



Summer 2015 Examination

Subject Code: 17213

Model Answer

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.

1. Attempt any TEN:

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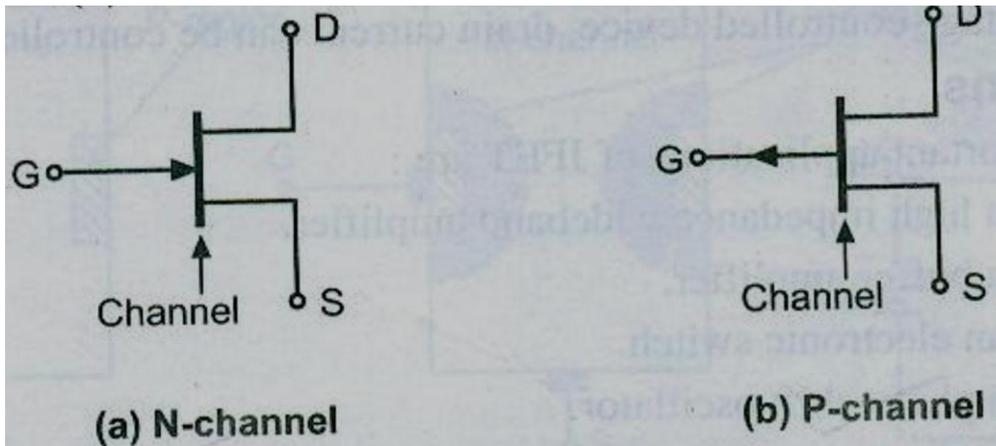
a. Define passive component. Give its examples

Ans a. **Definition: 1 M; Examples: 1M**

Passive components: the Passive components is one which does not introduce any gain
Eg: Resistor, Capacitor, and Inductor.

b. Draw the symbol of n- channel and p- channel JFET.

Ans b. **Each Symbol- 1M**



c. Give the two applications of varactor diode.

Ans c. **Any two applications- 2M**

- Varactor diodes are used in tuning circuits.
- They are used in high frequency amplifiers.

d. List the types of coupling used in amplifiers.

Ans d. **Types of coupling- 2M**

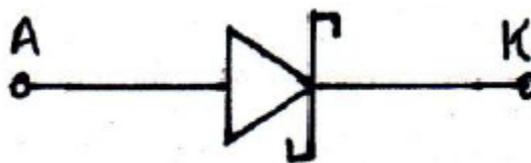
1. Resistance – capacitance (RC) coupling.
2. Inductance (LC) coupling.
3. Transformer coupling (TC)
4. Direct coupling (D.C.)

e. Draw symbol of Zener diode and Schottky diode.

Ans e. **Each symbol- 1M**



Zener Diode



Schottky diode



f. Give two advantages and two disadvantages of IC's

Ans f. Two advantages: 1M; 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.

g. List the types of filter.

Ans g. Types of filter: 2 M

Filters are classified depending on the components used and depending on the configuration in which they are connected.

Some of the important types are as follows:

1. Capacitor input filter (shunt capacitor filter)
2. Choke input filter (series inductor filter)
3. LC filter
4. π type filter OR CLC filter
5. RC filter.

h. Define the following FET parameters:

- Amplification factor.- **1M**
- Transconductance-**1M**

Transconductance

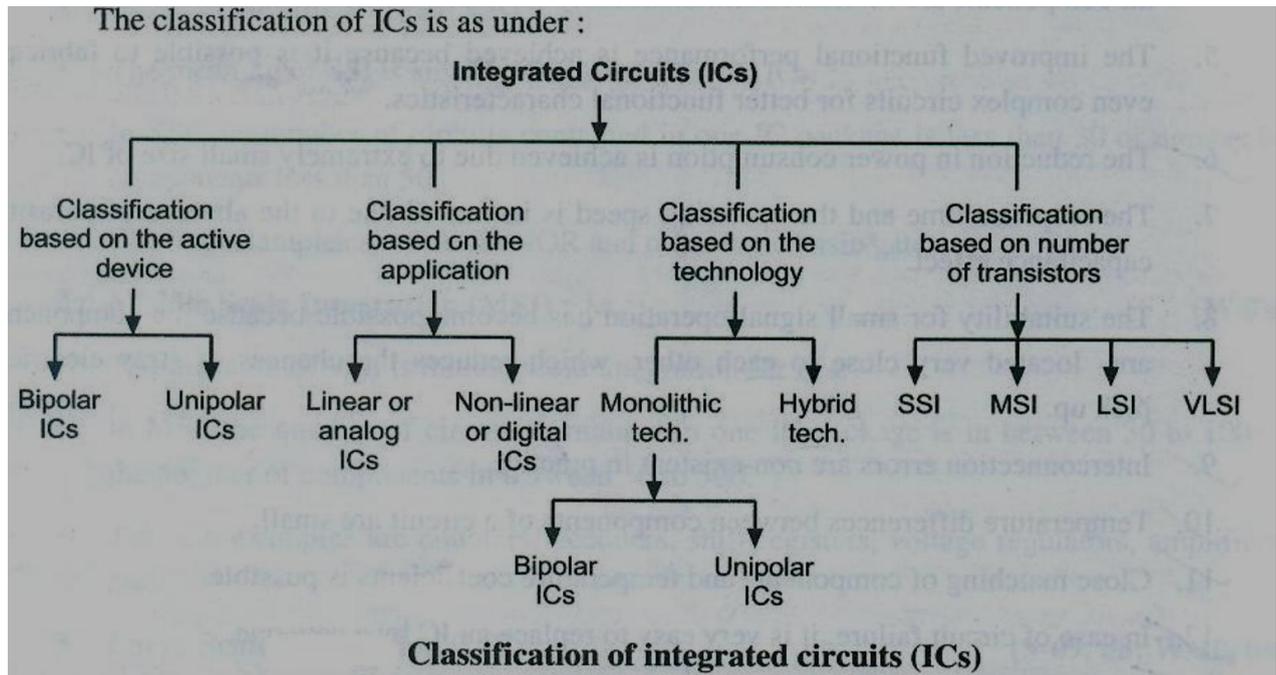
Transconductance is defined as the ratio of change in Drain current (ΔI_D) to change in Gate to Source Voltage (ΔV_{GS}) at a constant V_{DS} .

Amplification Factor

Amplification Factor is defined as the ratio of change in Drain to Source Voltage (ΔV_{DS}) to change in Gate to Source Voltage (ΔV_{GS}) at a constant I_D .

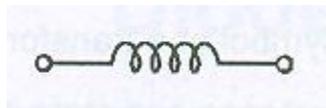
i. Give the classification of IC's.

Ans i. **Classification of IC's- 2M**

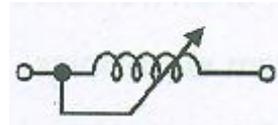


j. Draw the symbol of fixed and variable inductor.

Ans j. **Each symbol: 1M**



Fixed Inductor



Variable Inductor

k. State any four applications of LED.

Ans k. **Any four application-2M**

- Infra-red LEDs are used in burglar alarm systems.
- For solid state video displays which are rapidly replacing CRT.
- An image sensing circuit for picture phones.
- In array of different types for displaying alpha-numeric characters.
- Displays.

l. What are non- linear resistors? State its types.

Ans l. **Definition: 1M; Types: 1M**

If the voltage across and current through a resistor possess a non-linear relationship, then that resistor is known as nonlinear resistor.

Types of nonlinear resistors:

Different types of nonlinear resistors are:

1. Thermistor
2. LDR
3. VDR

2. Attempt any FOUR:

16

a. State any four applications of electronics

Ans a. **Any four applications: 4M**

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.

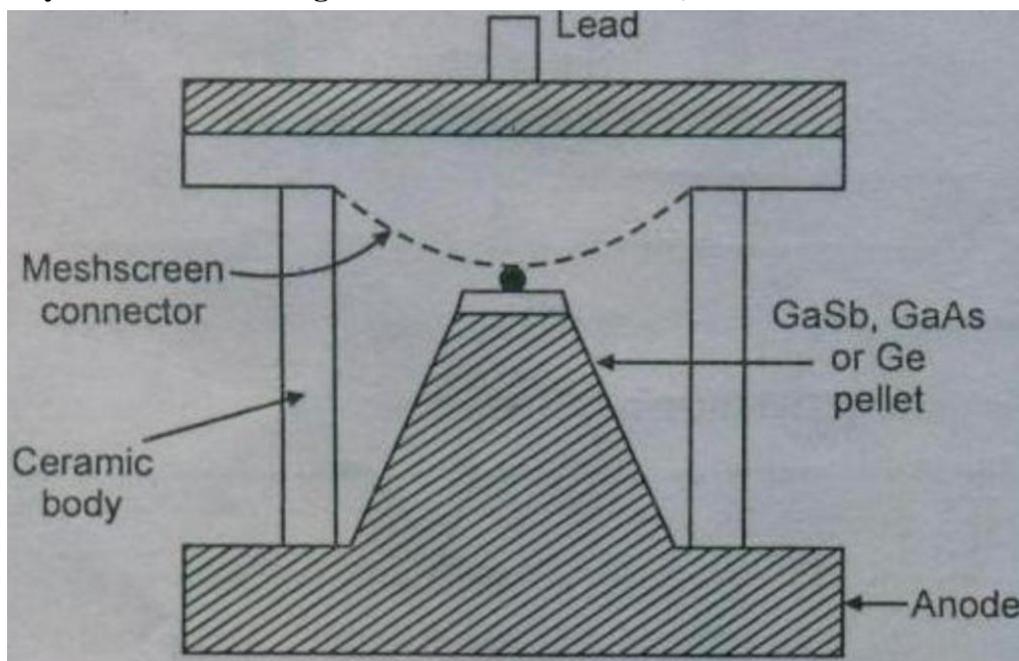
4. Medical sciences: Electronics helps doctors and scientists in the diagnosis and treatment of various diseases. E.g. X-rays, ECG, Oscillographs and Short-wave diathermy units.

