SUMMER – 14 EXAMINATION

Model Answer

Subject Code : **17213** Page No: 1/

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.

Marks

1. A) Attempt any ten **(20)**

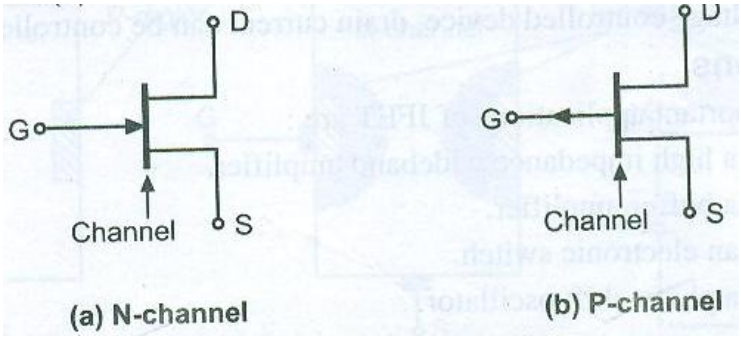
a) From the following list, identify the active components –

Resistor, FET, Switch, Capacitor, Diode, Relay.

Ans : Active components: FET, Switch, Diode, Relay. **2M**

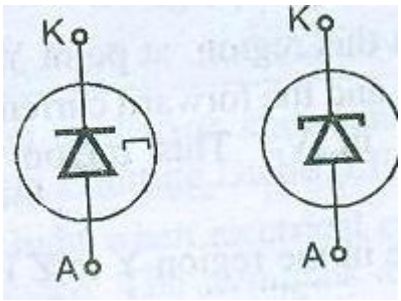
b) Draw the symbol of N-channel and P-channel JFET.

Ans : **1+1M**



c) Draw the symbol of Tunnel diode and write one application on it.

Ans : **1M**



Symbols of tunnel diode

Applications : (Any one) **1M**

1. It is used as a high speed switch (switching time very low).
2. It is used as logic memory storage device.
3. It is used as very high frequency oscillator (about 1 GHz)
4. It is used in relaxation oscillator circuits.

d) List the types of coupling used in amplifiers.

Ans : **2M**

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

e) List the specifications of P-N junction diode (any 2).

Ans : ` **2M**

1. Maximum reverse voltage (V)
2. Repetitive peak voltage (V)
3. Maximum forward current (mA)
4. Power dissipation.
5. Repetitive peak forward current.
6. Average forward current (A)
7. Surge current (A)
8. Operating ambient temperature (^oC)
9. Maximum junction temperature (^oC)
10. Forward voltage (V)
11. Reverse saturation current (μA)
12.

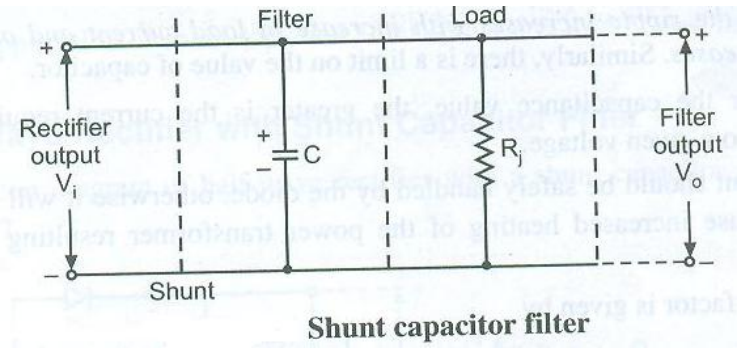
f) Write advantages of IC (any two.)

Ans : **2M**

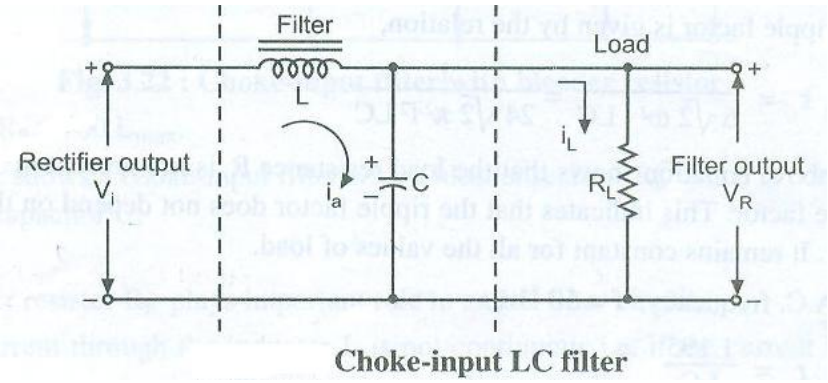
1. The physical size of an IC is extremely small (generally thousand times smaller) than that of discrete circuits.
2. The weight of an IC is very less as compared to that of an equivalent discrete circuits.
3. The reduction in power consumption is achieved due to extremely small size of IC.
4. Interconnection 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.

g) Draw the circuit diagram of C and LC Filter.

Ans : **(1+1M)**



Shunt capacitor filter



Choke-input LC filter

h) Write the typical values of amplification factor and trans conductance of FET.

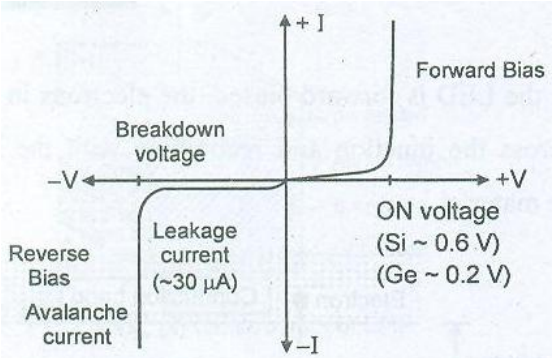
Ans : **(1+1M)**

Amplification factor : It can be as high as 100.

Trans conductance of FET : upto 5000 µmhos.

i) Draw the V-I characteristics of LED.

