MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC – 27001 – 2005 Certified)

SUMMER – 13 EXAMINATION

Subject Code: **12058** **Model Answer** Page No: 1/27

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.

Q1. Attempt any ten of the following (20)

a) Give typical value of rectification efficiency for Half wave rectifier and Bridge rectifier.

Ans: Typical value of rectification efficiency for half wave rectifier is 40.6%
and for bridge rectifier is 81.2%. (1+1)

b) List any four filters you have studied.

Ans : Four types of filters are: (2)

I. Series inductor (or choke) filter.
II. Shunt capacitor filter.
III. Choke input (LC or L type) filter.
IV. Capacitor input (CLC or π) filter.

c) Draw construction of n-p-n and p-n-p transistors.

Ans: Diagram 1 (1)

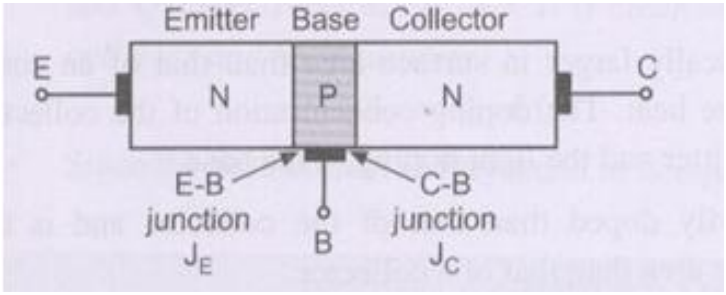
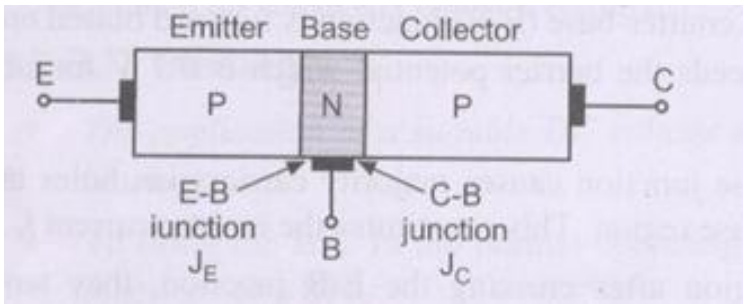


Diagram 2 (1)



d) Give the application of multistage amplifier.

Ans : (Any two) (2)

i) It is widely used as voltage amplifier.

ii) It is also used in radio and television receivers.

iii) It is used in Power amplifier also.

iv) It is mostly used for impedance matching between the individual stages.

v) It is used in liner integrated circuit.

e) Give the phase relationship between input and output voltage of single stage common emitter amplifier.

Ans : The phase relationship between input & output voltage of single stage CE amplifier is out of phase by 180°. (2)

f) State typical values of knee voltages for Silicon and Germanium diode.

Ans : Typical value of knee voltage for Silicon is 0.6V and for Germanium it's 0.2V. (1+1)

g) For emitting Red and Blue colour light, which semiconducting materials are used for manufacturing LED's.

Ans: Gallium Phosphide (GaP) or Gallium-Arsenide-Phosphide (GaAsP) is used in red LED (1)

and

for a blue light Zinc Salenide (ZnSe) and Indium Gallium Nitride (InGaN) (1)

h) Give typical value of PIV rating for Half-wave and Bridge rectifier.

Ans : The Peak Inverse Voltage (PIV) for a half wave rectifier is the peak voltage (Vm) of the input AC signal.

Mathamaticaly, PIV = Vm

The Peak Inverse Voltage (PIV) for a full wave bridge rectifier is the peak voltage (Vm) of the input AC signal.

Mathematically, PIV = Vm. (1+1)

i) In active mode operation of transistor state Emitter-base and Collector-base bias condition.

Ans : The base- emitter (B-E) junction is forward biased and collector- base junction is reverse biased to operate the transistor in the active region. (1+1)

j) Compare width of emitter collector and base regions in BJT.

Ans : Width of Base is very thin, Collector width is larger than emitter width & emitter width is between base & collector. (2)

k) Write down output voltages for IC's 7818 and 7924.

Ans : output voltage for IC 7818 is +18V. and output voltage for IC 7924 is -24V. (1+1)

l) Define gain, Bandwidth of small signal amplifier.

Ans: Gain: (1)

Gain is defined as the ratio of output quantity to the input quantity.

Bandwidth: (1)

It is defined as the range of frequency over which the voltage gain of an amplifier remains constant is called bandwidth of amplifier. It is denoted by BW.

BW = f_2-f_1 Hz.

Where f_1 = lower cut off frequency, f_2 = upper cut off frequency.

Q2. Attempt any four of the following :

a) Define Load regulation and Line regulation for regulated power supply with the expression.

Ans : **Load regulation:** (2)

The load regulation (L.R) is defined as the change in output voltage when the load current is changed from zero (no load) to maximum (full load) value.

It is calculated as

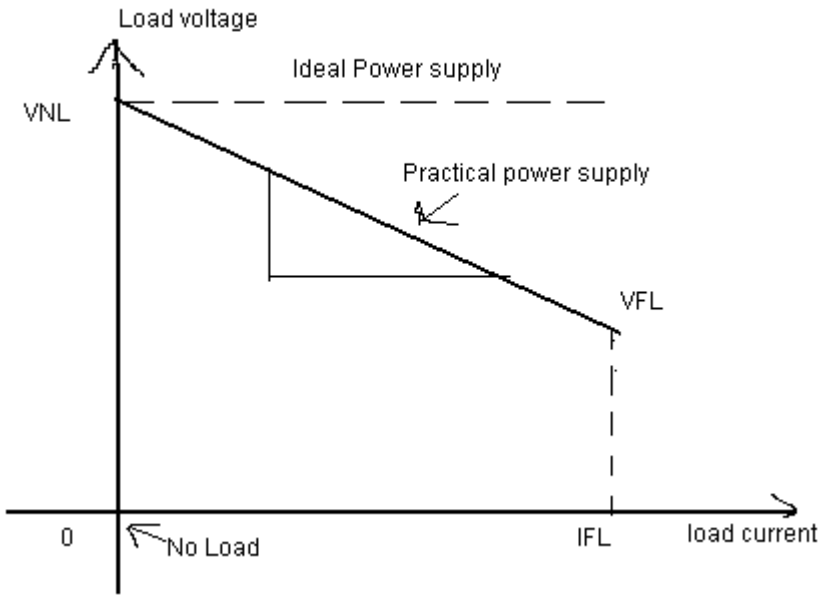
Load regulation (LR) = V_{NL} - V_{FL}

where

V_{NL} = Output voltage on no load

V_{FL}= Output voltage on full load

$$\% \text{ voltage regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100 \ \Big| \text{Vin constant}$$



Line Regulation: (2)

The source regulation is defined (SR) is defined as the change in regulated load voltage due to change in line voltage in a specified range of 230V$\pm$ 10% at a constant load current.

OR

It is defined as the change in output voltage due to change in input voltage with load R_L constant(I_L constant).

The source regulation (S.R) = $V_{LH} - V_{LL}$

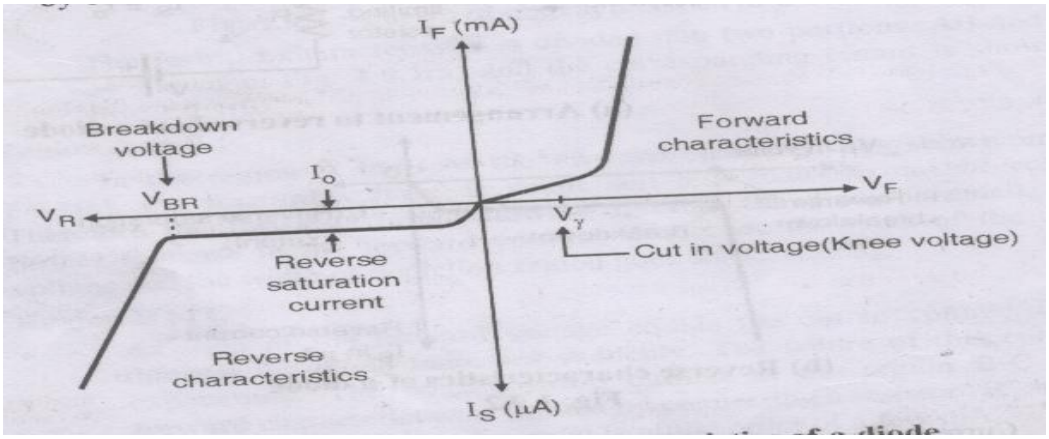
V_{LH} = Load voltage with high voltage

V_{LL} = Load voltage with low voltage

$$\% \text{ line Regulation} = \frac{Vo \times 100}{Vo} \Big|_{\substack{RL \text{ constant} \\ \text{or} \\ IL \text{ constant}}}$$

b) Draw the V-I characteristics of P-N junction diode in forward and reverse bias. Define static and dynamic resistance.