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. Explain the operating principle of tunnel diode.

Ans b. **Operating Principle: 2M, diagram – 2 marks**

(Note: any other relevant diagram should be considered)



Operating Principle:

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.

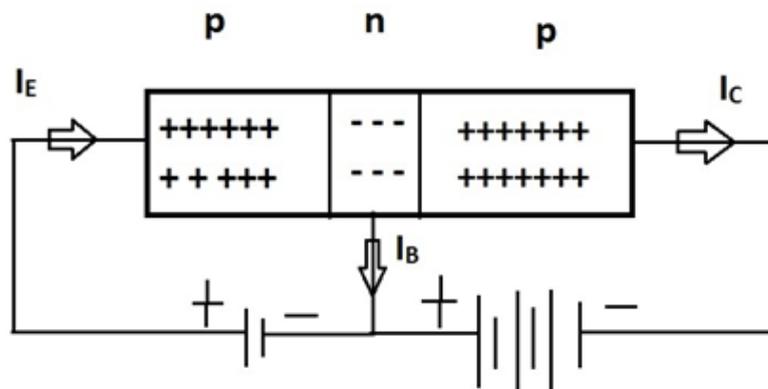
So increase in the impurity concentration, the depletion region width will reduce. The thickness of depletion region of this diode is so small. That indicates there is large probability of an electron can penetrate through this barrier.

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

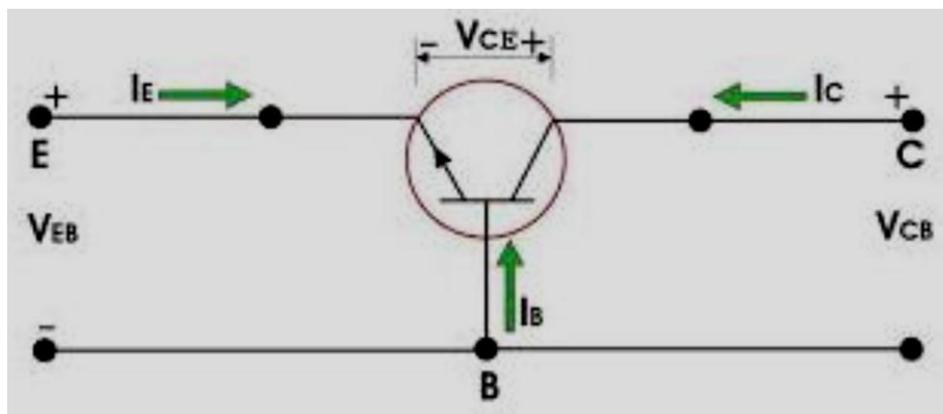
An ordinary PN junction diode has an impurity concentration of about 1 part in 10^8 and its depletion region width is of the order 5 microns. If the concentration of impurity is increased to about 1 part in 10^3 , the device characteristics are completely changed. Due to the thin potential energy barrier, the electrons penetrate through the junction rather than surmounting them. This quantum mechanical behavior is referred to as tunneling and these high impurity density PN junction devices are called tunnel diodes.

c. Draw the neat diagram of PNP transistor and describe it's working.

Ans c. **Diagram: 2M; Working: 2M**



OR



Working

- 1) Base emitter junction is forward biased and base collector is reverse biased.
- 2) The emitter is common and base is the input terminal, collector is the output terminal.
- 3) $I_E = I_B + I_C$ basic equation of transistor.
- 4) The holes from emitter are repelled and they move towards the base. Base is lightly doped and they get attracted by collector which is reverse biased.
- 5) The current gain for CE mode is $\beta = I_C / I_B$.



d. Distinguish between PN junction diode and zener diode.

Ans d. **any Four Points: 4 M**

| 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. |

e. Define oscillator. State its need and condition required for sustained oscillations.

Ans e. **Define: 2M; Need: 1M; Condition: 1M**

(Note: Any relevant correct definition should be considered)

The electronic oscillator is a voltage amplifier with a LC tank circuit as a collector load having a positive feedback and generating the undamped oscillations across the load.

(OR)

An oscillator is a electronic circuit that produces a periodic waveform on its output with only dc supply voltage as an input.

Need of Oscillators:

The AC generating machine i.e. alternator can generate frequencies up to 1 kHz.

It is not possible to generate very high frequencies with the alternator due to its limitations.

Therefore, electronic oscillators are necessary.

Barkhausen Criterion for Oscillations

1. Loop gain ($\beta.A_v$) ≥ 1

2. Phase shift between the input and output signal must be equal to 360° or 0° .

f. Draw the neat diagram of two stage transformer coupled amplifier. Give its two advantages.

Ans f. **Diagram: 2M; Two advantages: 2M**

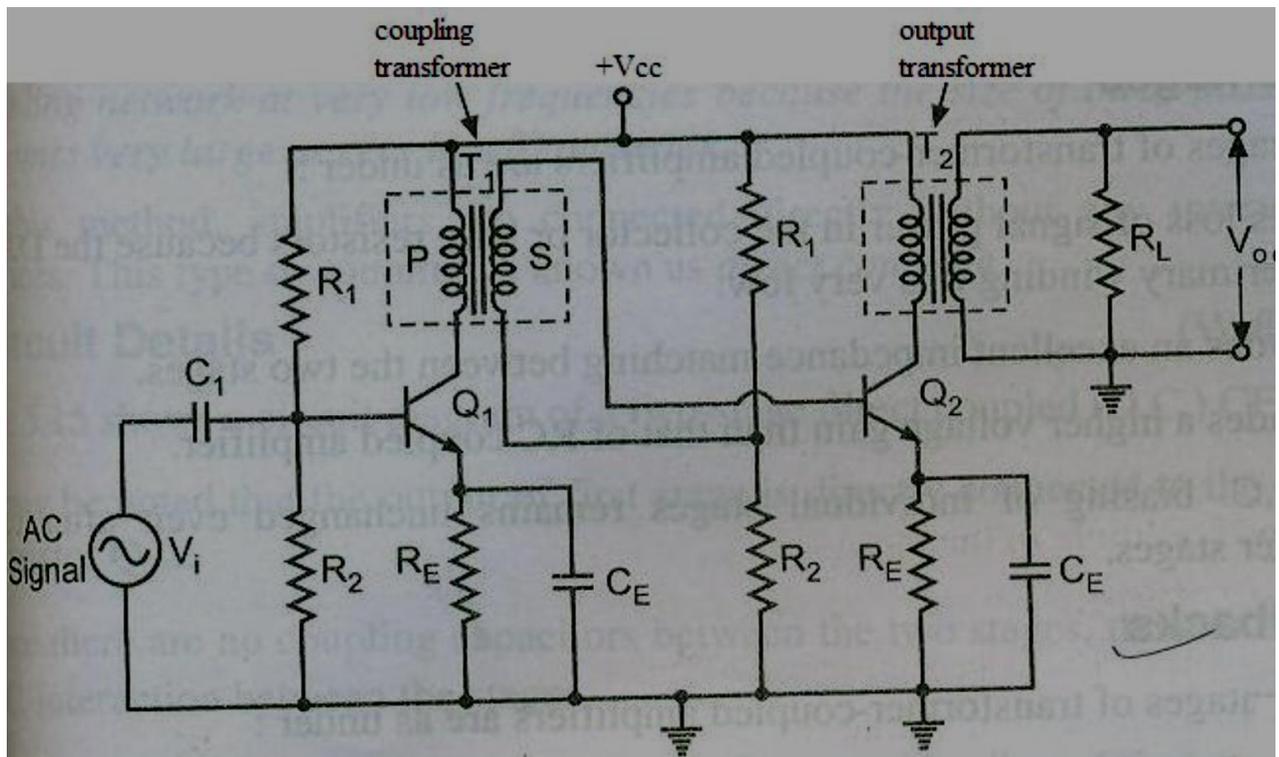


Fig: Frequency Response of Transformer Coupled Amplifier

Advantages:

- Transformer coupling is mostly employed for impedance matching
- It is used as final stage. It is used to transfer power to the low impedance load such as loudspeaker.
- For amplification of radio frequency (RF) signal.
- In power amplifiers.

3. Attempt any FOUR:

16

a. Draw the characteristics of LDR. Explain how variation of resistance takes place with intensity of light.

Ans a. **Diagram: 2 M; Explanation: 2M**

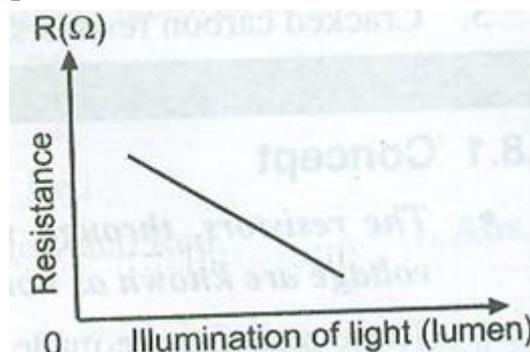


Fig: Characteristics

- Depending on thickness, surface area and length of the layer, the resistance value changes. The electrodes are formed by evaporating metal in vacuum.
- As the intensity of light increases, resistance of LDR decreases.
i.e. Resistance of LDR \propto 1/ Intensity of light.

b. Explain the mechanism of avalanche break down in P- N junction diode.