Ans : **2M**

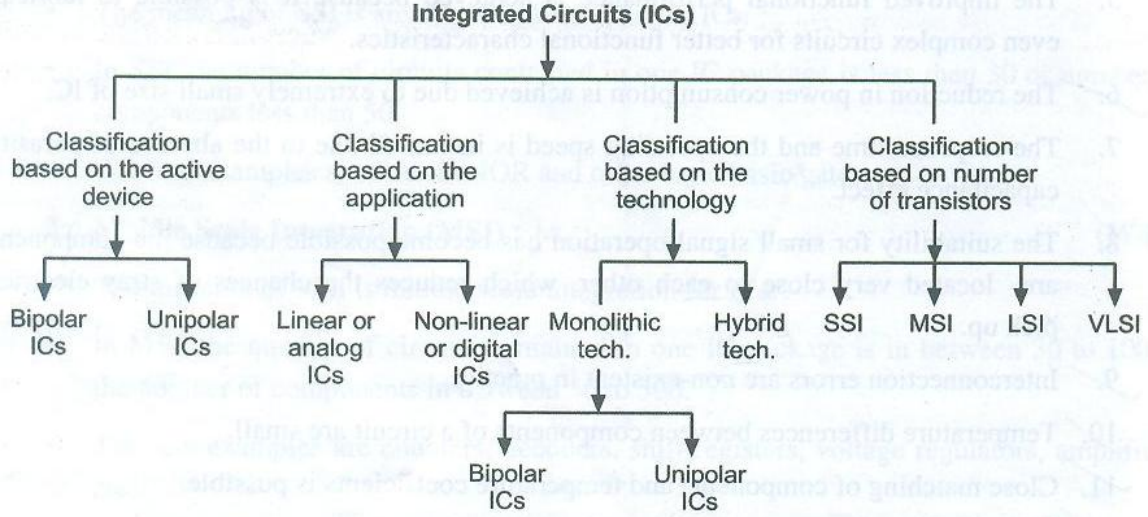


characteristics of LED

j) Give the classification of ICs.

Ans : **2M**

The classification of ICs is as under :



Classification of integrated circuits (ICs)

k) Define knee voltage and PIV.

Ans : **(1+1M)**

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.

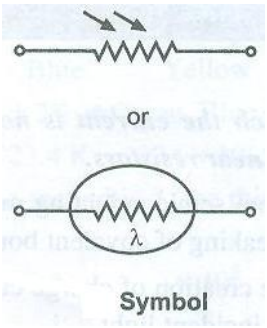
PIV

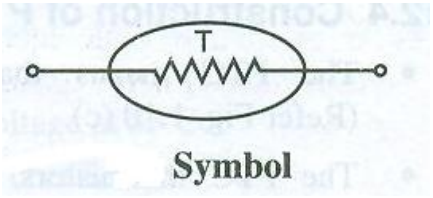
- The maximum value of reverse voltage that a diode can withstand without destroying its PN junction during the non-conduction period is called peak inverse voltage.
- The diode should be so chosen as to withstand this reverse voltage.

l) Draw the symbol of LDR and TDR.

Ans : (1+1M)

LDR **TDR**





2. Attempt any four. **16**

a) Write one application of electronics in any four different fields.

Ans : Any relevant answer should consider **(Any one- 4M)**

1. **Communication and Entertainment :**
   a) Wire communication or Line communication.
   b) Wireless communication.

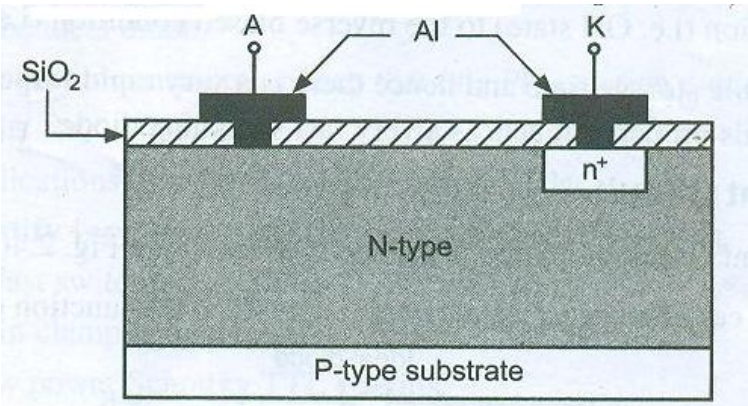
   The examples of wire communication are Telegraphy, Telephony, Telex and Teleprinter. The examples of wireless communication are radio broadcasting, TV broadcasting, satellite communication.
2. **Defense :** The most important application is RADAR.
3. **Industrial Applications :** Electronic circuits 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. Eg. X-rays, ECG, Oscillographs and Short-wave diathermy units.

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

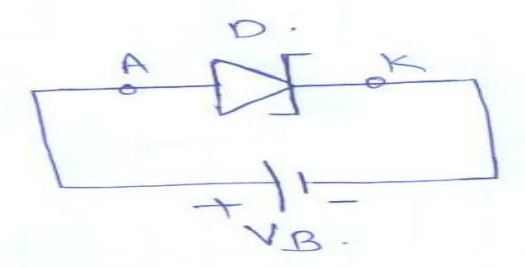
b) Explain the working of Schottky diode.

Ans : **(2+2M)**



Construction of a Schottky diode

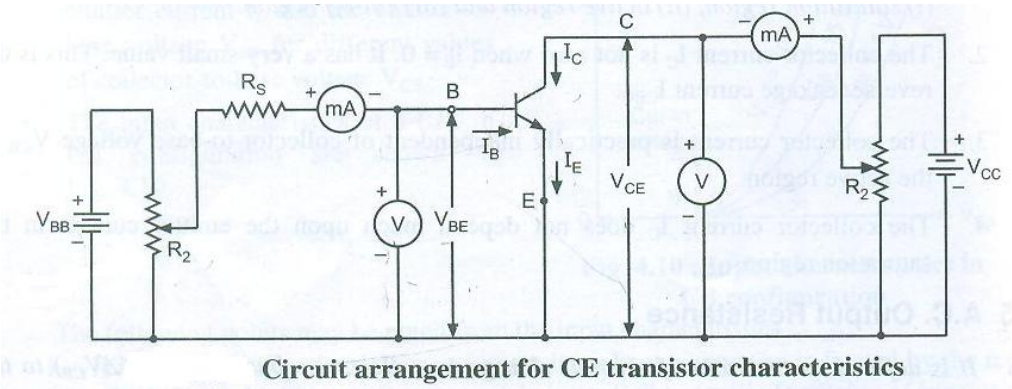
OR



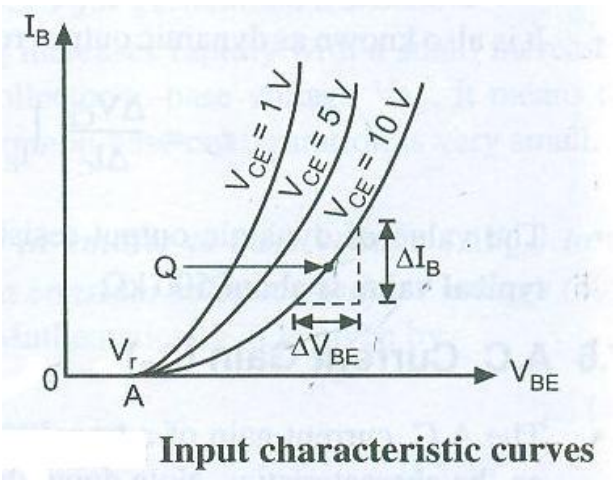
- The metal region of a Schottky diode is heavily occupied with the conduction band electrons and the N-type region is lightly doped.
- There are no minority carriers as in other types of diodes, but there are only majority carriers as electrons. It operates only with majority carriers.
- When it is forward biased, higher energy electrons in the N-regions are injected into the metal region where they give up their excess energy very rapidly.
- Since there are no minority carriers as in a conventional diode, there is no charge storage and hence there is no reverse recovery diode when it is switched from the forward biased condition (i.e. ON state) to the reverse biased condition (i.e. OFF state).
- It has negligible storage time and hence there is a very rapid response to a change in bias. Because of this property, it acts as a very fast switching diode.

c) Draw the circuit diagram of CE configuration and draw its Input and Output characteristics.