Ans : Diagram (2)



Static resistance: The resistance of diode at the operating point can be obtained by taking the ratio of Vf and If. This resistance offered by the diode is called as static resistance and it is denoted by Rf. (1)

Static resistance : Rf = Vf/ If.

Dynamic resistance: It is defined as the ratio of change in voltage to the change in current. (1)

Dynamic resistance = Δ V/ ΔI.

c) Derive the relation between α and β with respect to BJT. (4)

Ans :

$\alpha = Ic/IE$

(But $I_E = I_B + I_c$)

$\alpha = I_C/I_B + I_C$

Divide by I_B both Numerator & Denominator

$\alpha = (I_C/I_B)/(I_B/I_B + I_C/I_B)$

as $\beta = I_C/I_B$

$\alpha = \beta/1+\beta$

OR

$\beta = I_C/I_B$

(But $I_E = I_B + I_c$)therefore $I_B = I_E - I_C$

$\beta = I_C/I_E - I_C$

Divide by I_E to both Numerator& Denominator

$\beta = (I_C/I_E) / (I_E/I_E - I_C/I_E)$

as $\alpha = Ic/IE$

$\beta = \alpha/1-\alpha$

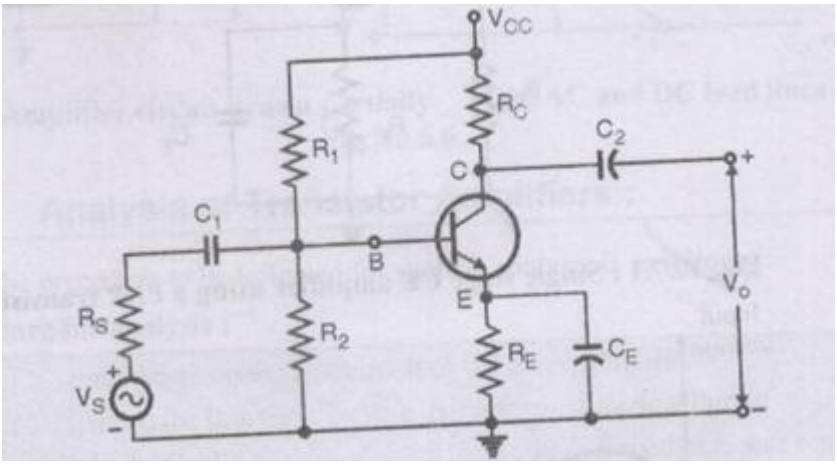
d) Compare CB and CE configurations with respect to input resistance, output resistance, current gain, voltage gain. (4)

Ans :

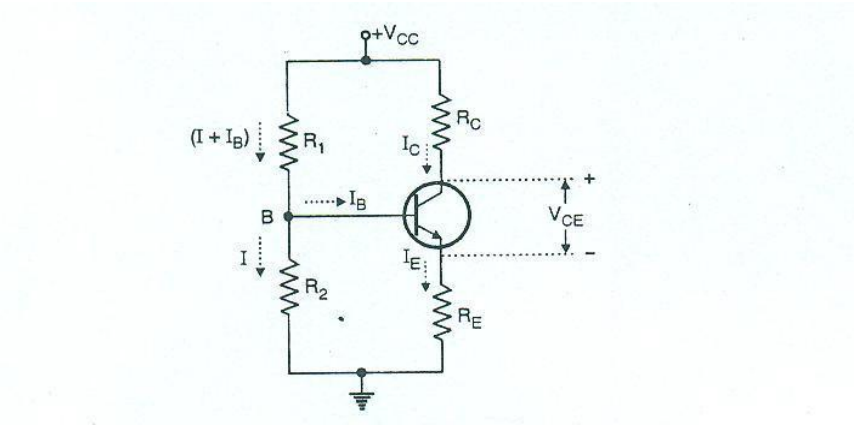
Sr.No	Parameter	CB	CE	CC
1	Input resistance	Low (20Ω)	Medium (1KΩ)	High (500kΩ)
2	Output resistance	Very high (1MΩ)	Medium (40KΩ)	Low (50Ω)
3	Current gain	$\alpha_{dc} = I_C/I_B$ or 1	$\beta_{dc} = I_C/I_B$ or β(20-200)	γdc $= I_E/I_B$ or (β+1)
4	Voltage gain	High	Higher than CB	Less than or nearly equal to1

e) Draw circuit diagram of single stage CE amplifier. Draw its DC equivalent circuit.

Ans : Single stage CE amplifier: (2)

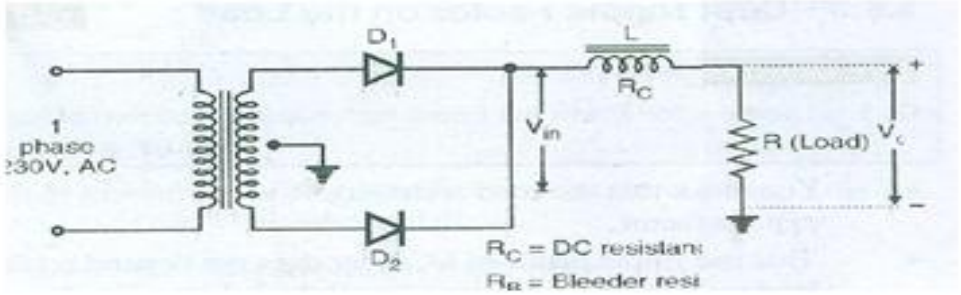


DC equivalent circuit (2)

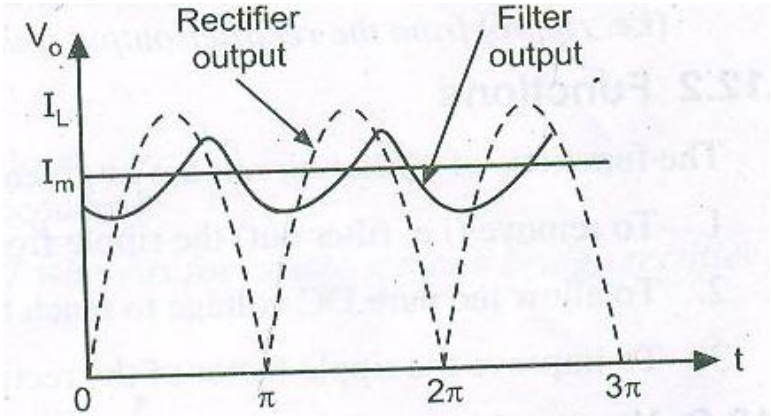


f) Draw circuit diagram of center tapped full wave rectifier with series inductor filter. Draw its input and output waveform.