Ans b. **Explanation: 4M**

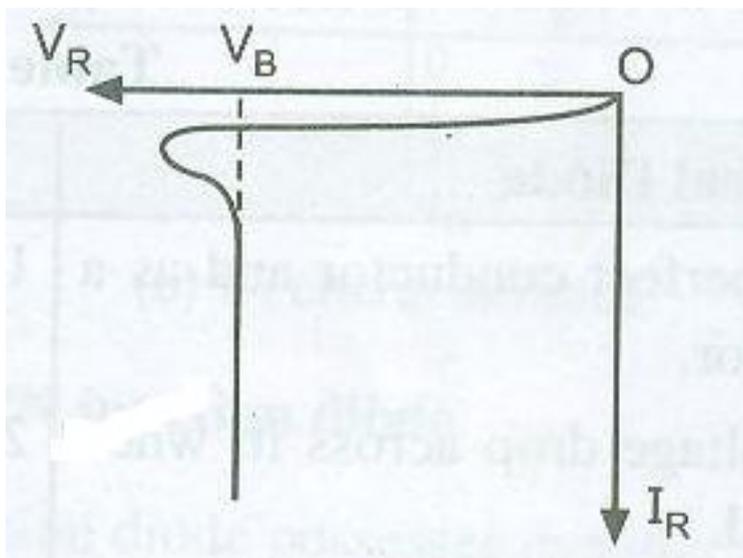
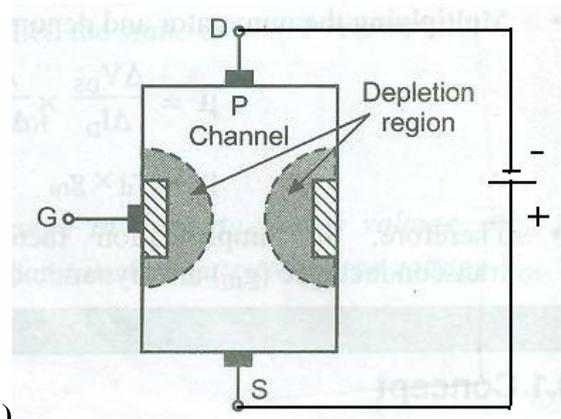
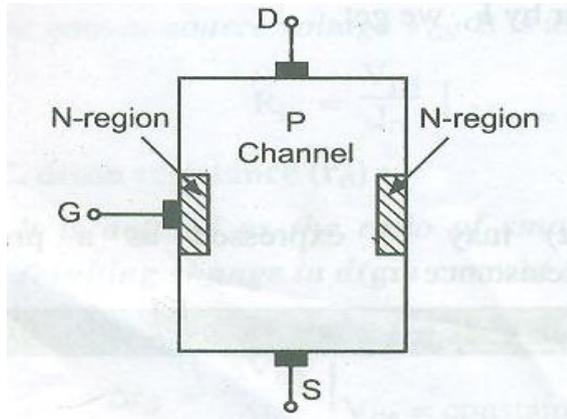


Fig: Avalanche Breakdown

- Under reverse bias condition, the minority carrier flowing through the P- N junction acquires a kinetic energy depending upon the velocity with which they move.
- The increase in reverse voltage increases the amount of kinetic energy imparted to minority carrier, as they diffuse across the PN junction.
- When sufficient voltage is applied, the minority carrier acquires a large amount of kinetic energy (or momentum).
- When these minority carriers collide with semiconductor (Germanium or silicon) atoms within the crystal structure of a PN junction they impart sufficient energy to break covalent bond and generate additional carrier (i.e. electron- hole pairs).
- They knock out the electrons from the covalent bonds of a PN junction.
- These additional carriers pick up the energy from the applied voltage and generate still more carriers. As a result of this, the reverse current through the PN junction increase.
- The cumulative process of carrier generation (i.e. multiplication) is known as avalanche breakdown.
- Under breakdown condition, the reverse current is no longer limited by the PN junction. But it can be limited only by the circuit components.
- The value of breakdown voltage depends upon the degree of doping in PN junction.

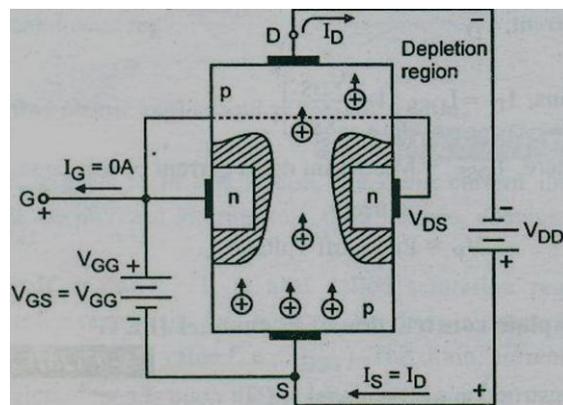
c. Draw the construction of p- channel FET and describe it's working.

Ans c. **Construction: 2M; Working: 2M**



(OR)

Working:



P- Channel JFET

1. In absence of voltage V_{DS} :

- When there is no applied voltage between the drain (D) and source (S), the depletion layer is symmetrical around the P-N junction.
- The conductivity depletion layer is zero because there are no mobile charge carriers in this region.

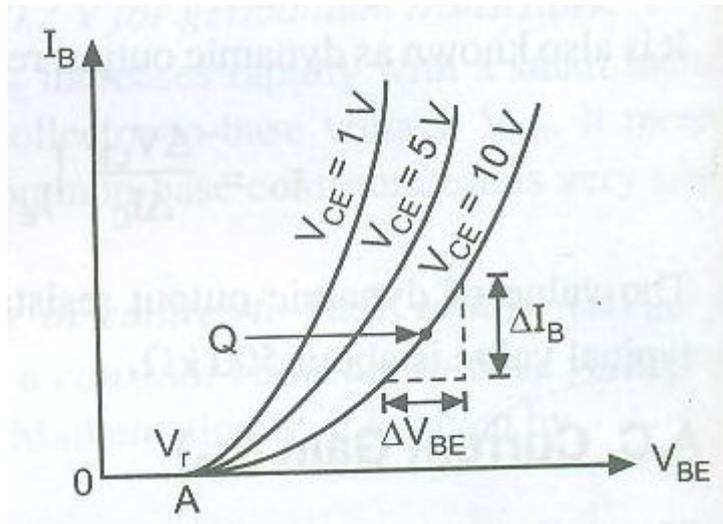
2. In presence of voltage V_{DS} :

- When the voltage is applied between the drain D and source with a battery V_{DD} and the gate G is kept open, the holes flow from source to drain through the narrow channel existing between the depletion regions. This constitutes the drain current I_D . The value of drain current is now maximum as I_{DSS} .
- When the gate to source voltage V_{GS} is applied by a battery V_{GG} and is increases above zero, the reverse bias voltage across the gate source junction is now increased. As a result of this, The depletion layers are widened.
- This reduces the effective width of the conducting channel, thereby increasing the resistance of P- type bar. Consequently, the flow of holes from source to drain decreases, thereby decreasing the drain current, On the other hand, if the reverse voltage on the gate is decreased, and the width of the depletion region also decreases. This increases the width of the conducting channel and hence the drain current increases.

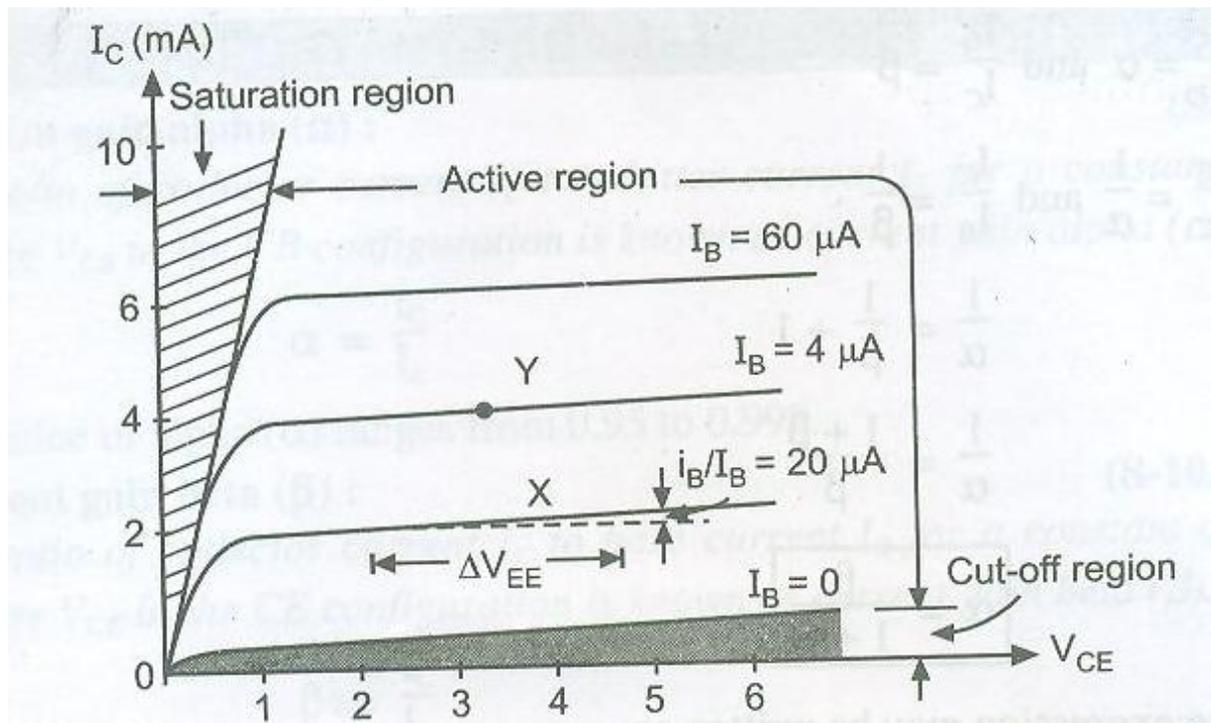
- When the reverse voltage on the gate is increased further, a stage is reached at which two depletion regions touch each other. At the gate voltage V_{GS} the conducting channel is completely blocked and the drain current is reduced to zero.

d. Draw the input and output characteristics of CE configuration and label them.