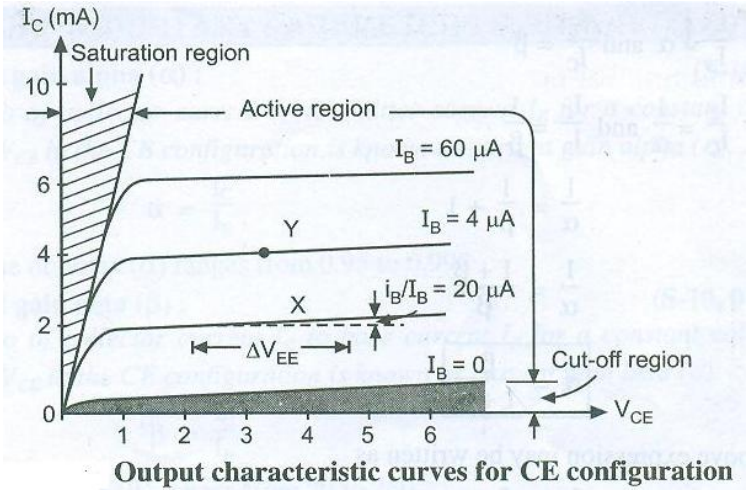
Ans : **(2+1+1M)**



Circuit arrangement for CE transistor characteristics



Input characteristic curves



Output characteristic curves for CE configuration

d) Define voltage gain, current gain and power gain. State the need for multistage amplifiers.

Ans : **(Each one for 1 mark)**

i) Voltage gain (A_V) :

The ratio of output voltage to the input voltage.

- Output voltage is given by Vo, input voltage is denoted by Vi

Therefore, Voltage gain = Output voltage / Input voltage = Vo / Vi = A_V

ii) Current gain (A_I) :

- The ratio of output current to input current is known as current gain.
- Output current is denoted by Io and input current is denoted by Ii.

  Therefore, Current gain (A_I) = Output current / Input current = I_o/I_i.

iii) Power gain (A_P) :

- The ratio of output power to input power is known as power gain.
- Output is denoted by Po and input power is denoted by Pi.

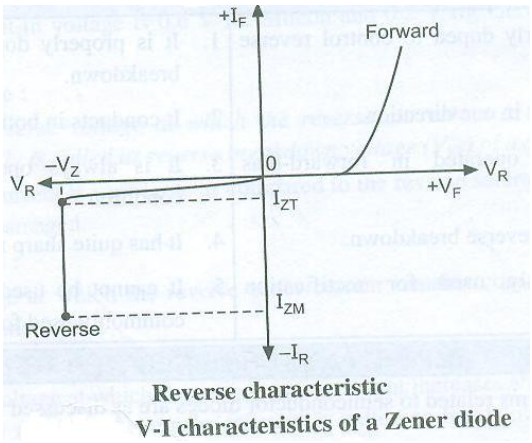
  Therefore, Powai gain (A_P) = P_o / P_i
- Power gain should be ideally infinite and practically as high as possible.

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.

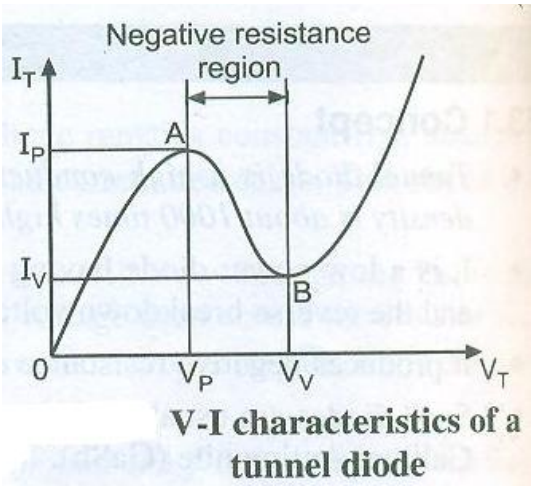
e) Draw the V-I characteristics of Zener Diode and Tunnel Diode.

Ans : **(2+2M)**



Reverse characteristic

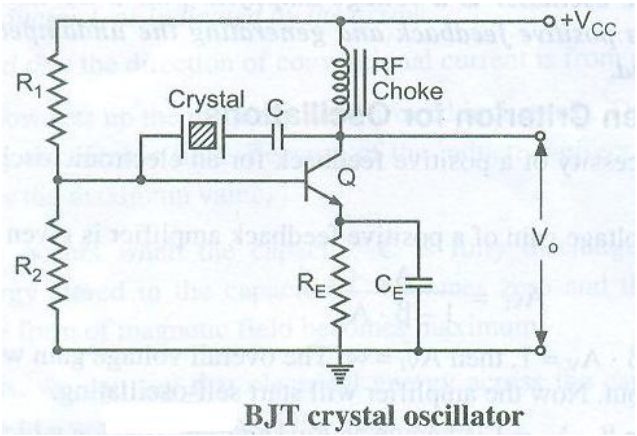
V-I characteristics of a Zener diode



V-I characteristics of a tunnel diode

f) Draw the circuit diagram of crystal oscillator. State its two applications.