Ans : Diagram (2)



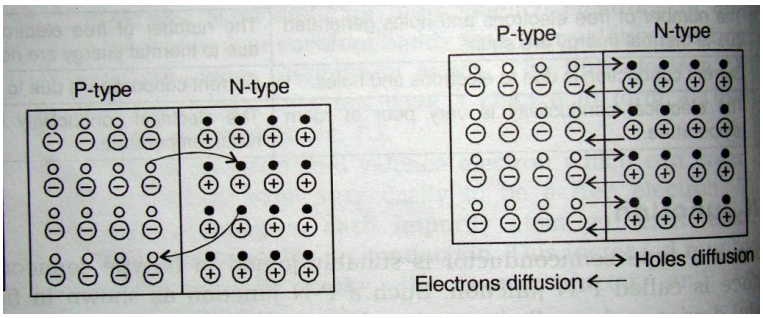
Waveforms (2)



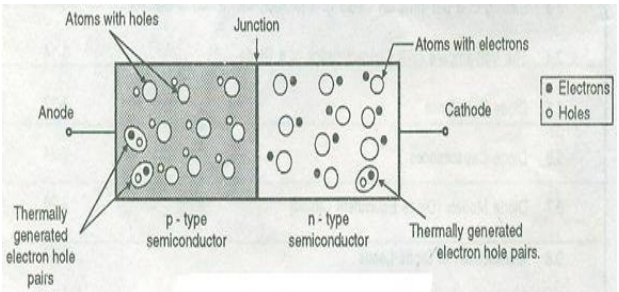
Q3. **Attempt any FOUR** **(16)**

a) Explain the formation of unbiased PN junction diode with suitable diagram.

Ans : Diagram (any one) (2)



OR



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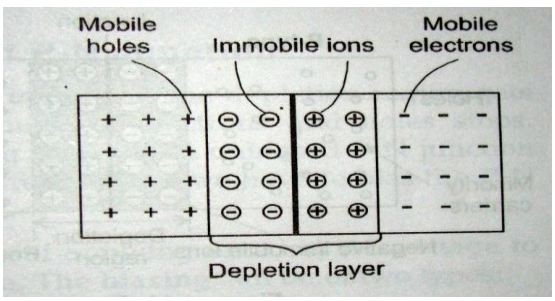
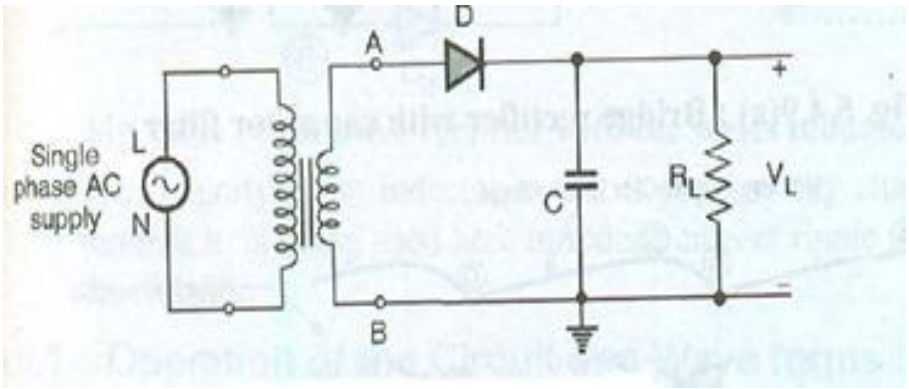


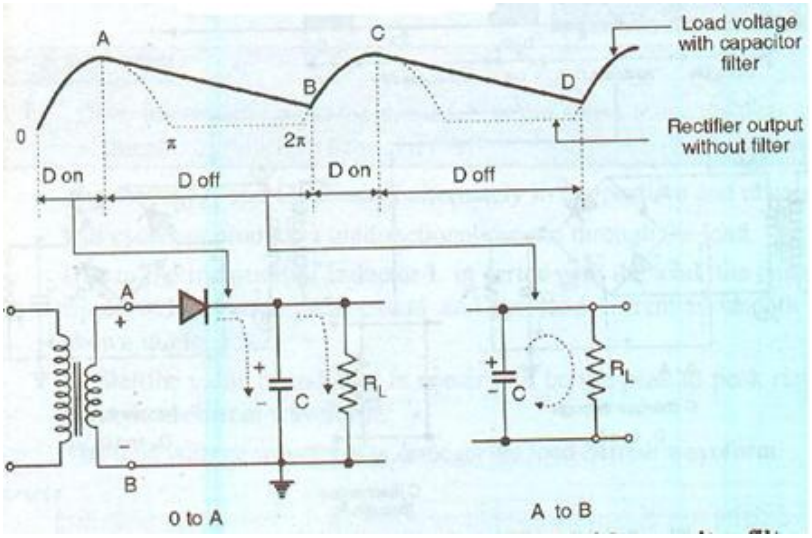
Explanation (2)

- P-type & N-type region are joined together to form a P-N junction diode.
- The N-side consists of a large number of electrons and few thermally generated holes whereas the P-side consists of a large number of holes and a few thermally generated electrons.
- Thus the electrons are majority carriers and holes are minority carriers in the N-region whereas their roles are exactly opposite in the P-region .
- As shown in the diagram due to diffusion process the free electrons i.e. majority carriers of N-side will diffuse in to P-side and recombine with the holes there.
- At this point it leaves behind a positive immobile ion on N-side as shown in the figure.
- When the electron combine with a hole on P-side, the atom which accepts this electrons loses its electrical neutral status and becomes a negative immobile ion as shown.
- Due to recombination process a large number of positive immobile ions accumulate near the junction on N-side and a large number of negative immobile ions accumulate on p-side near the junction as shown.
- The negative charged ions on P-side start repelling the electrons which attempt to diffuse on P-side and thus further diffusion totally stops.
- A region has only immobile ions and no free charge carrier like holes or electrons. The region which is "depleted" of the free electrons and holes is called '**depletion region'**.
- Due to the presence of immobile positive and negative ions on opposite sides of the junction, an electric field is created across the junction. This electric field is known as the **barrier potential.**

b) Draw Circuit diagram of half wave rectifier with capacitor input filter. How filtration takes place in it.

Ans : Diagram (2)





Operation and Waveforms : (2)

Connect the capacitor C in shunt with the load RL. The capacitance offers a lower reactance path to the AC components of the current. To DC, this acts like an open circuit. All the DC current passes through the load. Only a small part of the AC component passes through the load reducing a small ripple voltage.

The capacitor changes the conditions under which the diode conducts.

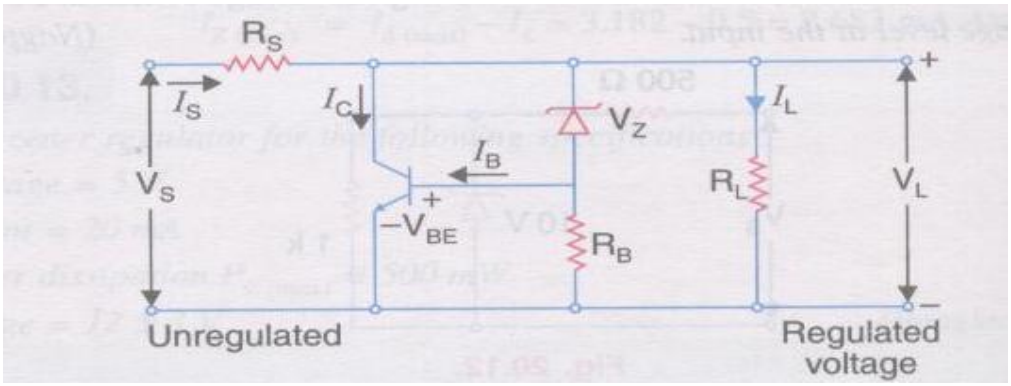
For the intervals 0 to A, B to C the diode is forward biased and the capacitor charges through the diode almost instantly.

For the intervals A to B ,C to D the capacitor voltage is higher than the instantaneous secondary voltage .Hence the diode the is off and the capacitor discharges through R_L slowly.

c) Draw circuit diagram of transistorized shunt regulator circuit and describe its operation .