Ans: (each Characteristics – 2 marks)



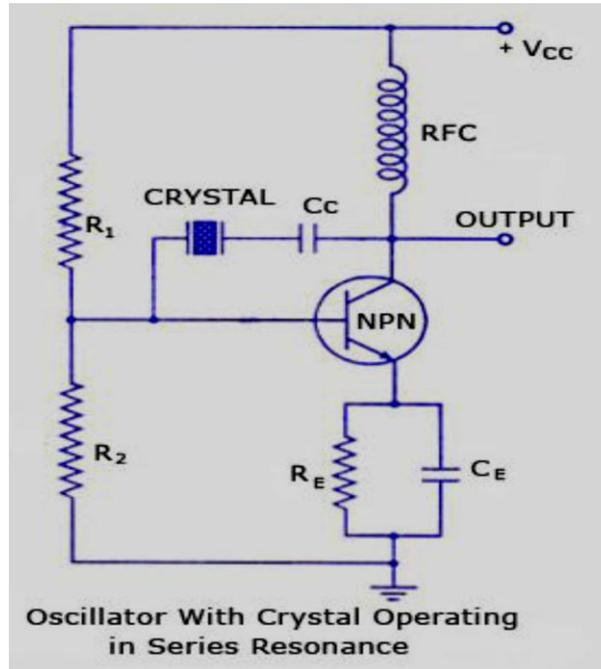
Input characteristics of CE configuration



Output characteristics of CE configuration

e. Draw the circuit diagram of crystal oscillator and explain its operating principle.

Ans e. **Circuit Diagram: 2M; Operating Principle: 2M**



- 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 f_o is in between the series resonant frequency f_s and the parallel resonant frequency f_p of an electrical equivalent circuit of a crystal, Thus, the frequency of oscillations is set by the series resonant frequency f_s of the crystal. This produces the undamped oscillations of stable frequency f_o .
- f. A transistor has a typical β of 100. If the collector current is 40mA, what is the value of base current and emitter current?

Ans f.

Given:

$$\beta = 100; I_c = 40\text{mA}; I_B = ?; I_E = ?$$

Now,

For I_B

$$\beta = I_c / I_B$$

$$I_B = 40\text{mA} / 100$$

$$I_B = 0.4\text{mA}$$

-----2 M

For,

$$I_E = I_B + I_C$$

$$= 0.4 + 400$$

$$I_E = 400.4 \text{ mA}$$

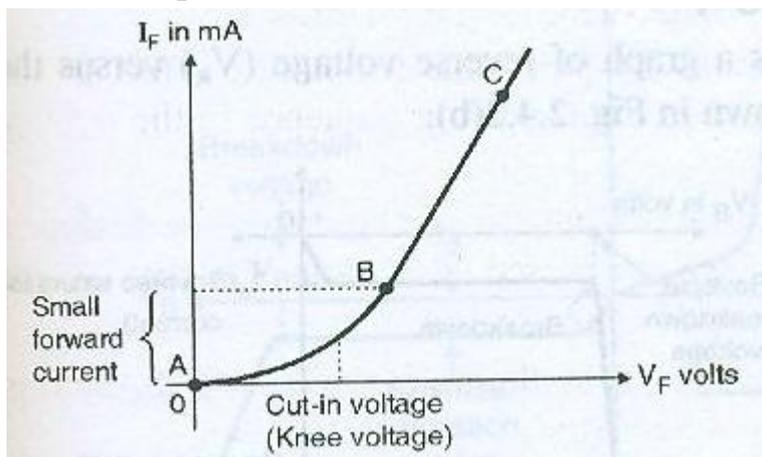
----- 2M

4) Attempt any FOUR:

16

a. Draw the forward and reverse characteristics of PN junction diode and describe in brief.

Ans a. **Diagram: 2 M; Description: 2M**



- The forward characteristic is the graph of the anode to cathode forward voltage V_F versus the forward current through the diode (I_F).
- The forward characteristics is divided into two portions, AB and BC
- Region A to B of the forward characteristics.
The forward voltage is small and less than the cut in voltage. Therefore the forward current flowing through the diode is small. With further increase in the forward voltage, it reaches the level of the cut in voltage and the width the depletion region goes on decreasing.

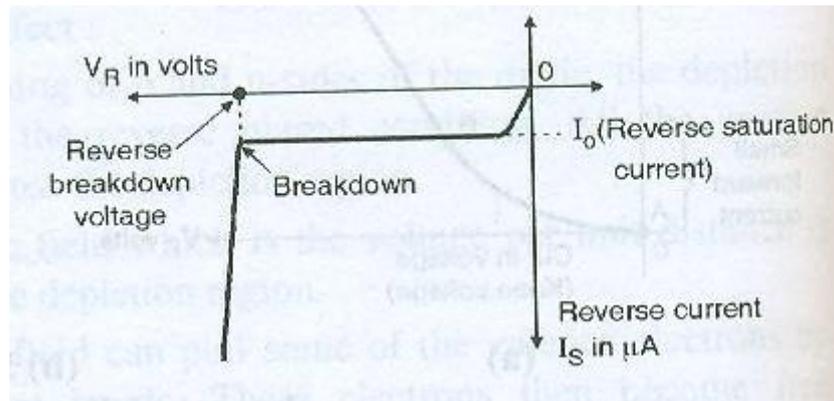
Region B to C:

- As soon as the forward voltage equals the cut in voltage, current through the diode increase suddenly. The nature of this current is exponential. The large forward current in the region B-C of the forward characteristics is limited by connecting a resistor R in series with the diode. Forward current is of the order of a few mA.
- The forward current is a conventional current that flows from anode to cathode. Therefore it is considered to be a positive current, and the forward characteristics appears in the first quadrant.

Cut in voltage (Knee voltage):

- The voltage at which the forward diode current starts increasing rapidly is known as the cut in voltage of a diode. The cut in voltage is very close to the barrier potential. Cut in voltage is also called as knee voltage.
- Generally a diode is forward biased above the cut in voltage. The cut in voltage for a silicon diode is 0.6 V and that for a germanium diode is 0.2V.

Reverse characteristics of a Diode.



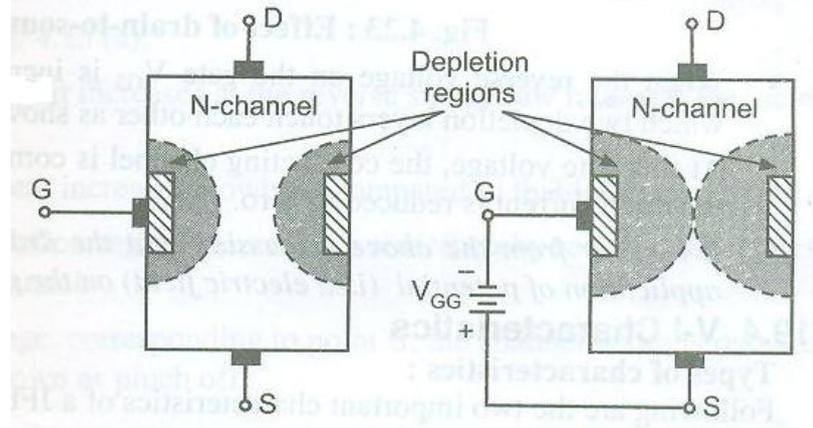
- Current flowing through a diode in the reverse biased state is the reverse saturation current which flows due to the minority carriers.
- Therefore it is treated as a negative current. Hence the reverse characteristics appears equal to I_0 if the temperature is constant.
- As the reverse voltage is increased, the reverse saturation current remains constant equal to I_0 if the temperature is constant. This is because, reverse saturation current does not depend on reverse voltage but it depends only on temperature.
- But as the reverse voltage reaches the breakdown voltage value. a large current flows through the diode, due to the reasons discussed earlier.
- Thus we define the reverse breakdown voltage of a pn junction diode as the reverse voltage at which breakdown takes place and a large reverse current starts flowing through the diode.
- Operation in the breakdown region should be avoided because the diode may be damaged due to excessive power dissipation.
- Typically the reverse breakdown voltage for p-n junction diode is in range of 50 to 100 volts.

b. Explain with the help of a diagram the effect of input field on the output current of JFET.

Ans b. **Diagram: 2M; Explanation: 2M**

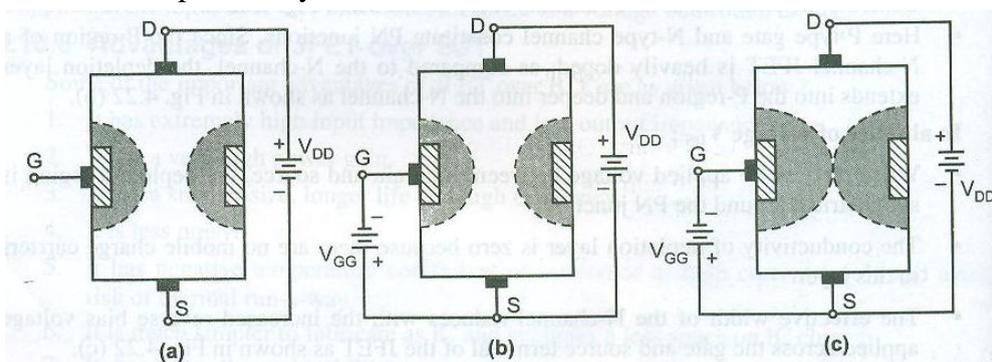
1. In absence of voltage V_{DS} :

- When there is no applied voltage between the drain and source, the depletion region is symmetrical around the PN junction.
- The conductivity of depletion layer is zero because there are no mobile charge carriers in this layer.
- The effective width of the N- channel reduces with the increased reverse bias voltage applied across the gate and source terminal of JFET.