Ans : **(2+2M)**



BJT crystal oscillator

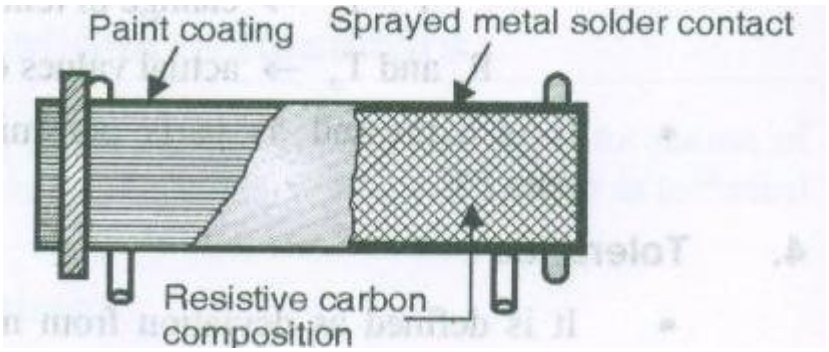
Applications :

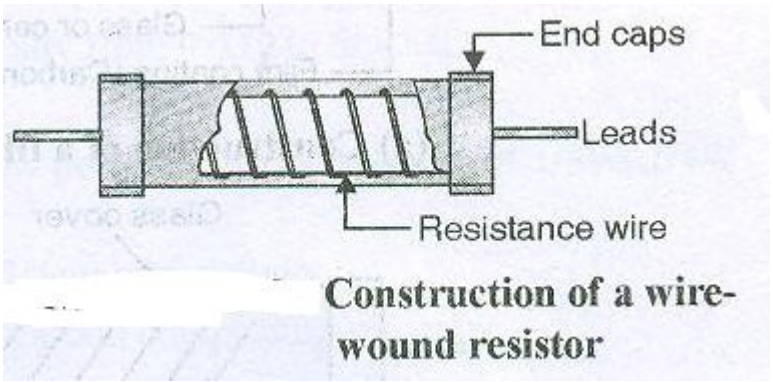
- Communication transmitter.
- Digital watches and clock.

Q3. Attempt any four : **16**

a) Draw the construction diagram of carbon composition resistor and wire wound resistor. Write two applications of wire wound resistor.

Ans : **(1+1+2M)**





Construction of a wire-wound resistor

Applications : (Any two)

i. Zener voltage regulator.

ii. Power amplifiers.

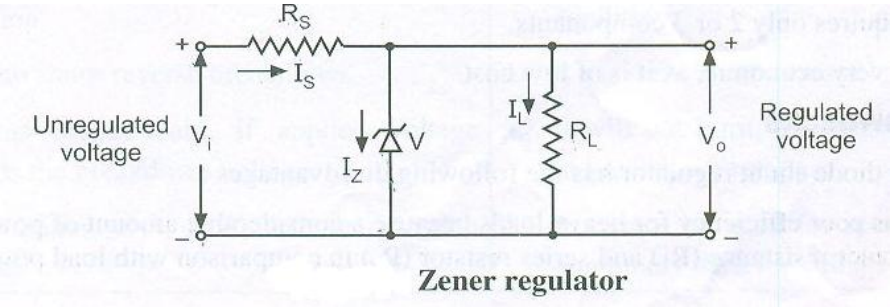
iii. High power resistors in DC power supplies.

iv. High power circuits in radio and TV receivers.

v. Low frequency, high power applications.

b) Explain the Zener diode as a voltage regulator.

Ans : **(2+2M)**



Zener regulator

Operating Principle

- For proper operation, the input voltage V_i must 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,

  $I_S = V_i - V_z / R_s = V_i - V_o / R_s$
- We know that the input current I_S is the sum of Zener current I_z and load current I_L.

  Therefore, $I_S = I_z + I_L$

  or $I_z = I_s - I_L$
- 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,

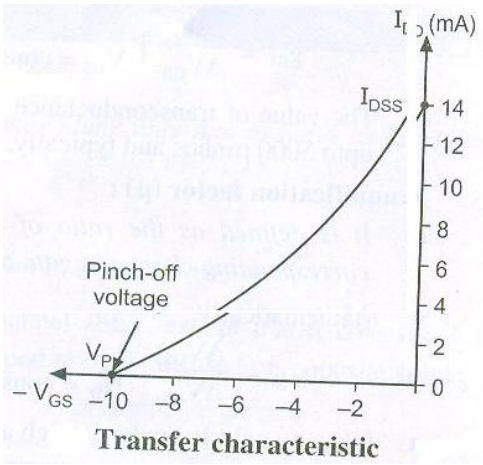
  $Vo = Vi - Is \cdot Rs$
- As the input current is constant, the output voltage remains constant (i.e. unaltered or unchanged). The reverse would be true, if the load current decreases. This circuit is also correct for the changes in input voltage.
- As the input voltage increases, more Zener current 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 R_L.

c) Draw the transfer characteristics of N-channel FET. Define AC Drain resistance.

Ans : (2+2M)



AC Drain resistance :

- It is defined as the ratio of small change in drain-to-source voltage ΔVDS to the resulting change in drain current (ΔID) for constant gate-to-source voltage VGS.
-

d) What is the need for biasing a transistor ? List the types of biasing.

Ans : (2+2M)

Need :

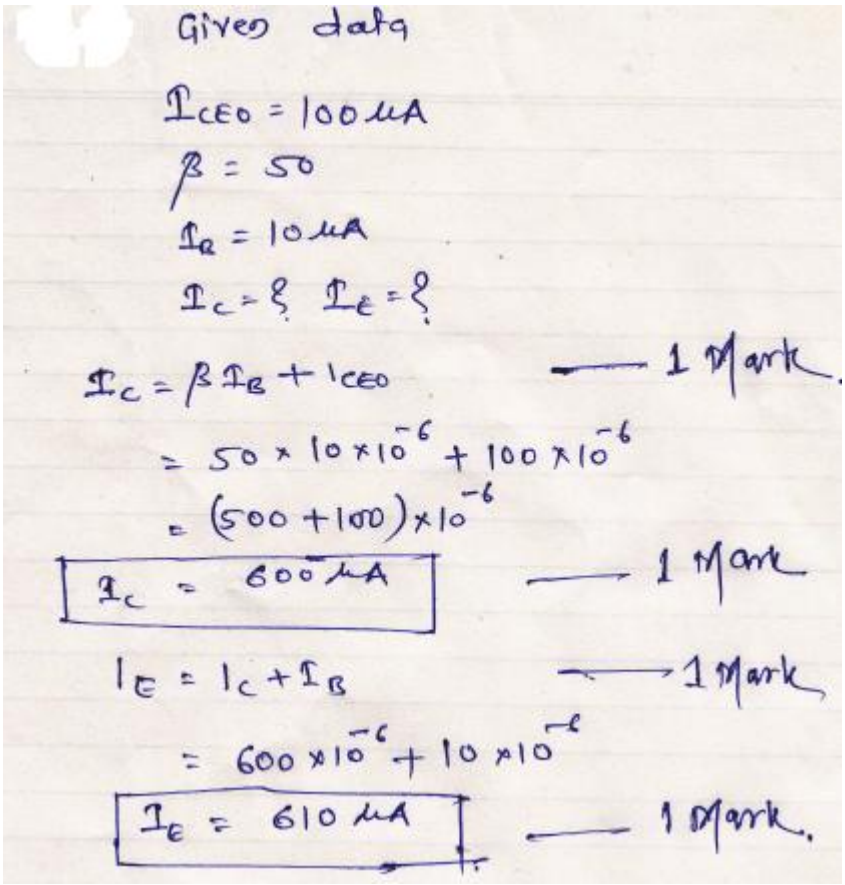
- The basic need of transistor biasing is to keep the base-emitter (B-E) junction properly forward biased and the collector-emitter (C-E) junction properly reverse biased during the application of A.C. signal.
- This type of transistor biasing is necessary for normal and proper operation of transistor to be used for amplification.