Ans:

Transistorized Shunt Regulator Diagram (2)



Operation (2)

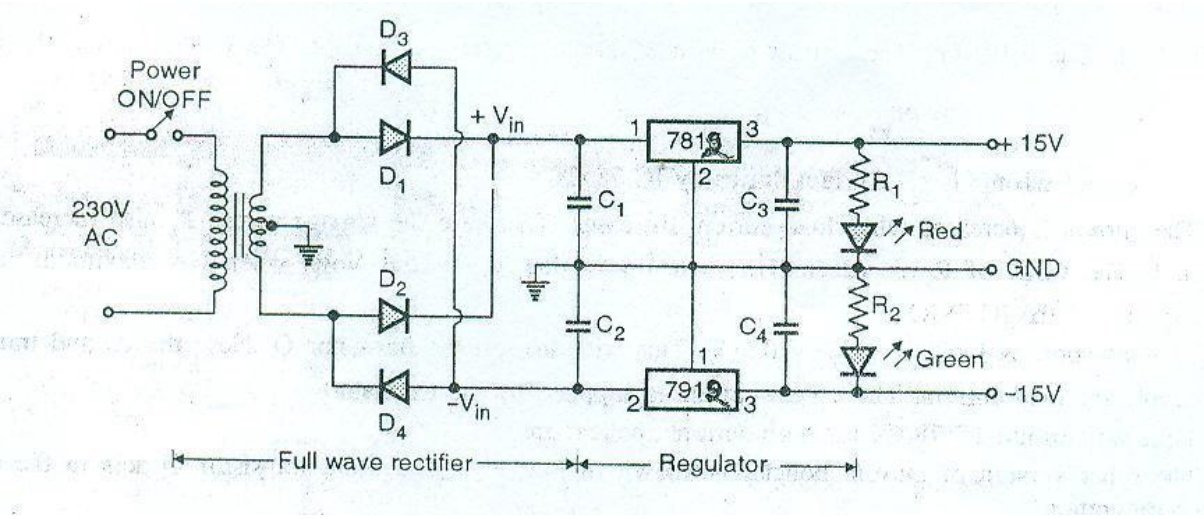
- From the figure, since the transistor is connected in shunt with the load resistance ,therefore the circuit is known as Shunt Regulator.
- From the figure V_L is equal to the sum of the zener voltage V_Z and the base – emitter voltage V_{BE} of the transistor.
- $V_L = Vz + V_{BE}$
- Since the voltage for a given zener diode is fixed,therefore any increase or decrease in load voltage will have a corresponding effect on the V_{BE}.
- Suppose that Unregulated input voltage (Vs) increases.so, the load voltage also increases.
- As a result of this from equation, V_{BE} also increases.
- I_B of transistor increases.
- Due to this I_C also increases.
- This causes the input current(Is)to increase , which in turn increases the voltage drop across series resistance (V_{RS}).
- Consequently ,the load voltage decreases. This is because sum of the voltage drop across series resistance (V_{RS}) and the load voltage (V_L) is equal to input voltage (Vs) at all times i.e.
- $Vs = V_Rs + V_L$ or $V_L = Vs – V_Rs$
- Summary

Vs ↑ → V_L ↑ → V_{BE} ↑ Ic ↑ → VRs ↑ → V_L ↓

So, V_L gets regulated .

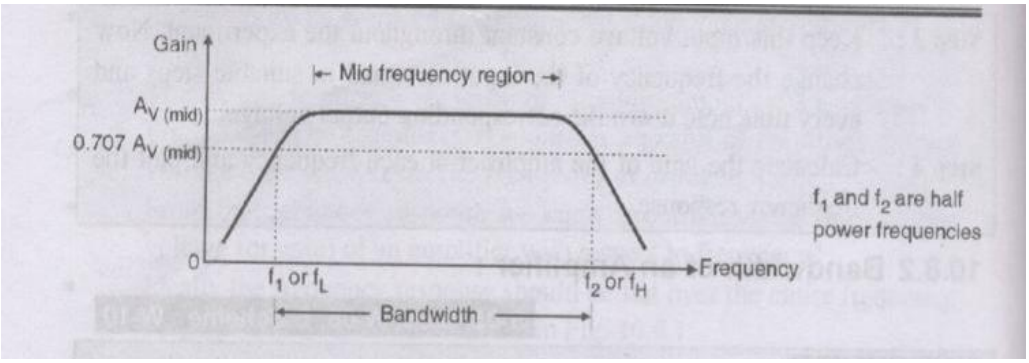
The transistor shunt regulator is suitable for the loads in which the load current varies from a finite minimum value to a finite maximum value

d) Draw circuit diagram of dual tracking power supply which gives ±12V. (4)



e) Draw the frequency response of single stage amplifier and explain the effect of coupling capacitance and junction capacitance on it.

Ans : Diagram (2)



Frequency Response of CE amplifier

Coupling Capacitor C_C : (1)

The C_C coupling capacitor 10μf couples one stage amplification to next stage. If it is not used, the bias conditions of the next stage will be drastically changed due to the shunting effect of R_C. This is because RC will come in parallel with the upper resistance R1 of the biasing network of the next stage. Therefore, the coupling capacitor C_C isolates the d.c. of one stage from the next stage, but allows the passage of a.c. signal.

Effect of coupling capacitor :-

Coupling capacitors are used for blocking the DC part and allowing the AC part of the signal to pass through.

$Xc = \frac{1}{2\pi fc}$ (Reactance of capacitor Xc)

When frequency is low, Xc will increase because of that impedance will increase and the signal will be attenuated.

Junction capacitance : (1)

Another important factor responsible for the reduction in gain of the amplifier at high frequencies is the presence of the device. In case of a transistor, there exists some capacitance due to the formation of depletion layer at the junctions. These are the inter electrode capacitances. These are not present physically but inherently present with the device.

The capacitance C_{BC} between the base and collector connects the output with the input. Because of this, negative feed back takes place and the gain decreases.

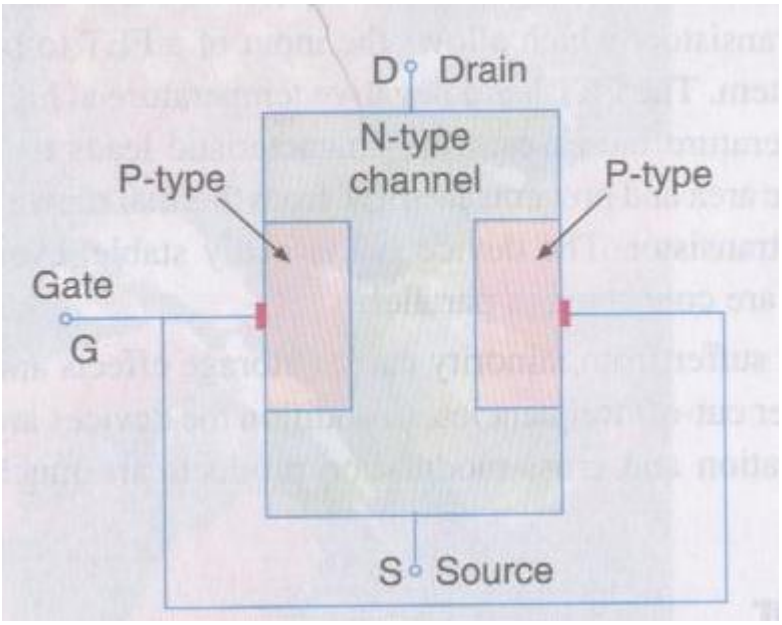
The capacitance C_{BE} offers a low impedance path at high frequencies in the input side. This reduces the input impedance of the device and the effective input signal is reduced. So, the gain decreases.

The capacitance C_{CE} produces a shunting effect at high frequencies in the output side.

The voltage drop increases with decrease in frequency that in turn reduces the output voltage & gain of the amplifier.

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

Ans : Diagram of N Channel JFET (2)



Construction of N channel JFET : (2)

It consists of an N-type semiconductor bar with two P- type heavily doped regions diffused on opposite sides of its middle part .The P-type regions form two P-N junctions.

The space between the junctions (i.e. N-type regions) is called a CHANNEL. Both the P-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 the ohmic contacts are made on both ends of the N-type semiconductor and are taken out in the form of two terminals called Drain (D) and source (S).

The Drain is a terminal through which the electrons leave the semiconductor bar and source (S) is a terminal through which the electrons enter the semiconductor.

Whenever a voltage is applied across the drain and source terminals ,a current flows through the N-channel. The current consists of only one type of carriers (i.e) electrons ,therefore FET is unipolar device

g) Define two port network and draw the hybrid model for CE.