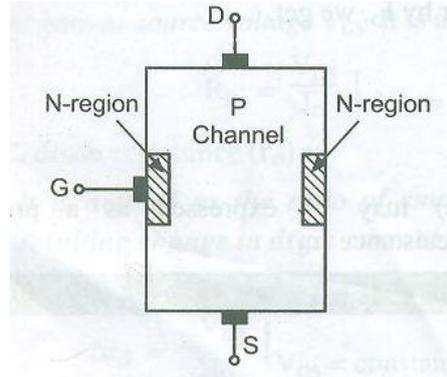
2. In presence of voltage V_{DS} :

- When the voltage is applied between the drain and source with a battery V_{DD} and the gate is kept open, the electrons flow from source to drain through the narrow channel existing between the depletion layer.
- This constitutes the drain current I_D and its conventional direction is indicated from drain to source.
- When the gate to source voltage V_{GS} is applied by a battery V_{GG} and increased above zero, the reverse bias voltage across the gate source junction is now increased. As a result the depletion layers are widened.
- This reduces the effective width of the conducting channel, thereby increasing the resistance N type bar.
- Consequently the flow of electrons from source to drain decreases, thereby decreasing the drain current.
- On the other hand, if the reverse voltage on the gate is decreases, the width of the depletion layer also decreases. This increases the width of the conducting channel and hence the drain current increases.
- When the reverse voltage on the gate V_{GS} is increased further, a stage is reached at which two depletion layers touch each other.

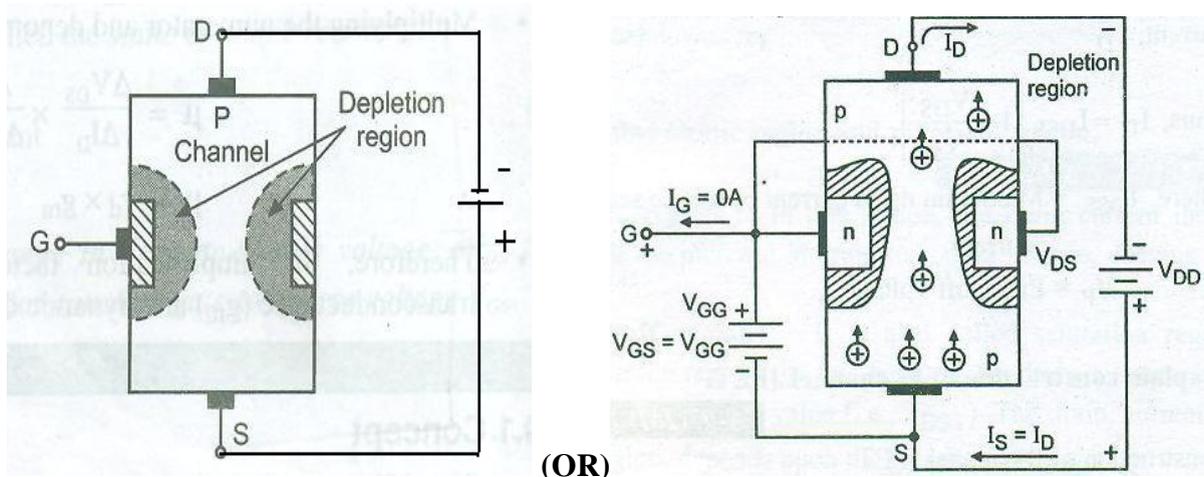


- At this gate voltage, the conducting channel is completely blocked and the drain current is reduced to zero.
- It is clear from above discussion that the drain current can be controlled by the application of potential (i.e. electric field) on the gate.

(OR)



P- Channel JFET



(OR)

3. In absence of voltage V_{DS} :

- When there is no applied voltage between the drain (D) and source (S), the depletion layer is symmetrical around the P-N junction.
- The conductivity depletion layer is zero because there is no mobile charge carrier in this region.

4. In presence of voltage V_{DS} :

- When the voltage is applied between the drain D and source with a battery V_{DD} and the gate G is kept open, the holes flow from source to drain through the narrow channel existing between the depletion regions. This constitutes the drain current I_D . The value of drain current is now maximum as I_{DSS} .
- When the gate to source voltage V_{GS} is applied by a battery V_{GG} and is increases above zero, the reverse bias voltage across the gate source junction is now increased. As a result of this, The depletion layers are widened.
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- When the reverse voltage on the gate is increased further, a stage is reached at which two depletion regions touch each other At the gate voltage V_{GS} the conducting channel is completely blocked and the drain current is reduced to zero.

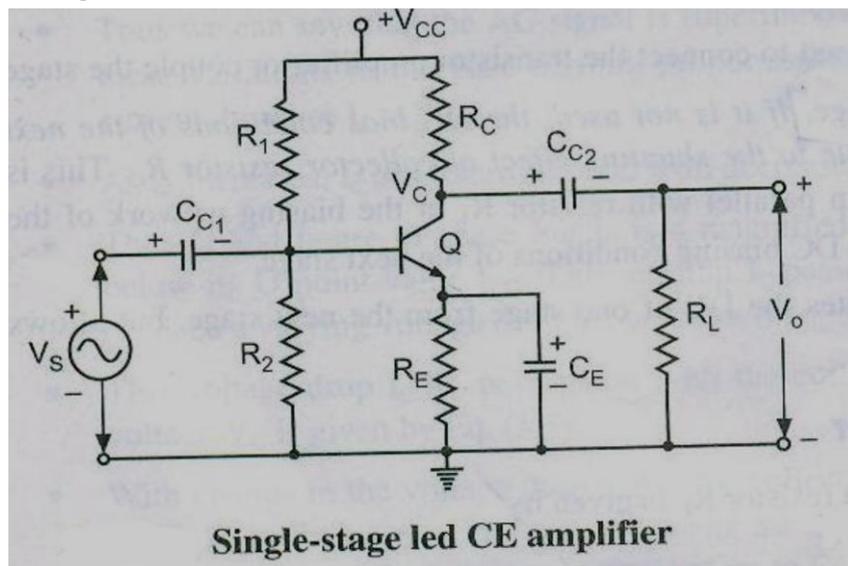
c. Differentiate between Half wave rectifier and bridge full wave rectifier (any four points)

Ans c. **Any four points: 4 M**

| Sr.No | Parameters | Half Wave | Bridge Full Wave |
|-------|--|-------------------------|--------------------------|
| 1 | Number of diodes | 1 | 4 |
| 2 | Peak secondary voltage, V_s | V_m | V_m |
| 3 | Peak Inverse voltage | V_m | V_m |
| 4 | D.C. current $I_{D.C}$ | $I_m / \pi = 0.318 I_m$ | $2I_m / \pi = 0.636 I_m$ |
| 5 | Maximum rectification efficiency, η_{max} | 40.6% | 81.2% |
| 6 | Transformer utilization factor(TUF) | 0.287 | 0.812 |
| 7 | Ripple frequency, f_r | f_i | $2f_i$ |

d. Draw the circuit diagram of single stage CE amplifier. Give function of each component.

Ans d. **Circuit Diagram: 2M; Function: 2M**



- The circuit diagram of a voltage amplifier using single transistor in CE configuration is shown in figure. It is also known as a small-signal single-stage CE amplifier or RC coupled CE amplifier. It is also known as a voltage amplifier.
- The potential divider biasing is provided by resistors R_1 , R_2 and R_E .
- It provides good stabilization of the operating point. The capacitors C_{C1} and C_{C2} are called the coupling capacitors used to block the AC voltage signals at the input and the output sides.
- 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.
- 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.

e. Define the following for CE amplifier:

- | | |
|------------------|------------------|
| i. Bandwidth | iii. Power gain |
| ii. Current gain | iv. Voltage gain |

Ans e. **Each definition: 1M**

Bandwidth:

The range of frequency over which the voltage gain of an amplifier remains constant is known as bandwidth of an amplifier.

It is denoted as bandwidth of an amplifier.

Current Gain:

The ratio of output current to input current of a BJT amplifier is known as current gain. It is denoted by a letter A_i

$$A_i = \text{Output current} / \text{Input current} = I_o / I_i$$

Power Gain:

The ratio of output power to input power of a BJT amplifier is known as power gain. It is denoted by a letter A_p

$$A_p = \text{Output power} / \text{Input power} = P_o / P_i$$

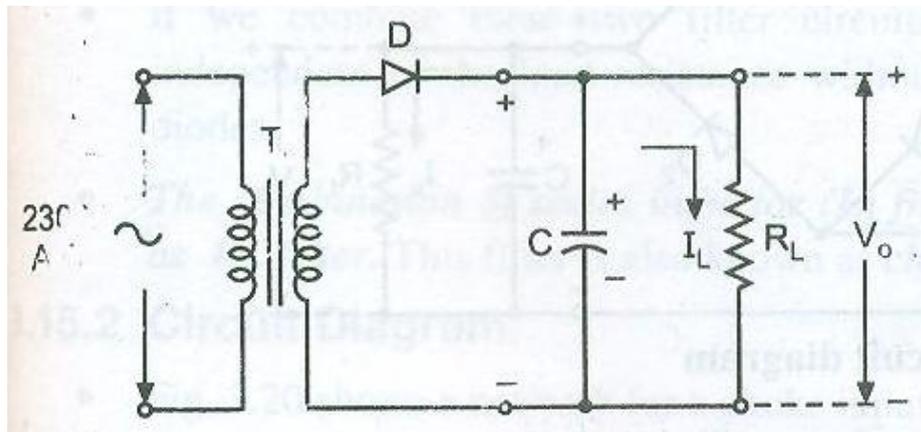
Voltage Gain:

The ratio of output voltage to input voltage of a BJT amplifier is known as voltage gain. It is denoted by a letter A_v .