Types of biasing

i. Base bias (or fixed bias)
ii. Base bias with emitter feedback.
iii. Base bias with collector feedback
iv. Voltage divider bias (or self bias)
v. Emitter bias.

e) In NPN transistor, I_{CEO} = 100 µA, = β50 I_B = 10µA. Find I_C and I_E.

Ans :



OR

(2+2M)

1) $\beta = I_C / I_B$

Therefore, $I_C = \beta \times I_B = 50 \times 10 = 500$ µA

2) $I_E = I_C + I_B = 500 + 10 = 510$ µA

f) Define oscillator. State the criterion / conditions for sustained oscillations.

Ans : (Any two condition) **(2+2M)**

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 road.

OR

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

Barkhausen Criterion for Oscillations

- There is a necessity of a positive feedback for an electronic oscillator to supply the loss of power.
- The overall voltage gain of a positive feedback amplifier is given by

$A_{Vf} = A_V / 1 - \beta . A_V$

- If loop gain $\beta \cdot A_V = 1$, then $A_{Vf} = \infty$. The overall voltage gain will be infinity only when there is no input. Now the amplifier will start self-oscillating.
- This condition $\beta \cdot A_V = 1$ is known as Barkhausen criterion. The conditions are started as under :

  1. The sustained (i.e. continuous) oscillations are produced, if at the oscillation frequency, the magnitude of loop gain is slightly greater than unity.

     i.e. $\beta \cdot A_V > 1$ or $A_V > 1/\beta$

  2. The total phase shift between the input and output signals is an integral or 2 radians i.e. $<\beta \cdot A_V = 0^o$

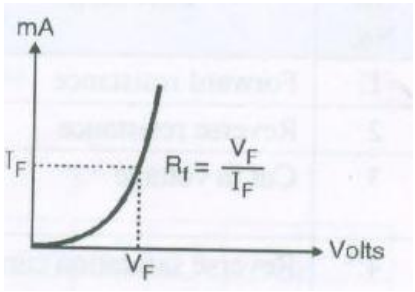
Q4. Attempt any four **16**

a) Define static and dynamic resistance of diode with the help of V-I characteristics of diode.

Ans : **(2+2M)**

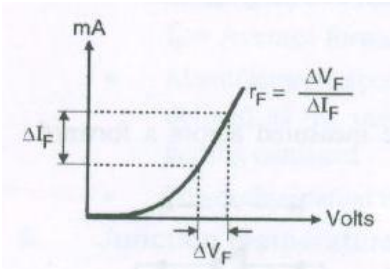
Definition of static resistance:

- The resistance of a diode at the operating point can be obtained by taking the ratio of VF and IF. The resistance offered by the diode to the forward DC operating conditions is called as **"DC or static resistance".**



Definition of Dynamic resistance :

- The resistance offered by a diode to the AC operating conditions is known as the **"Dynamic Resistance".**



b) Compare HWR and FWR on the basis of

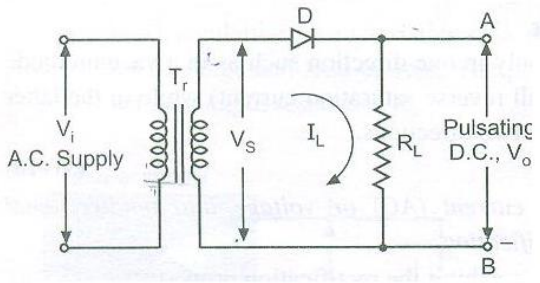
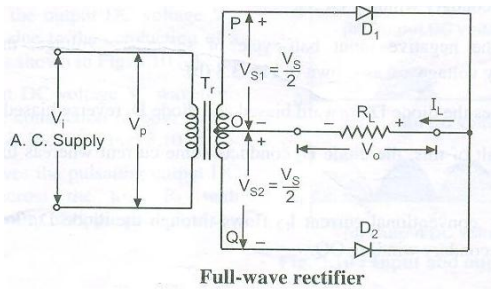
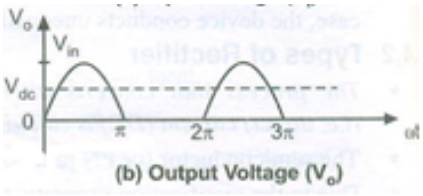
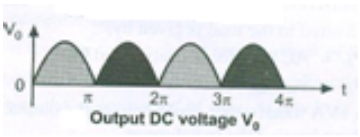
1. Circuit diagram

2. Output waveform

3. PIV

4. Ripple factor.

Ans: **(4M)**

	HWR	**FWR**
Circuit diagram		 Full-wave rectifier
Output waveform	 (b) Output Voltage (V_o)	 Output DC voltage V_o
PIV	**Vm**	**2Vm**
Ripple factor	**1.21**	**0.482**

c) What is α and β ? Derive the relationship between them.

Ans : **(1+1+2M)**

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**

$\alpha (1+\beta) = \beta$

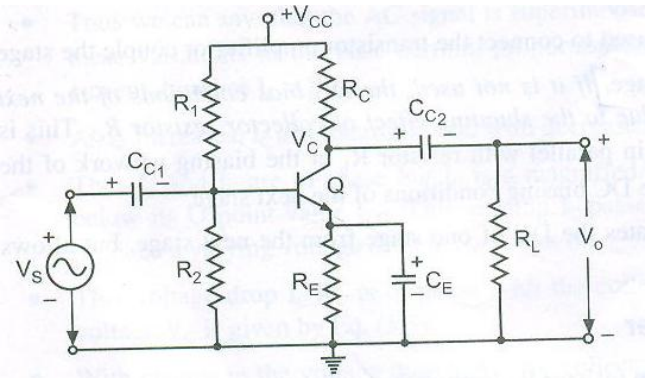
$\alpha + \alpha \beta = \beta$

$\alpha = \beta - \alpha\beta = \beta (1 - \alpha)$

Therefore, $\beta = \alpha /(1 - \alpha)$

d) Draw the single stage CE amplifier. Write the function of each component.

Ans : (2+2M)



Single-stage led CE amplifier

- 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 CE 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 RL represents the resistance of whatever is connected at the output. It may be load resistance or input resistance of the next stage.

e) State the need of filter. Identify the suitability of C, L, LC, π filter for light load and heavy load application.