Ans Two Port Network (2)

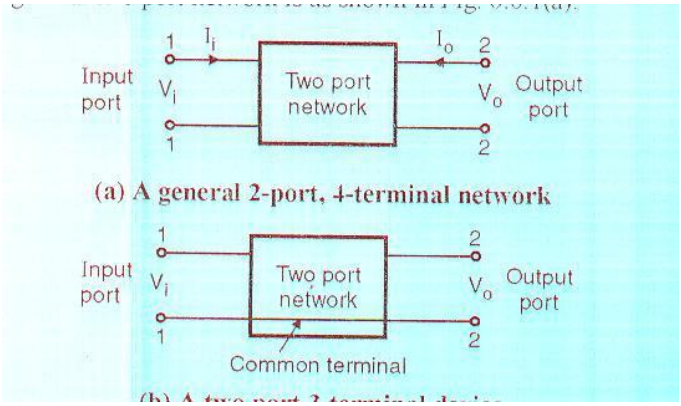
This network has an input port and an output port. Therefore total number of terminals are four.

- The two port network model is used in mathematical circuit analysis techniques to isolate portions of larger circuits.
- For example transistors are often regarded as 2 ports, characterized by their h – parameters.
- Transistor consists of 3 terminals. So, one of the three terminals is common to the input and output ports.
- Depending on which terminal is made common to input & output port there are three possible configurations of transistors.

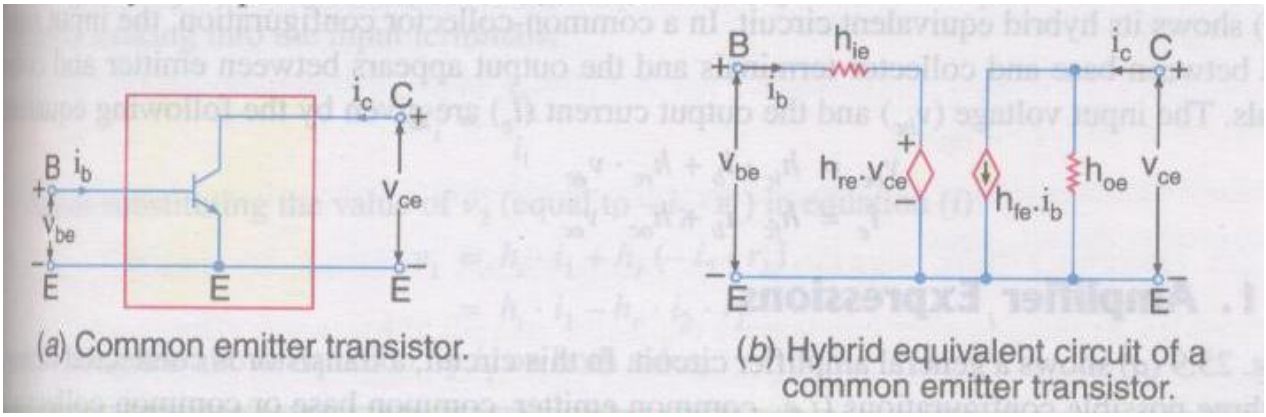
1) Common Base Configuration

2) Common Emitter Configuration

3) Common Collector Configuration



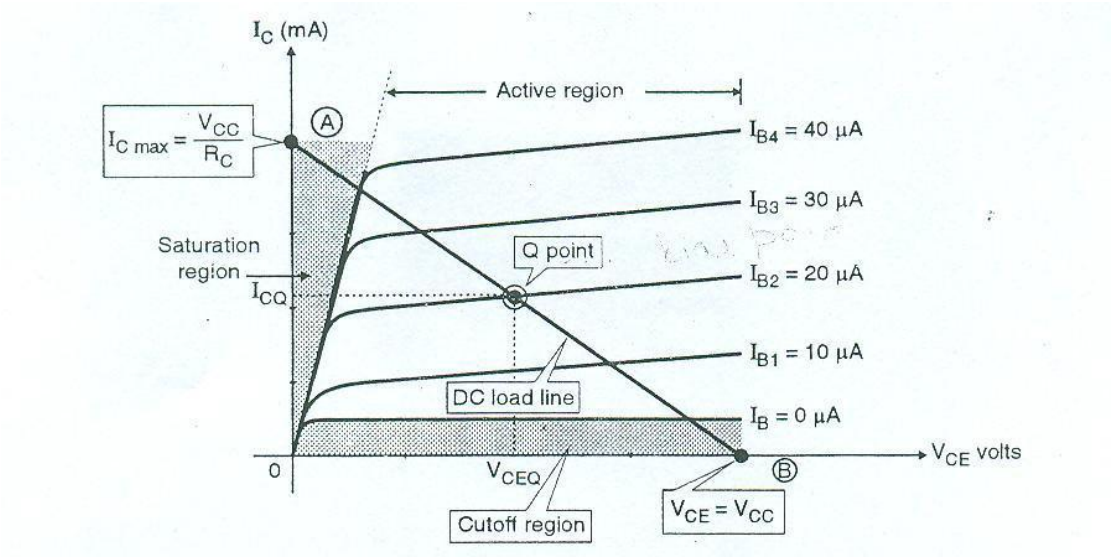
Hybrid model of CE **(2)**



Q4. Attempt ANY FOUR (16)

a) Draw output characteristics of transistor in CE mode .Indicate DC load line with Q point, saturation region and cut off region .

Diagram (4)

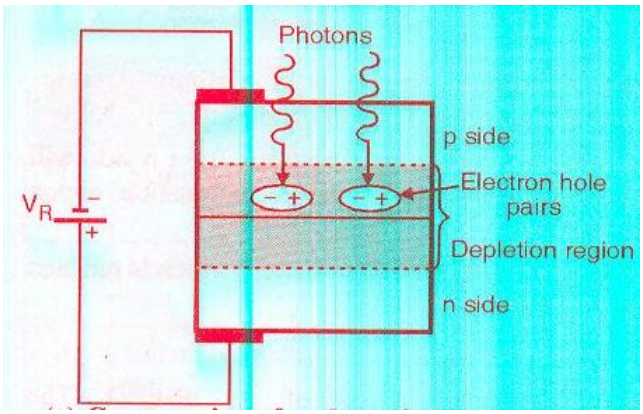


b) Draw constructional details of photodiode. Draw its symbol. Explain its working.

Ans Symbol (1)

Constructional details of photodiode :-

Diagram (1)



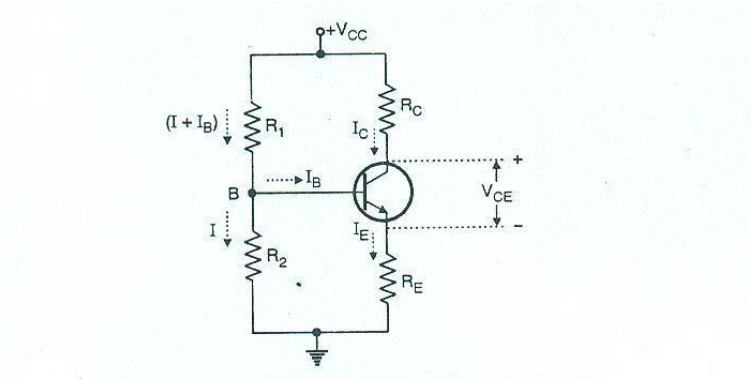
Operating principle of photo diode:- (2)

When the P-N junction is reverse biased, a small amount of reverse saturation current flows . When light energy bombards a P-N junction it dislodges valence electrons. The more light striking the junction the larger the reverse current in a diode. It is due to generation of more & more charge carriers with the increase in level of illumination.

c) Draw the voltage divider circuit. What is the function of R_E, R_1 and R_2 in it.

Ans Diagram (2)

Voltage Divider Bias.



Function of R_E, R_1 and R_2 : **(2)**

It is the most widely used DC biasing circuit. It is commonly known as voltage divider bias or self bias.