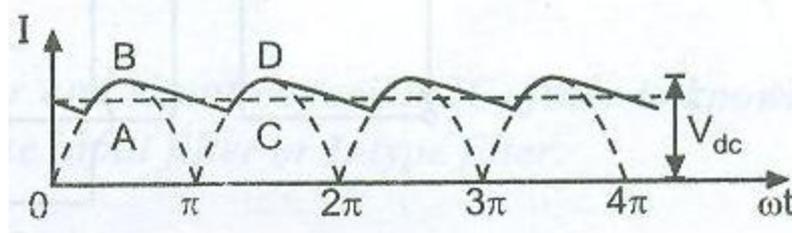
$$A_v = \text{Output voltage} / \text{Input voltage} = V_o / V_i$$

f) Draw diagram of half wave rectifier with shunt capacitor filter. Draw input and output waveforms.

Ans f. **Diagram: 2M; Waveforms: 2M**



Circuit diagram of half wave rectifier with shunt capacitor filter



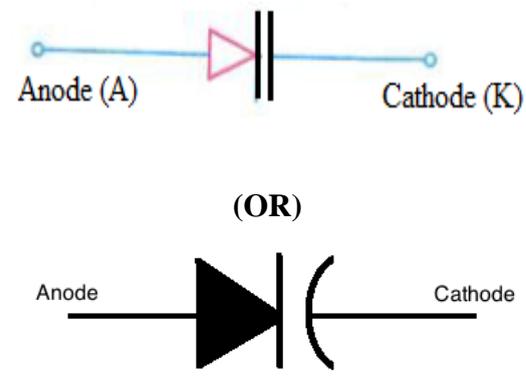
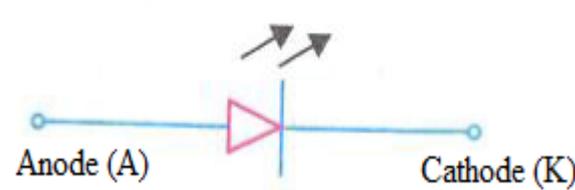
Input and Output waveforms

5. Attempt any FOUR:

16

a. Differentiate between varactor diode and LED

Ans a. **Any four relevant correct points: 4M**

| Sr.No | Varactor Diode | LED |
|-------|---|--|
| 1 |  |  |
| 2 | Basically it is operates in reverse biased condition. | Basically it is operates in forward biased condition. |
| 3 | The mode of operation depends on the capacitance that exists at the p-n junction when varactor is reverse biased. | The operation depends on principle of electroluminescence i.e. during recombination; the electrons give away the excess energy in the form of light. |
| 4 | Used in FM modulator, TV Receivers, Automatic tuning circuits. | Used in Optocouplers, Infrared remote control, indicator in electronic circuits. |

b. Define (in words):

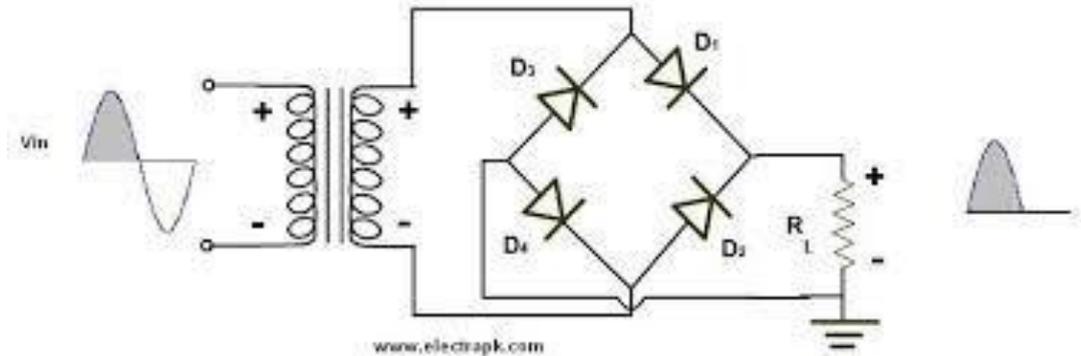
- | | |
|-------------------------------|--------------------------------|
| i. Reverse Saturation Current | iii. Depletion layer |
| ii. Knee voltage | iv. Static resistance of diode |

Ans: **Each Definition: 1M**

- i. **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.
- ii. **Knee voltage:** The applied forward voltage at which the PN junctions start conducting is called the cut-in voltage. It is also known as knee voltage (V_k or V_z). The value of cut-in voltage is 0.7 V for Silicon and 0.3 V for Germanium PN junction diodes.
- iii. **Depletion layer:** The region in PN junction which comprises of immobile ions is called depletion region.
- iv. **Static resistance of diode:** The resistance of a diode at the operating point can be obtained by taking the ratio of V_F and I_F . The resistance offered by the diode to the forward DC operating conditions is called as “**DC or static resistance**”.

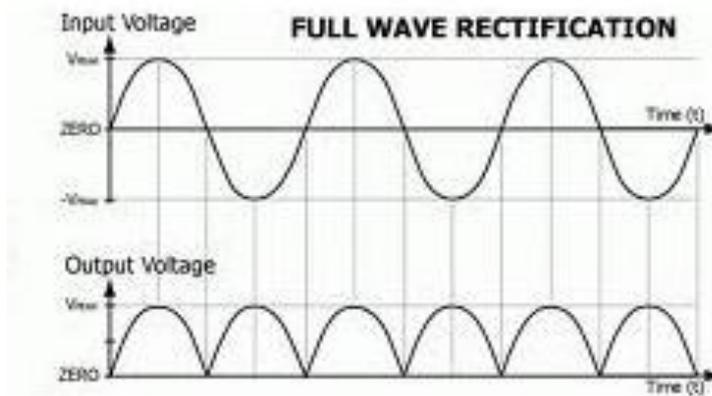
c. With the help of waveform explain the working of bridge type full wave rectifier.

Ans c. (Circuit diagram – 2 marks, explanation – 1 mark, waveform – 1 mark)



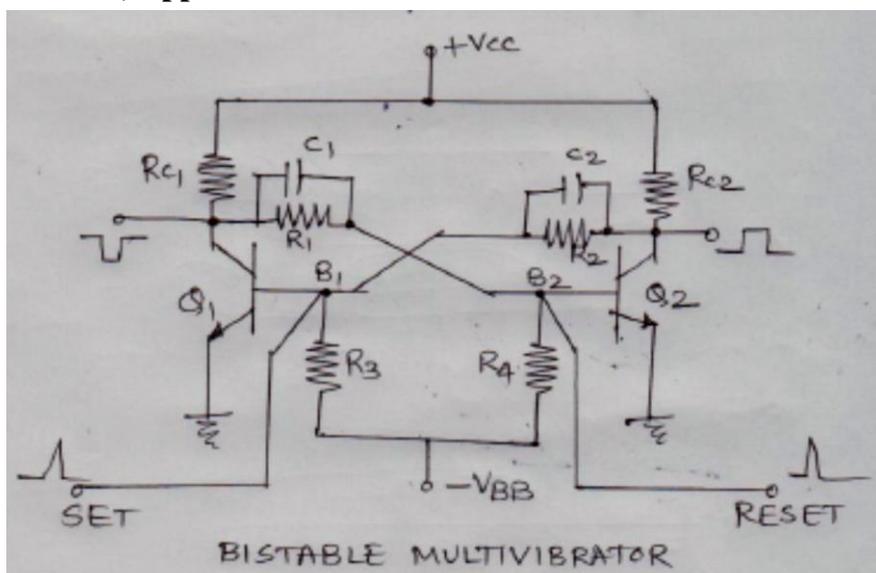
Working:

- 1) In this circuit four diodes are used which form a bridge, an ordinary transformer is used.
- 2) In the +ve half cycle D1, D4 hence current flows through D1, RL and D4.
- 3) In the -ve half cycle D2, D3 hence current flows through D1, RL and D4.
- 4) In both the cases current passes through the load resistor in the same direction.



d. Draw the circuit diagram of bistable multivibrator using transistor and give its two applications.