Ans :

Need : **(2M)**

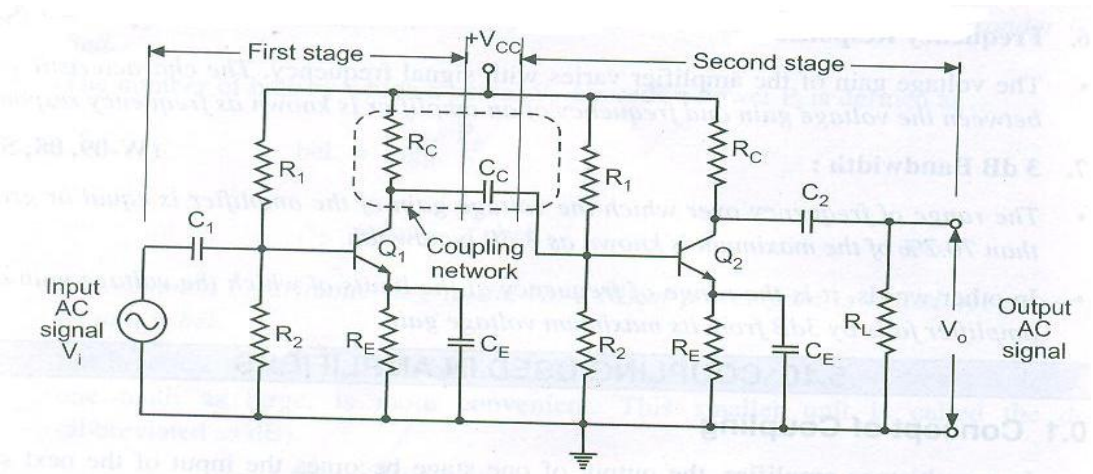
- The rectifiers provide a pulsating output DC voltage across the load containing some ripple and hence these circuits do not provide ripple free (i.e. pure or steady) DC voltage.
- The presence of ripple (i.e. AC component) is most undesirable in many electronic circuits and systems because it may affect their normal operation.
- So ripple must be kept away from the load and it should be removed from the rectified (i.e. pulsating) output.
- Therefore, there is a necessity of filter circuit for removing, i.e., smoothing or filtering the ripple and allowing the (pure or steady) DC voltage to reach the load.

(2M)

Sr.No	Heavy load	Light load
1.	L & LC	C, LC & CLC(π)

f) Draw the RC coupled two stage amplifier circuit. Write the advantage and disadvantage of it. (any 2)

Ans : **(2+1+1M)**



Two-stage RC coupled CE amplifier

Advantages : (any 2)

- It is the most convenient and least expensive multistage amplifier.
- It has a wide frequency response and large bandwidth.
- It provides excellent audio fidelity.
- It has no core distribution.
- The DC biasing of individual stages remain unchanged even after cascading of stages.
- It provides less frequency distortion.
- It has low amplitude in the output.

Disadvantages : (any 2)

- The overall voltage gain of the amplifier is comparatively less, because of the loading effect of successive stages.
- It has a tendency to become noisy with age, especially in moist climates.
- It provides poor impedance (or resistance) matching between the amplifier stage. Therefore, it cannot be used as final stage of the amplifier.
- The voltage gain reduces at low frequencies due to coupling capacitors.

Q5. Attempt any four : 16

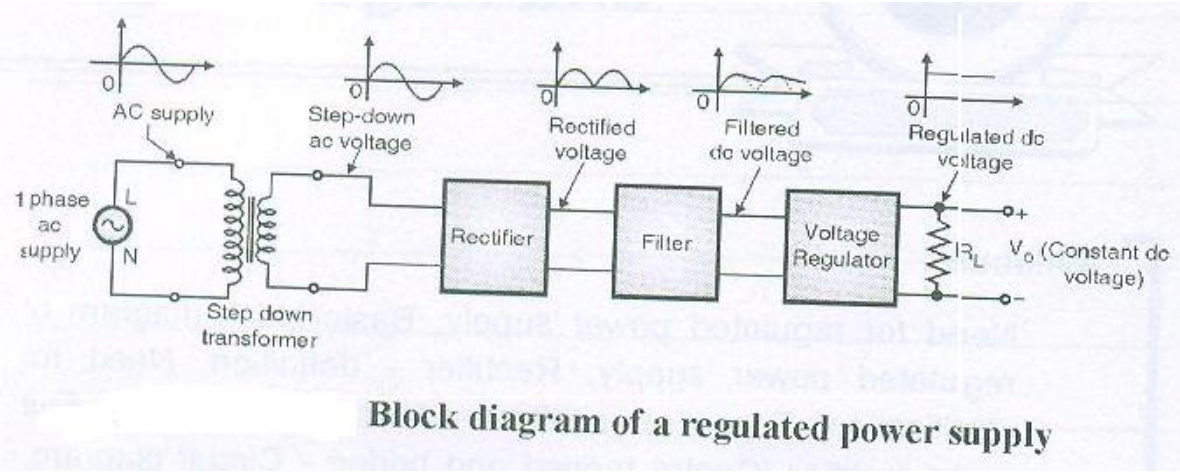
a) Compare ideal diode and practical diode.

Ans : (Any four-4M)

	Ideal Diode	**Practical (Real) Diode**
1	It can act as perfect conductor and as a perfect insulator	It cannot act as perfect conductor and as a perfect insulator
2	It has zero voltage drop across it, when forward biased.	It has very low voltage drop (<1V) across it, when forward biased.
3	It draws zero reverse saturation current, when reverse biased.	It draws negligibly small reverse saturation current, when reverse biased.
4	It has zero cut-in (knee) voltage.	It has very low cut-in (knee, <1 V) voltage.
5	It offers zero resistance, when forward biased.	It offers very low resistance, when forward biased.
6	It offers infinite resistance, when reverse biased.	It offers very high resistance, when reverse biased.
7	It cannot be manufactured.	It can be manufactured.

b) Draw the block diagram of regulated power supply along with waveform at each block.