Function of R_1 and R_2 : The name voltage divider is derived from the fact that resistors R1 and R2 form a potential divider across the supply V_{CC}. The voltage drop across the resistor R2 forward biases the base-emitter junction of a transistor.

Function of R_E**:** The emitter resistor R_E provides the DC stability.

By suitably selecting this voltage divider network, the operating point of the transistor can be made almost independent of current gain β.

d) What is coupling and bypass capacitor. State its use.

Ans : Emitter Bypass Capacitor C_E : (2)

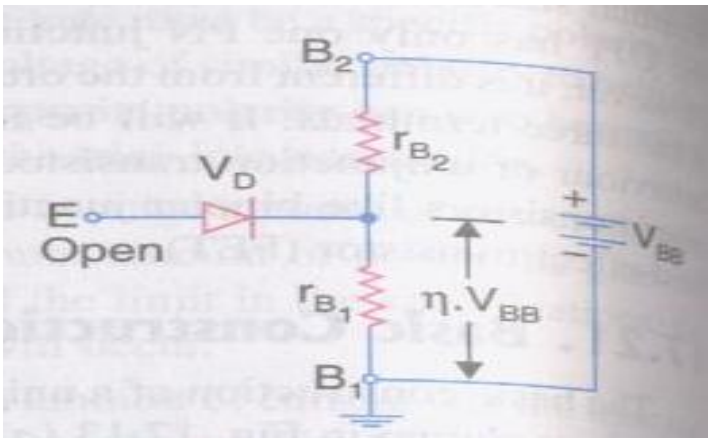
An emitter bypass capacitor C_E 100μF is used in parallel with R_E to provide a low reactance path to the amplified ac signal. If it is not used then amplified ac signal flowing through R_E will cause a voltage drop across it, thereby reducing the output voltage.

Coupling Capacitor C_C : (2)

The C_C coupling capacitor 10μf couples one stage amplification to next stage. If it is not used, the bias conditions of the next stage will be drastically changed due to the shunting effect of R_C. This is because R_C will come in parallel with the upper resistance R_1 of the biasing network of the next stage. Therefore, the coupling capacitor C_C isolates the d.c. of one stage from the next stage, but allows the passage of a.c. signal.

e) Draw Equivalent circuit of UJT. Define ŋ . What is the meaning of negative resistance region?

Ans : UJT equivalent circuit with battery V_{BB} (2)



Definition of ŋ (Intrinsic Stand Off Ratio) (1)

Consider the Equivalent circuit of UJT with battery V_{BB} applied across its base terminlas B_1 and B_2.As the emitter is open V_{BB} divides itself across r_{B1} and r_{B2}.The voltage across the resistance r_{B1}

$$V_1 = \frac{r_{B1}}{r_{B1} + r_{B2}} \times V_{BB} = \frac{r_{B1}}{r_{BB}} \times V_{BB}$$

The resistance Ratio $\frac{r_{B1}}{r_{BB}}$ is an important characteristics of UJT.

It is known as Intrinsic Stand Off Ratio.It is given by

$$ŋ = \frac{r_{B1}}{r_{BB}} = \frac{r_{B1}}{r_{B1} + r_{B2}}$$

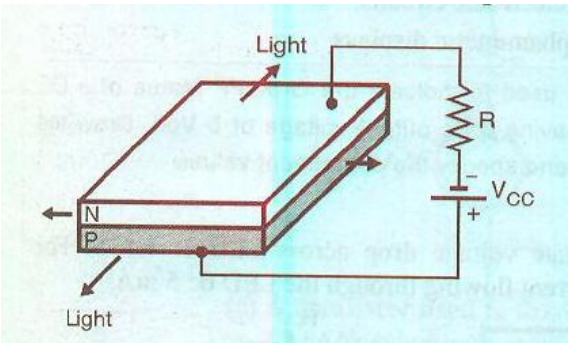
Generally the value of ŋ is between 0.5 to 0.8.

Negative resistance region:- (1)

The region between the peak point and the valley point is called negative – resistance region. In this region the emitter voltage decreases from Vp to Vv and emitter current increases from I_P to Iv. The increase in emitter current is due to the decrease in resistance r_{B1}.Therefore , this region is called negative –resistance region.

f) Draw and explain construction of IRLED.

Ans: Diagram (2)



Construction (2)

- This type of LED emits light in the Infra red region of the electromagnetic spectrum in the range of 760 nm wavelength.
  The IR LED is a P-N junction diode It is made up of Gallium Arsenide and operated in forward biased condition.
- When the forward voltage is applied the electrons from N side will recombine with the holes on P side in the recombination region between P and N regions.
- During recombination some energy is released which is radiated in the form of Infra Red Light.

Q.5. Attempt any four (16)

a) What is necessity of multistage amplifier ? If four stages with individual voltage gains A_1, A_2, A_3 and A_4 are cascaded, what is total voltage gain ?

Ans : Necessity of multistage amplifier (2)

1) The amplification provided by a single stage amplifier is not sufficiently large and
2) The input and output impedances are not of correct value.

If four stages with individual voltage gains A_1, A_2, A_3 and A_4 are cascaded, then total voltage gain is, $A_V = A_{V1} \times A_{V2} \times A_{V3} \times A_{V4}$ (2)

OR

$G_V = G_{V1} + G_{V2} + G_{V3} + G_{V4}$

$= 20 \log_{10} A_{V1} + 20 \log_{10} A_{V2} + 20\log_{10} A_{V3} + 20\log_{10} A_{V4}$

$= 20 \log_{10} A_V$ (dB)

b) What do you mean by thermal runaway of transistor ? How it is avoided ?

Ans : Thermal Runaway of Transistor (3)

- The maximum power that a transistor can dissipated without getting damaged, depends largely on the maximum temperature that a collector – base junction can withstand.
- The rise in the collector – base junction takes place due to two reasons:
  - Due to increases in ambient temperature and
  - Due to the internal heating.

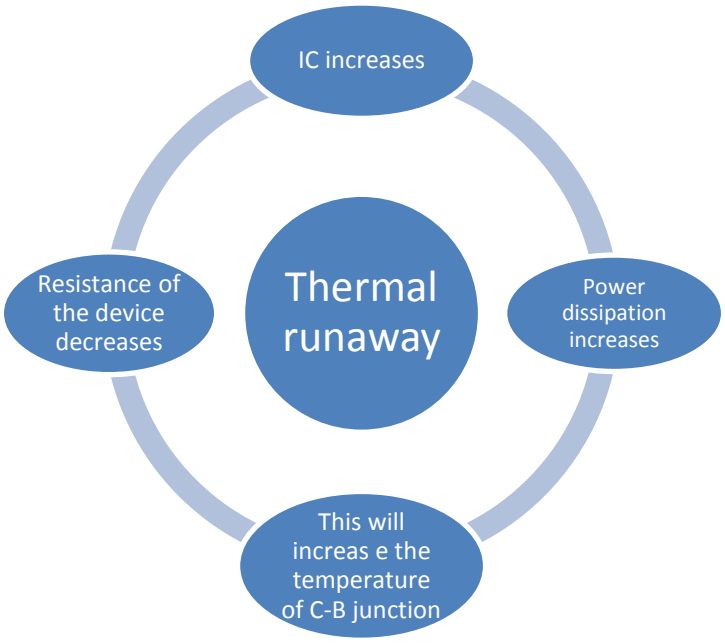
The internal heating is due to the following reasons:

i) When collector current increases, it causes an increase in power dissipation in the collector base junction.

ii) This increase in power increases the temperature of the collector-base junction.

iii) This increased junction temperature reduces the resistance.

iv) This reduced resistance will increase the collector current. This further increase in collector current will damage the transistor due to excessive internal heating. This process is called as "Thermal Runaway".



