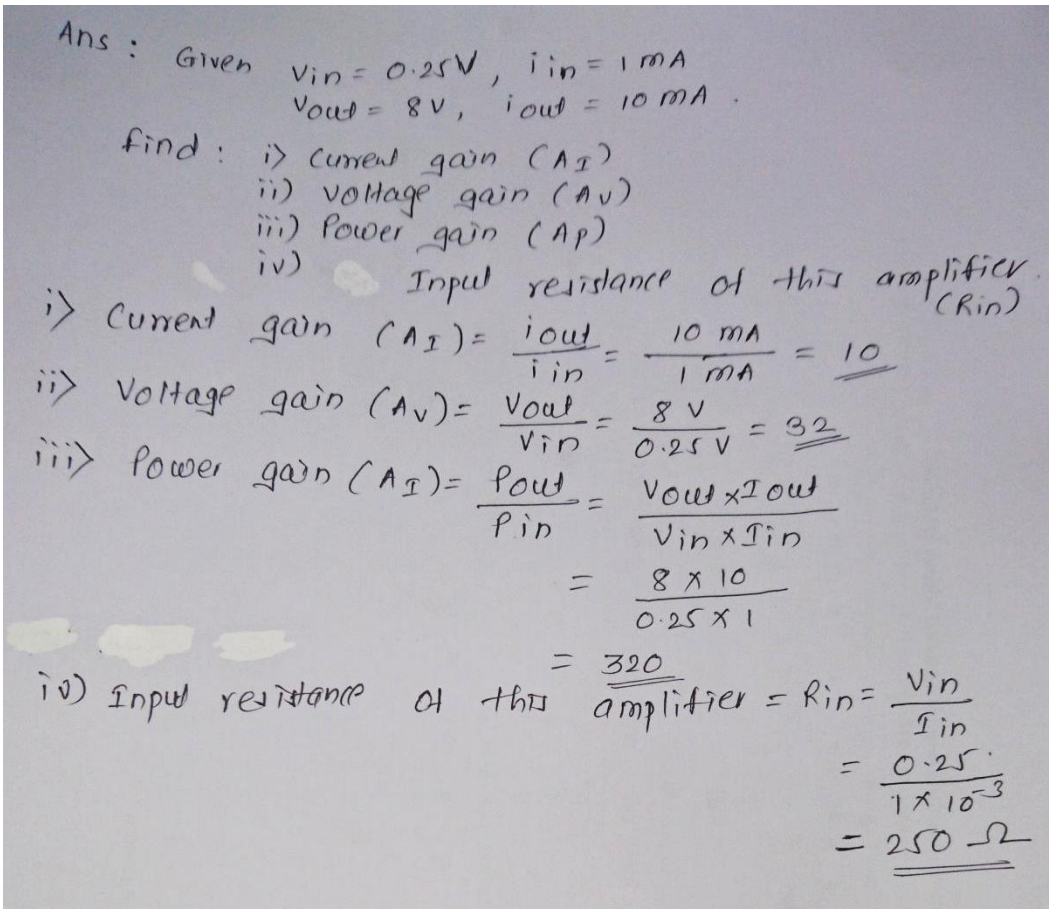
i) Current gain

ii) Voltage gain

iii) Power gain

iv) Input resistance of this amplifier

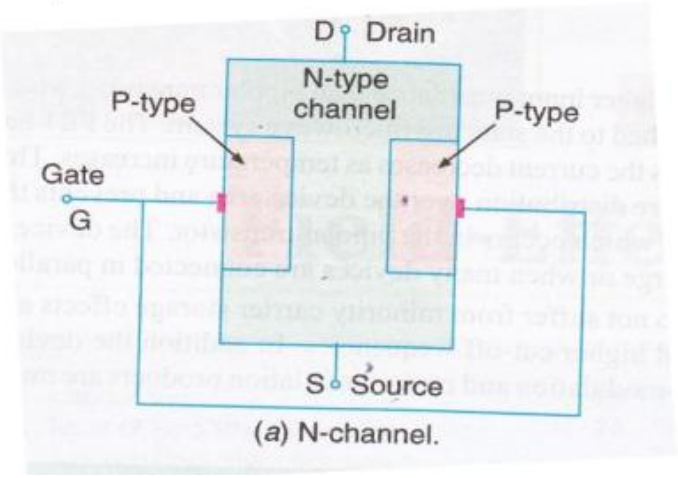
Ans: (each – 1 mks)




e) Draw and explain constructional details of N-channel JFET.

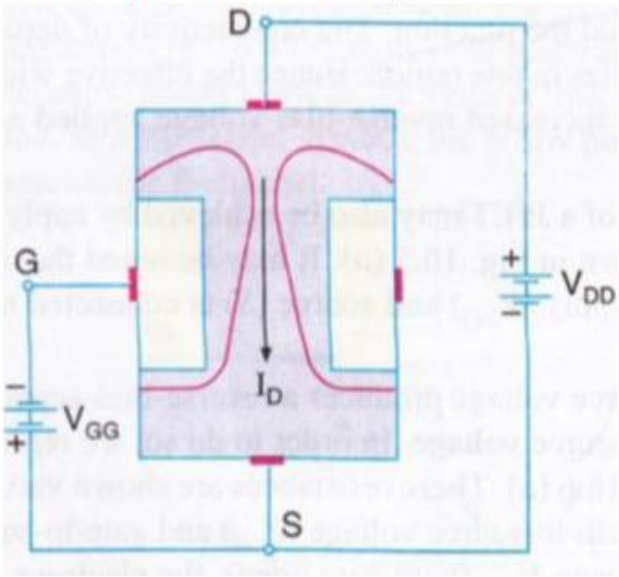
Ans: -

**Construction (1 Mark)**



(a) N-channel.

**Working (Diagram – 1 Mark, Explanation – 2 Marks)**




**1. VGS = 0V**

When a voltage is applied between the drain & source with a D.C supply voltage (VDD) with VGS = 0V, the electrons flows from source to drain through the narrow channel existing between the depletion regions. This constitutes drain current (ID). The value of drain current is maximum when VGS = 0V. This current is designated by the symbol IDSS.

**2. When VGS is negative**

When VGS is increased above zero, the reverse voltage across the gate source junction is increased. As a result depletion regions are widened. This reduces effective width of channel therefore controls the flow of drain current through the channel.

If VGS increased further, two depletion regions touch each other. The drain current reduces to 0.The gate to source at which drain current reduces to 0 is called as pinch off voltage

f) In full wave bridge rectifier Vm = 10 V, RL = 10 KΩ. find out VDC, IDC, ripple factor and PIV.

Ans: (each – 1 mks)

Solution :- Given :- $V_m = 10V$, $R_L = 10K\Omega$,

$V_{DC} = ?$

$I_{DC} = ?$

ripple factor = ?

PIV = ?

$I_m = \frac{V_m}{R_L} = \frac{10V}{10K\Omega}$

$\boxed{I_m = 1mA}$

For bridge rectifier -

$V_{DC} = \frac{2V_m}{\pi} = \frac{2 \times 10}{\pi} = 6.37\ V$

$I_{DC} = \frac{2I_m}{\pi} = \frac{2 \times 1mA}{\pi} = 0.67\ mA$

ripple factor $= \left[\frac{\left(\frac{V_m}{\sqrt{2}}\right)^2 - \left(\frac{2V_m}{\pi}\right)^2}{\left(\frac{2V_m}{\pi}\right)^2}\right]^{1/2} = 0.482.$

$PIV = V_m = 10V.$