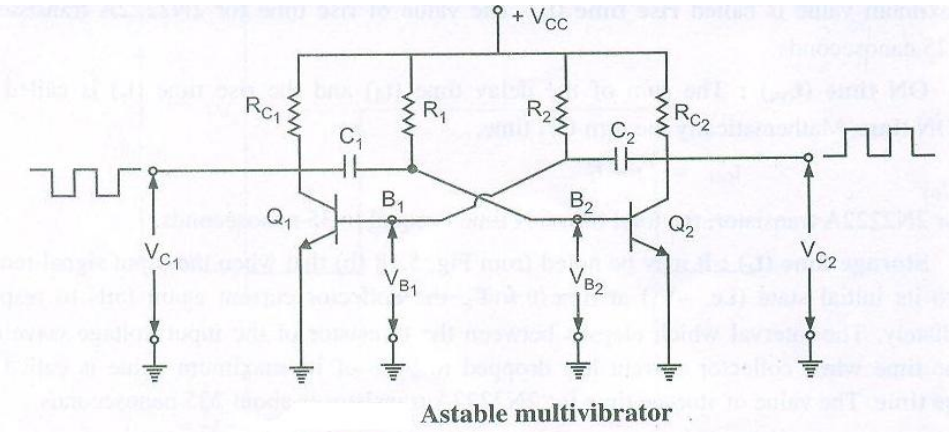
Ans : (2M Diagram, 2 marks waveforms)



Block diagram of a regulated power supply

c) Draw the circuit diagram of Astable multivibrator. Write two applications of it.

Ans : **(2+2M)**



Astable multivibrator

Applications : (Any two)

a) As a generator of square waves or pulses.

b) As a square wave relaxation oscillator.

c) As a frequency generator.

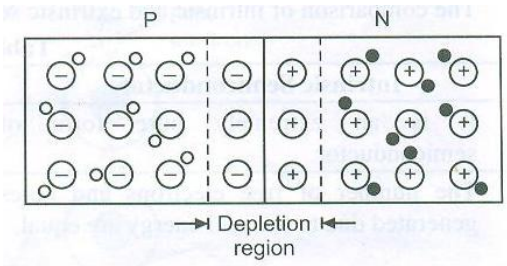
d) As a sawtooth generator.

e) As a standard frequency source when synchronized by an external crystal oscillator.

d) Explain the formation of depletion Region in P-N junction diode.

Ans : **(2+2M)**

- Diagram shows a PN junction just immediately after it is formed. It is a single crystal having P-type and N-type semiconductor made from Germanium or Silicon.
- The P-region has high concentration of holes (i.e. majority carriers) and negatively charged ions, whereas the N-region has high concentration of free electrons (i.e. majority carriers) and positively charged ions.
- For simplicity, minority carriers are not shown in fig.
- Holes and free electrons are the mobile charge carriers, but ions are immobile. In P-region, the positive charge on holes is equal to the total charges on its free electrons and immobile ions.
- Similarly, in N-region, the negative charge of its majority carriers is compensated by the charge of minority carriers and immobile ions.
- Therefore, the single crystal (PN junction) as a whole is electrically neutral, as so the P-region and N-region are considered separately.

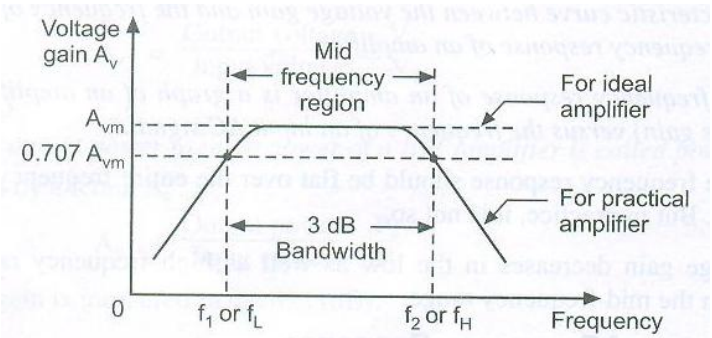


After formation of junction

- As soon as the PN junction is formed, some of the holes, which are near the junction, from the P-region diffuse into the N-region.
- They then combine with the free electrons in the N-region.
- Similarly some of the free electrons, which are near the junction, from the N-region diffuse into the P-region.
- These electrons also combine with the holes. The diffusion of holes from P-region to N-region and free electrons from N-region to P-region take place because they move randomly due to thermal energy and also because there is a difference in their concentrations in the two regions.
- Thus some of the holes and free electrons diffuse towards each other across the junction and recombine. But, in practice, this does not occur.
- The diffusion of holes and free electrons across the PN junction occurs for a very short time.
- In this process, the negative acceptor ions in the P-region and the positive donor ions in the N-region in the immediate neighbourhood of the junction are left uncompensated.
- This situation is shown in figure. Additional holes trying to diffuse into the N-region are now repelled by the uncompensated positive charge of the donor ions.
- The free electrons trying to diffuse into the P-region are repelled by the uncompensated negative charge of the acceptor ions.
- As a result, total recombination of holes and free electrons cannot occur and also the further diffusion of free electrons and holes across the junction is stopped.
- The depletion region will only contain positive charge on N-side and negative charge on P-side of the crystal as shown in fig.
- As the depletion region builds up the space-charge across the PN junction increases and as a result a potential difference builds up across the PN junction.

e) Draw the frequency response of RC coupled amplifier. State the reasons for decreasing gain on both sides of frequency Range.

Ans : **(2+1+1M)**



Frequency response of CE amplifier

1) Low frequency region : In low frequency region, the voltage gain (or output voltage) decreases with the decrease in frequency of an input AC signal due to the increased reactance of the coupling and bypass capacitors.

2) High frequency region : In high frequency region, the voltage gain (or output voltage) decreases with the increase in frequency of an input AC signal due to the BJT internal capacitances and stray capacitance.

f) Compare Zener diode and PN junction diode.

Ans : **(Any four-4M)**

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

Q6. Attempt any four : **16**

a) Define :

1) Max. forward voltage.

2) Breakdown voltage.

Does the breakdown always damage the diode ?

Ans : **($1_{1/2}+1_{1/2}+1M$)**

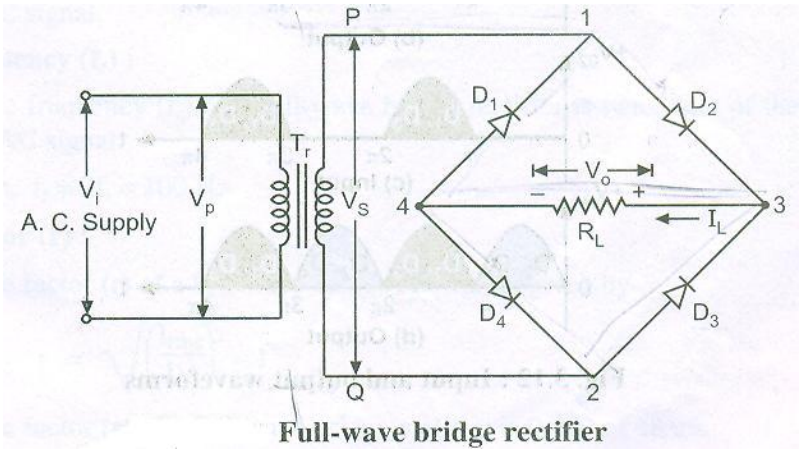
1) Max. forward voltage : It is the anode to cathode voltage measured across a forward biased diode.