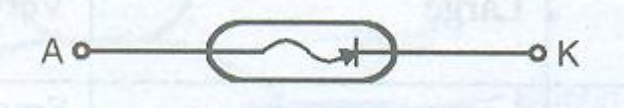
Avoid the thermal runaway: (1)

- Never exceed the collector current beyond a certain maximum value specified by the manufacturer.
- Never exceed the internal power dissipation above the maximum permissible value.
- Use heat sink

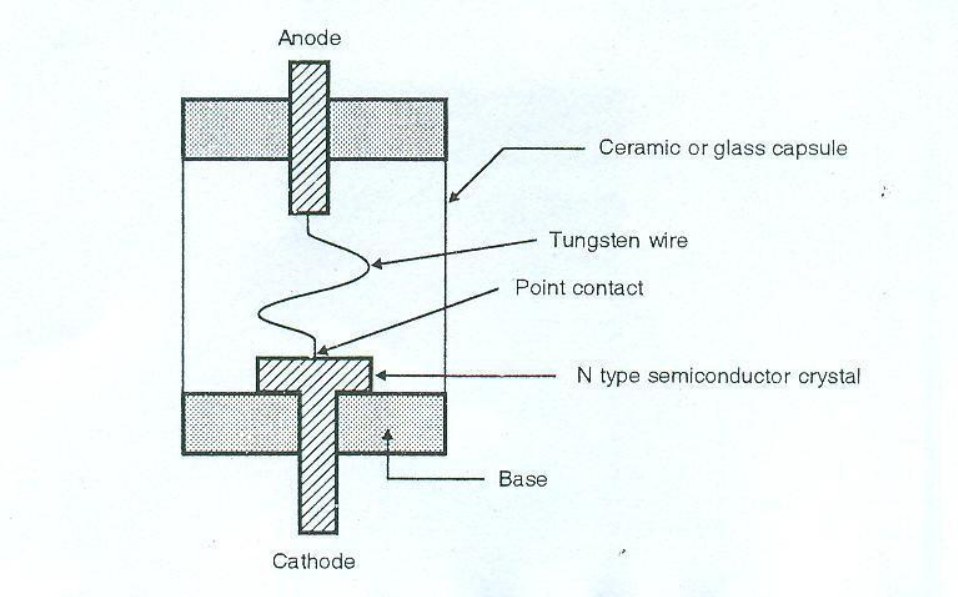
c) Draw symbol of point contact diode. Explain its construction. Write any two applications of it.

Ans: Point contact Diode :-

Symbol (1)



Construction (2)



- The N type semiconductor crystal (Si or Ge) is mounted on the base. A contact is made with this N type crystal and the connection is brought out as cathode.
- Anode is connected to a stiff pointed tungsten wire, which is placed under pressure in contact with the N type semiconductor crystal.
- The contact area of this wire with the N type crystal is much smaller than the cross sectional area of the wire.
- The entire assembly is enclosed in a ceramic or glass capsule.
- The tungsten wire is coated with indium which acts as an accepter impurity.
- The pn junction is formed at the point of contact between the tungsten wire and the n-type semiconductor.

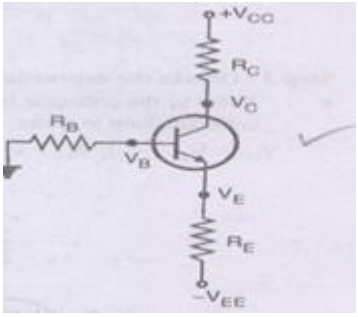
Applications : (Any two) (1)

1) AM detector in radio receiver
2) Video detector in TV
3) Microwave frequency mixer
4) In pulse circuits

d) Draw and explain emitter bias method for BJT.

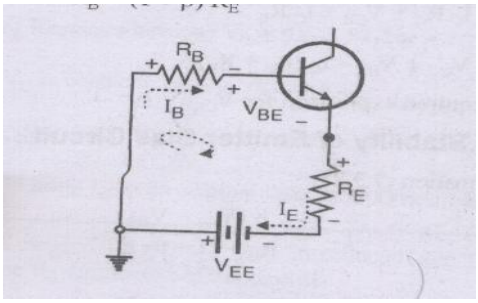
Ans : Emitter bias method for BJT

Step 1: Draw the circuit (2)



Analysis of Emitter bias: (2)

Step-2**: Obtain the expression for I_B:**



Refer to the base loop shown in fig. Apply KVL to the base loop to write,

$$V_{EE} = I_B R_B + V_{BE} + I_E R_E$$

But $I_E = I_c + I_B = (1+\beta) I_B$

$$V_{EE} = I_B R_B + V_{BE} + (1+\beta) I_B R_E$$

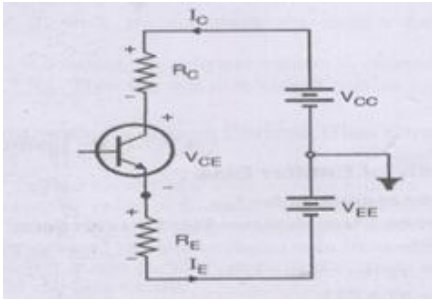
$$I_B = (V_{EE} - V_{BE}) / (R_B + (1+\beta) R_E)$$

Step-3: **Obtain the expression for I_C:**

$$IC = \beta I_B$$

$$= \beta \times (V_{EE} - V_{BE}) / (R_B + (1+\beta) R_E)$$

Step-4: Draw the collector circuit.



Step-5: **Obtain the expression for V_{CE}:**

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

Assume $I_E = I_C$

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

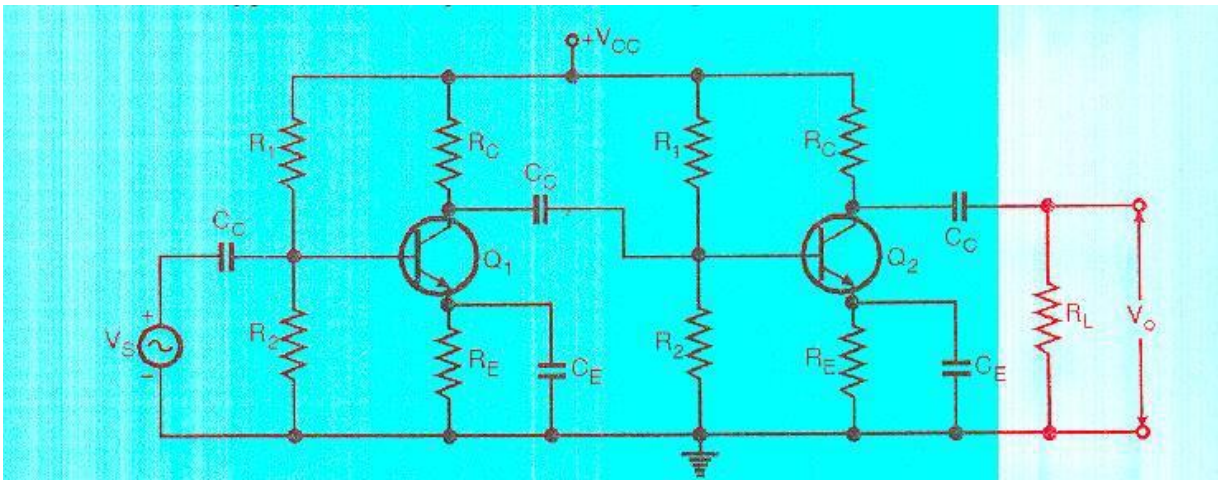
$$V_{CE} = V_{CC} + V_{EE} - I_C (R_C + R_E)$$

This is the required expression for V_{CE}

e) Draw the circuit diagram of 2 stage R-C coupled amplifier. State its advantages and disadvantages.