Ans d. **Diagram: 2M; Applications: 2M**

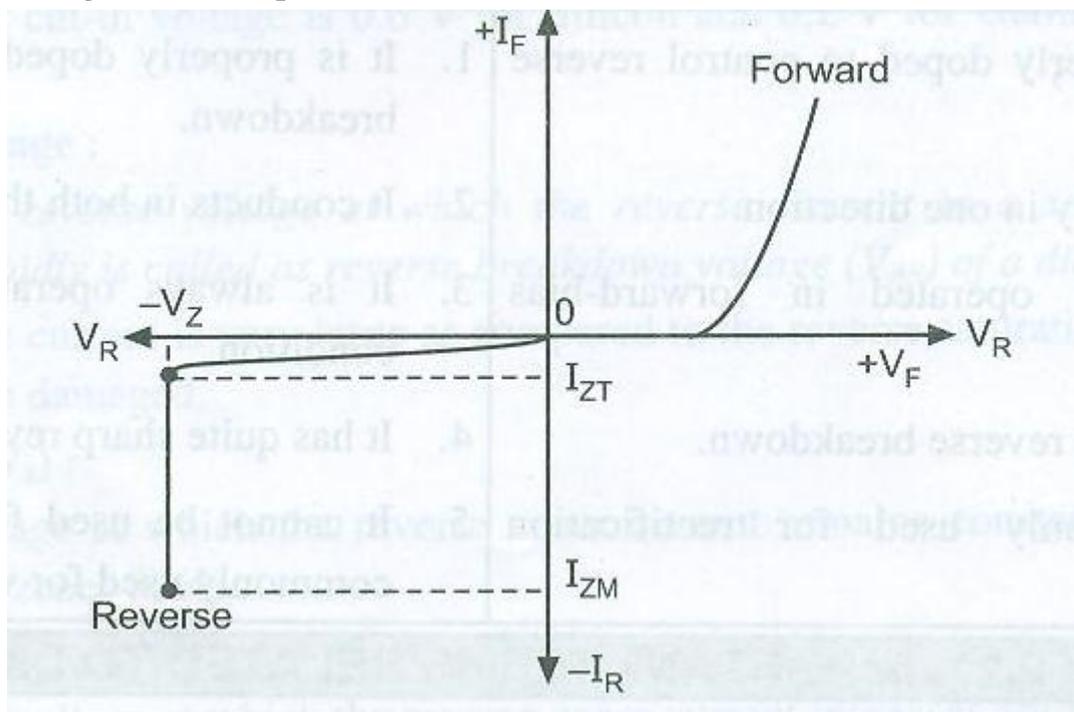


Applications: (any two)

1. It is used as a memory element in computer logic circuit.
2. It is used as a memory element in shift registers.
3. it is used as a memory element in counters.

e. Draw and explain the V- I characteristics of zener diode.

Ans e. **Diagram: 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 V_Z
- 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 V_Z 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.

f. Draw the neat circuit diagram of direct coupled amplifier. Give its two applications.

Ans f. **Diagram: 2M; Applications: 2M**

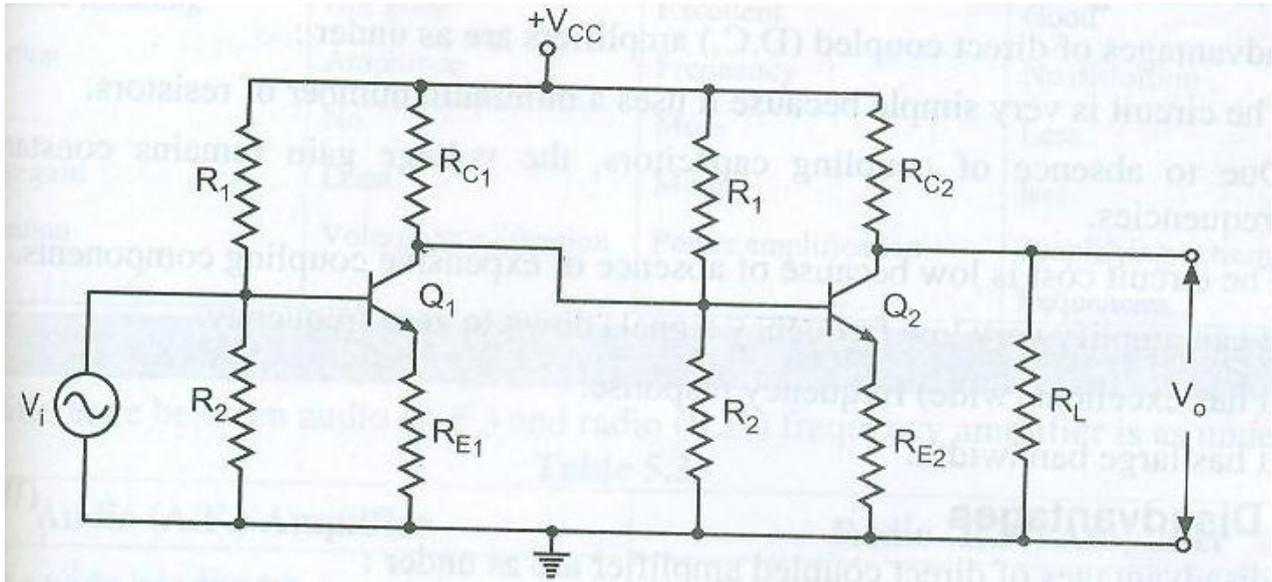


Fig: Direct coupled Amplifier

Applications:

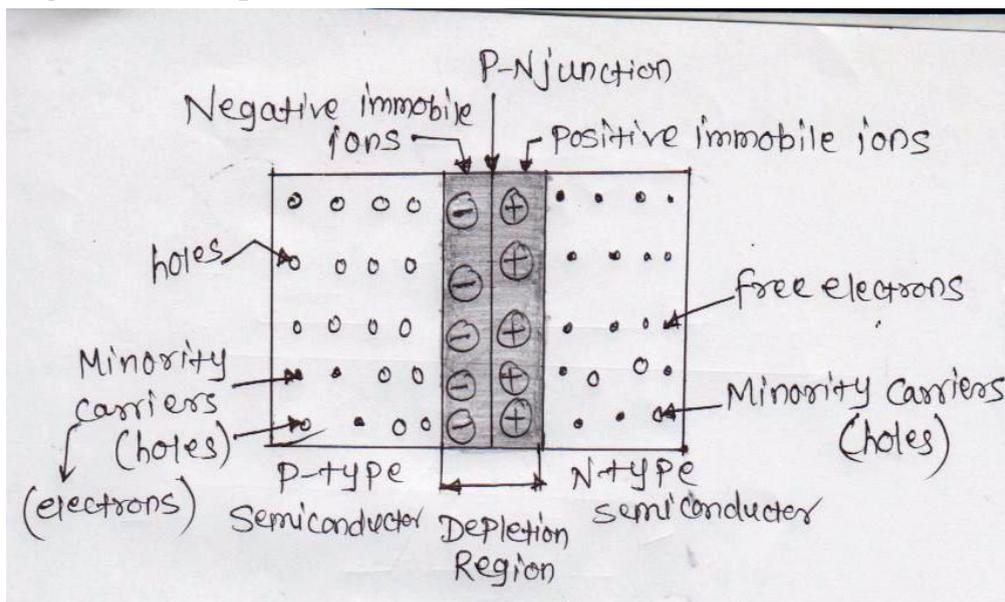
1. It is used as a voltage regulator in D.C. power supplies.
2. It is used in operational amplifier.
3. It is used in analog computers.
4. It is used for bioelectric measurements.
5. It is used in linear integrated circuits.

6. **Attempt any four:**

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a. Explain the formation of depletion layer in PN junction with neat sketch.

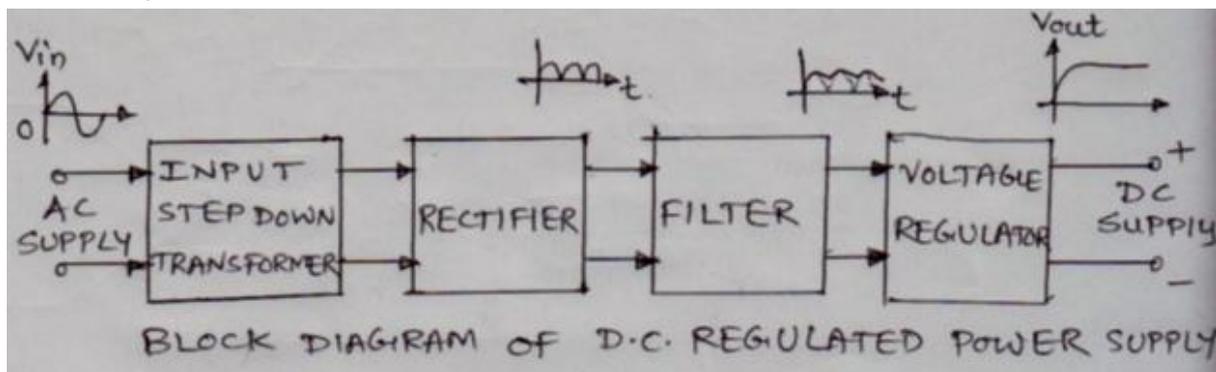
Ans a. **Diagram: 2M; Explanation: 2M**



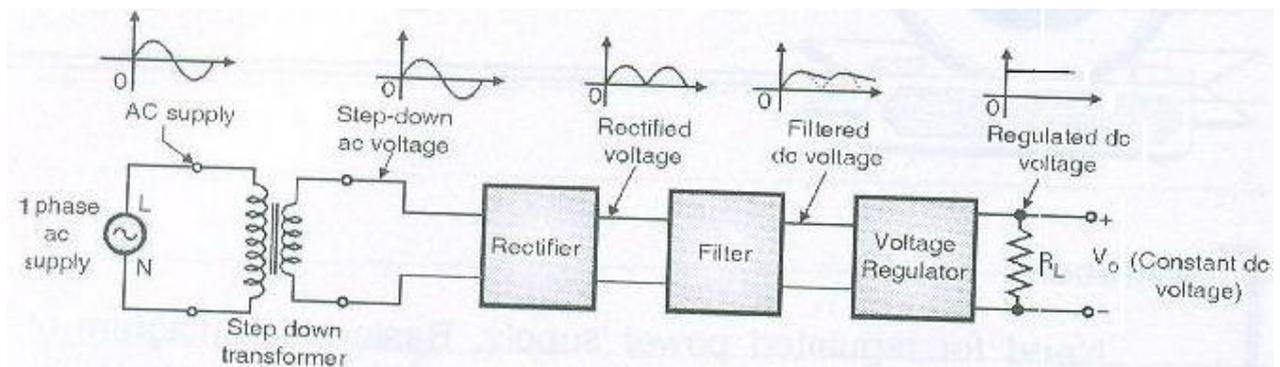
- At the instant P-N junction formation, the free electrons near the junction in the N- region begin to diffuse across the junction in to P- region where they combine with holes near the junction.
- The result is that N-region loses free electrons this creates a layer of positive charges (pentavalent ions) near the junction.
- The P-region loses holes and the result that there is a negative charges (trivalent ions near the junction).
- The shaded region on both sides of the junction in Fig. below contains only immobile ions and no free charge carriers such as electrons or holes.
- In other words this region is *depleted of free charge carriers*. Therefore region is called as *depletion region*.
- Once P-N junction is formed and depletion layer is created the diffusion of free electrons stops.
- The positive and negative charges set an electric field.

b. Draw block diagram of regulated power supply and state its need.