2) Breakdown voltage : The voltage, at which the abrupt increase in reverse current through the P-N junction occurs is known as breakdown voltage.

Breakdown does not damage the diode always.

b) Draw the circuit diagram of bridge rectifier. Write its 2 advantages of it over full wave rectifier.

Ans : **(2+2M)**



Full-wave bridge rectifier

Advantages : (Any two)

i. It can be used in applications allowing floating output terminals i.e. no output terminal is grounded.

ii. The need for centre-tap transformer is eliminated and hence needs a simple small size transformer as in a half-wave rectifier.

iii. If stepping up or stepping down of AC voltage is not needed, then it does not even require any transformer.

iv. There is no possibility of core saturation of transformer secondary winding and hence transformer losses are reduced.

v. The transformer needed is less costly as it is required to provide only half the voltage of an equivalent centre-tap transformer used in a full-wave rectifier.

vi. The PIV is one-half that of the centre-tap rectifier.

vii. The output is twice that of the centre-tap circuit for the same secondary voltage.

viii. The transformer utilization factor (TUF) is very large about 0.812.

ix. The rectifier efficiency is very high about 81.2%.

c) What is load line ? What is Q-point ?

Ans : (2+2M)

load line : The straight line drawn on the output characteristics of a transistor amplifier circuit which gives the values of collector current I_C and collector to emitter voltage V_{CE} corresponding to either D.C. or A.C. input conditions is called a load line.

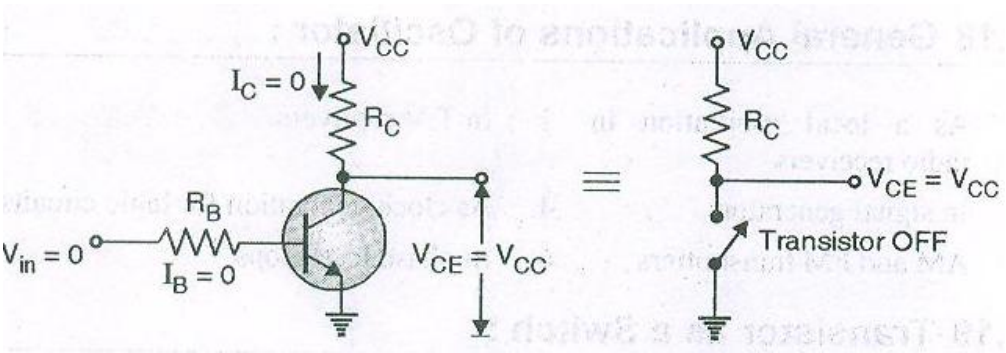
Q-point : The point decided by the zero signal (or DC) values of I_C and V_{ED}, lying on the DC load line is known as the d.c. operating point". The operating point is also known as Quiescent point or simply point.

d) Explain the working of transistor as a switch.

Ans : (2+2M)

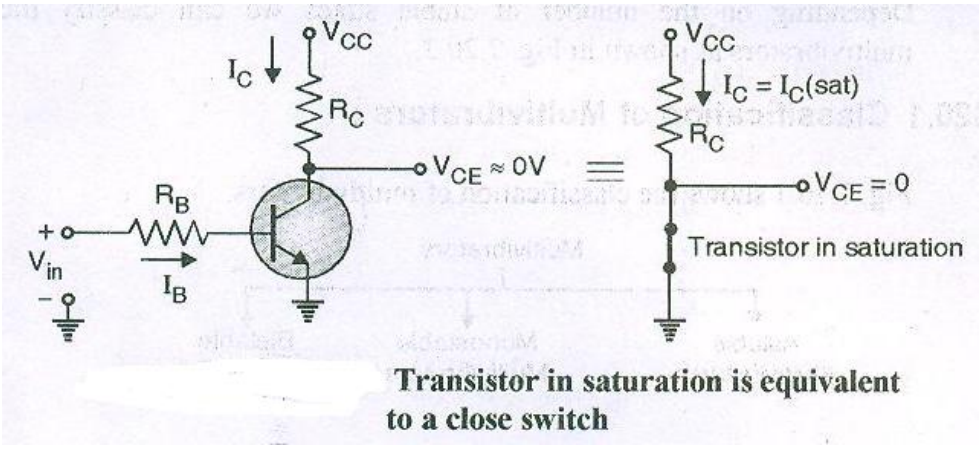
1. Transistor in cutoff region (open switch)

- 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 :

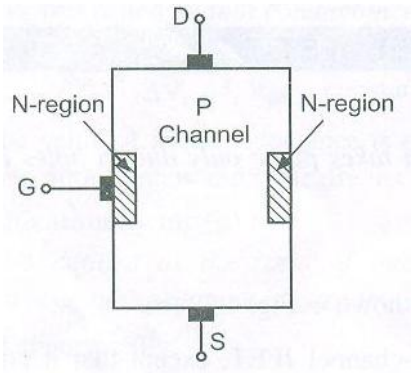
- When Vin is positive, a large base current flows and the transistor saturates.
- In the saturation region both the junctions of a transistor are forward biased. The voltage drop across the transistor (VCE) is very small of the order of 0.2V to 1 V depending on the type of transistor and collector current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

e) Draw and explain the construction diagram of P-channel FET. State two applications of FET.

Ans : (1+1+2M)



P-channel JFET

Construction :

- The construction of a P-channel JFET is as shown in figure.
- Its construction is similar to that of an N-channel JFET, except that it consists of a P-type silicon bar with two N-type heavily doped regions diffused on opposite sides of its middle part.
- The N-type regions form two PN junctions.
- The space between the junctions i.e. P-type junction is called a channel.
- Both, the N-type regions are connected internally and a single wire is taken out in the form of a terminal called the gate (G).
- The electrical connections (called ohmic contacts) are made to both ends of the P-type semiconductor and are taken out in the form of two terminals called drain (D) and source (S).
- The drain (D) is a terminal through which electrons enter the Silicon bar and source (S) is a terminal through which electrons leave the semiconductor.

Applications : (Any two)

i. It is used as a high impedance wideband amplifier.

ii. It is used as a buffer amplifier.

iii. It is used as an electronic switch.

iv. It is used as a phase-shift oscillator.

v. It is used as a constant current source.

vi. It is used as a voltage variable resistor (VVR) or voltage dependent resistor (VDR)

f) The I/P AC power to HWR is 140 watts and DC power output obtained is 60 watts. Calculate the efficiency of rectification.

Ans :

$\eta = P_L\ d_c / P_{ac}$ **(2M)**

= 60/140

= 0.428 OR 42.8% **(2M)**