Ans b. **Diagram: 2M; Needs: 2M**



(OR)

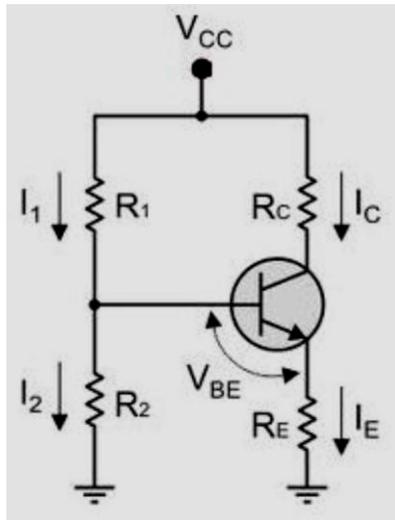


Need of regulated power supply

- The unregulated D.C. power supply suffers from the disadvantages of poor voltage regulation and high ripple factor.
- This may result the erratic operation of most of the electronic devices and circuits and also electronic gadgets such as pocket radios, electronic calculators, digital watches/ clocks, tape recorders etc.
- In order to avoid erratic operations of electronic circuits and also to improve voltage regulation and ripple factor, there is necessity of regulated D.C. power supply.

- c. Draw circuit diagram of voltage divider bias. How operating point stability is obtained in this circuit?

Ans c. **Diagram: 2M; Explanation: 2M**



Applying kvl and thevenin's theorem in input and output side we get,

$$V_{TH} = I_B R_{TH} + V_{BE} + I_E R_E$$

$$I_C = \beta I_B$$

$$I_C = V_{TH} / R_E$$

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 R_E to increase.

This in turn decreases the voltage V_{BE} 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.

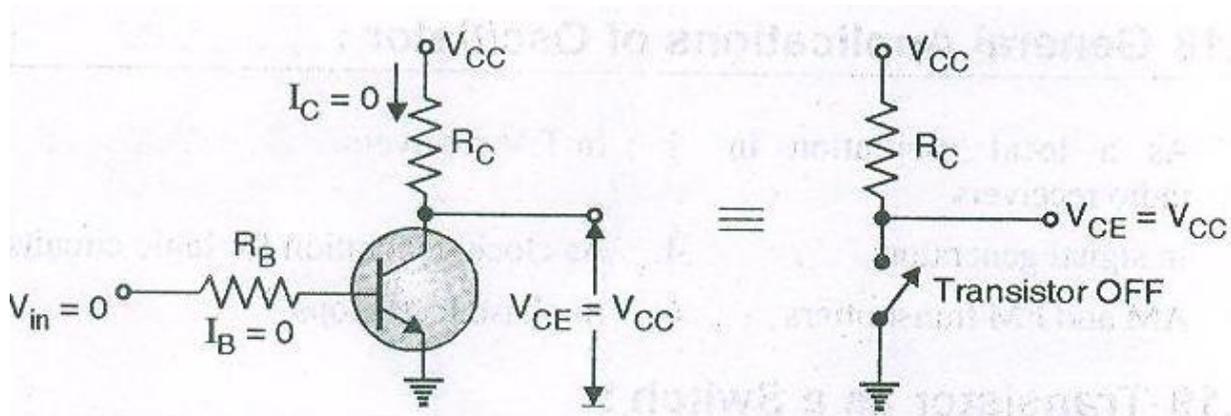
- d. Draw the circuit diagram of a transistor as a switch. Explain how the transistor work as an open switch in cut –off region and close switch in saturation region.

Ans d. **Circuit Diagram: 2M; Explanation: 2M**

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 (V_{CE}) is high. Thus in the cutoff region the transistor is equivalent to an open switch as shown in figure.

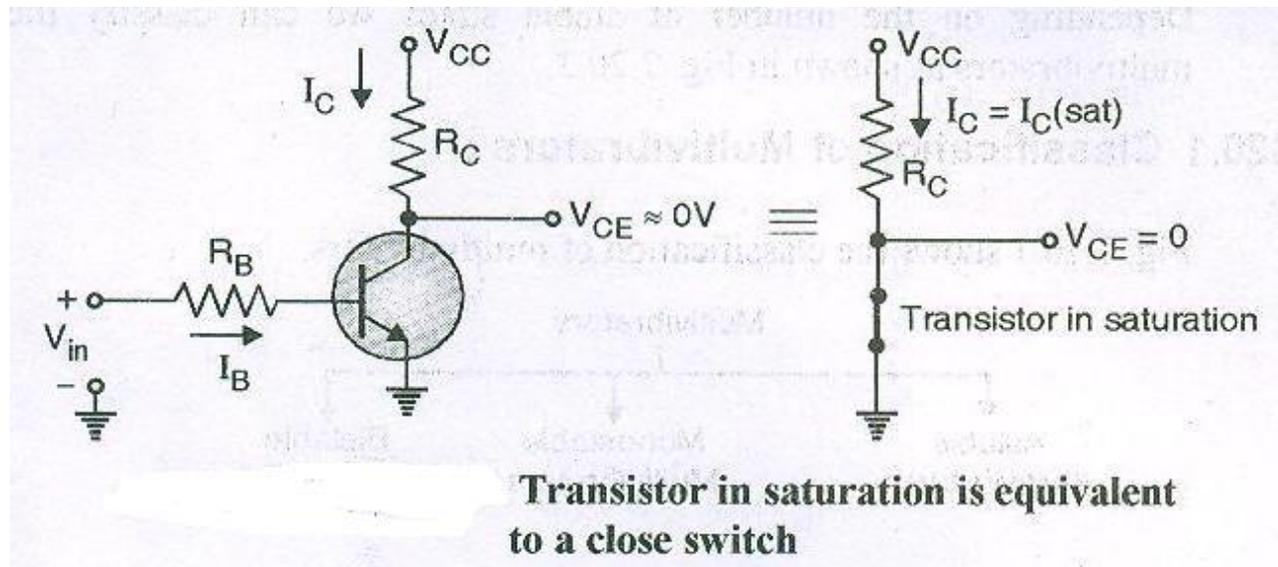


Transistor in the saturation region:

When V_{in} is positive, a large base current flows and the transistor saturates.

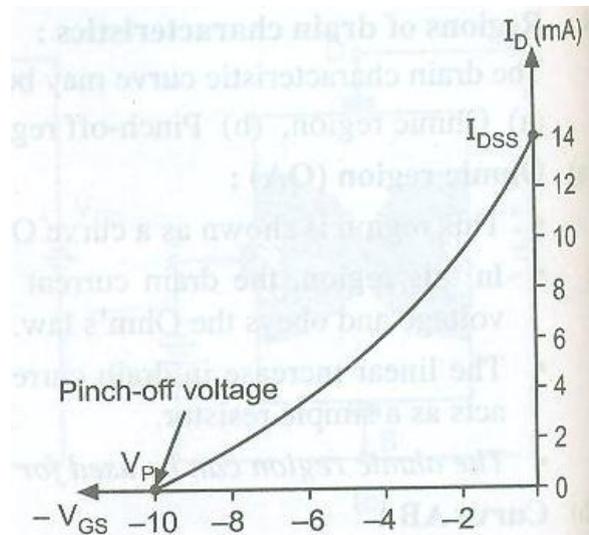
In the saturation region both the junctions of a transistor are forward biased. The voltage drop across the transistor (V_{CE}) is very small of the order of 0.2V to 1 V depending on the type of transistor and collector current is very large.

In saturation the transistor is equivalent to a closed switch as shown in figure.



e. Draw the transfer characteristics of JFET. Give the meaning of I_{DSS} and V_{gSoff} .

Ans e. **Diagram: 2M; Meaning of I_{DSS} : 1M; Meaning of V_{gSoff} : 1M**



I_{DSS} : The maximum amount of drain current at zero gate- to- source voltage V_{GS} is known as drain saturation current. It is denoted by I_{DSS} and is specified by the manufacturer.

$V_{GS(off)}$: The gate- to- source voltage V_{GS} at which the drain current is reduced to zero (or completely cut- off) is called pinch- off voltage. It is designated by a letter V_P or $V_{GS(off)}$.



- f. An A.C. supply of 230V is applied to half wave rectifier circuit through a transformer of turns ratio 2:1 Calculate
- DC output voltage----- **2M**
 - PIV of diode----- **2M**

Ans f.

Given: $V_1 = 230V$

$$N_2/N_1 = 1/2$$

1. We know that secondary voltage

$$\begin{aligned} V_2 &= N_2/N_1 \times V_1 \\ &= 230 \times 1/2 \\ &= 115V \end{aligned}$$

Maximum value of secondary voltage

$$\begin{aligned} V_m &= \sqrt{2} \times V_2 \\ &= \sqrt{2} \times 115V \\ &= 162.6 \text{ volts} \end{aligned}$$

Therefore, DC voltage

$$V_{dc} = V_m / \pi = 162.6 / 3.14 = \underline{\underline{51.7 \text{ volts}}}$$

2. PIV of diode

$$\text{PIV of diode} = V_m = \underline{\underline{162.6 \text{ volts}}}$$