Ans : Two stage RC – coupled amplifier

(2)



Advantages of two stage RC coupled amplifier. (any two) (1)

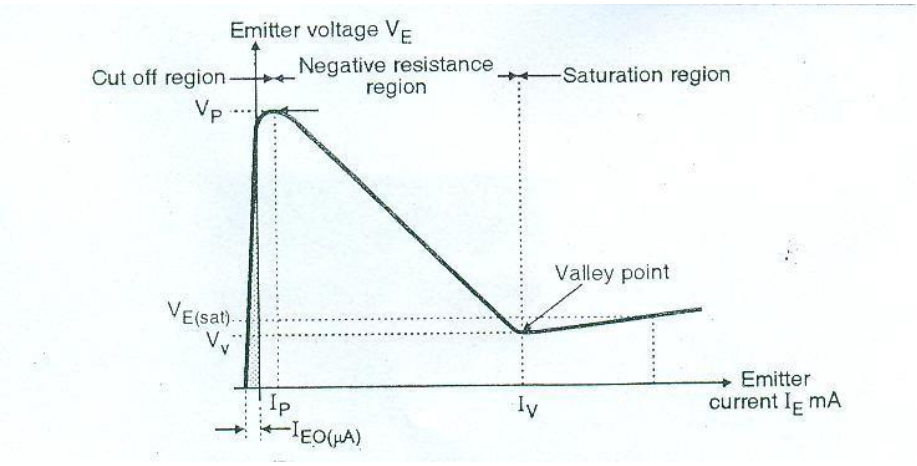
1) Wide frequency response.
2) It is most convenient coupling.
3) It is an inexpensive way of coupling.
4) It is high fidelity amplifier.
5) The distortion in the output is low.
6) Used for amplifying audio frequency (AF) signals.
7) Gain is very high and adjustable.

Disadvantages :- (any two) (1)

1) No impedance matching.
2) Gain reduces at low frequencies due to the coupling capacitors.
3) Overall voltage gain is less.
4) Ageing can make these amplifiers noisy.

f) Draw and explain characteristics of UJT.

Ans : Characteristics of UJT (2)



Explanation:- (2)

The above diagram shows the V-I characteristics Of UJT. There are two important points on the characteristics Curve namely the peak point and the valley point.

There are three region i.e. cut off region, negative resistance region and saturation region.

i) **Cut off region**:- the region to the left of peak point is called cut off region. The UJT is in off condition in this region.

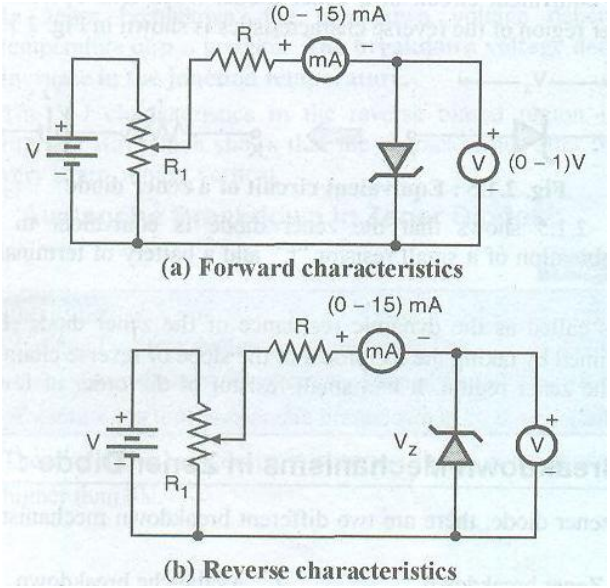
ii) **Negative resistance region**:- the region between the peak point and the valley point is called negative – resistance region. In this region the emitter voltage decreases from Vp to Vv and current increases.

iii) **Saturation region**:- the region beyond the valley point is called saturation region. In this region the device is in ON –state.

Q6) Attempt any four (16)

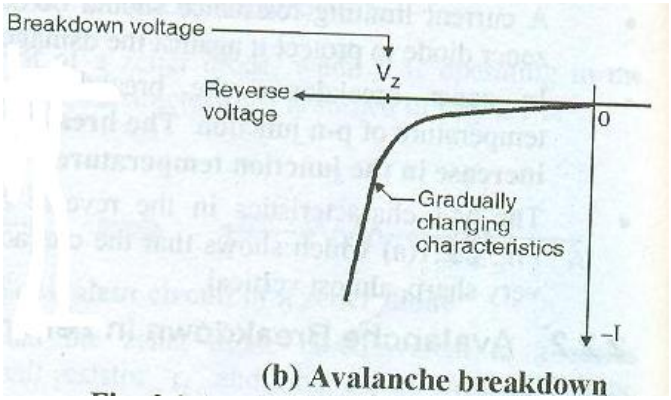
a) Draw the experimental set up for zener diode characteristics. Explain avalanche breakdown.

Ans : Experimental set up for Zener Diode characteristics (2)



Avalanche Breakdown (2)

Avalanche breakdown is observed for lightly doped zener diodes having breakdown voltage of greater than 8 volts. Whenever reverse voltage is applied to a lightly doped zener diode, conduction takes place due to movement of minority charge carriers with increased reverse bias, these minority charge carrier acquire more kinetic energy and they collide with the stationary atoms. During this process, they break covalent bonds and generate free electrons. These free electrons also acquire kinetic energy and collide with other atoms to generate more free carriers. Thus in a short time reverse current in a zener diode increases sharply due to presence of large number of free charge carriers. This type breakdown is referred as Avalanche breakdown and the effect is known as avalanche effect.



b) For a half-wave rectifier circuit Vs = 30 sinωt R_L = 1KΩ , R_f = 10Ω, Vbreakdown = 50V. Calculate values of Im, Irms, Id and Pdc output.

Ans: Given :-

Vs = 30 sinωt, R_L = 1KΩ , R_f = 10Ω, Vbreakdown = 50V

Solution :

Vs = 30 sinωt

Therefore, Vm = 30V

1) $Im = \frac{Vm}{R_f + R_L}$ (1)

$= \frac{30}{(1x10^3) + 10} = 29.7 \text{ mA} = 0.0297 \text{ A}$

2) $Irms = \frac{Im}{2} = \frac{29.7}{2} = 14.85 \text{ mA}$ (1)

3) $I_{dc} = Im/\pi = 9.45 \text{ mA}$ (1)

4) $P_{dc} = I_{dc}^2 \times R_L = (9.45 \times 10^{-3})^2 \times 1 \times 10^3$ (1)

$= 0.0893 \text{ W} = 89.3 \text{ mw}$

c) Explain the need of biasing for BJT.

Ans : Need of Biasing for BJT (4)

1) Biasing of transistor is required to turn it ON and to place it in a region where it operates linearly and provides a constant amount of voltage gain.
2) We know that transistor can operate in any of the three regions of operations namely cutoff, active region and saturation.
3) To operate the transistor in these regions the two junctions of a transistor should be forward or reverse biased as shown in table below :

Region of operation	Base emitter junction	Collector base junction	Application
Cutoff	Reverse biased	Reverse biased	As a switch
Active	Forward biased	Reverse biased	Amplifier
Saturation	Forward biased	Forward biased	As a switch

4) In order to do so, we need to connect external dc power supplies with correct polarities and magnitudes. This process is called as dc biasing of a transistor.

d) Write important features of IC 723.

Ans : Important features of IC723 (any four) (4)

- Input voltage 40V maximum
- It works as voltage regulator at output ranging from 2 to 37V at current upto 150mA.
- It can be used at load current up to 150mA.
- Input & output shunt circuit protection is provided.
- It has good line (0.01%) & load regulation (0.03%)
- Small size, lower cost.
- High ripple rejection.
- With the additional transistor used ILmax upto 10A is obtainable.
- Positive or negative supply operation.
- Internal power dissipation of 800mW.
- Built in foldback current limiting.
- Very low temperature drift.
- Can be used as either a linear or a switching regulator.

e) Compare between direct coupled and transformer coupled amplifier with respect to construction, frequency response, size, application.

Ans : Compare between direct coupled and transformer coupled amplifier (4)

Parameters	Direct Coupled	Transformer coupled
Construction	Simple because no coupling components.	Difficult because transformer is coupling components.
Frequency Response	Best frequency response	Poor frequency response
Size	Small	Large
Application	For amplification of low frequencies.	In power amplifiers.

f) 1) A transistor connected in CE configuration is biased to operate in active region of device characteristics when V_{CE} = 12volts, I_C = 10mA and I_B = 50 µA. Calculate the value of β of transistor.

Ans : 1) Given :- (2)

V_{CE} = 12V, Ic = 10 mA, I_B = 50 µA

Solution : $\beta = \frac{I_C}{I_B}$

$= \frac{10 \times 10^{-3}}{50 \times 10^{-6}}$

$\beta = 200$

2) For a transistor operated in CB configuration, I_C = 5.2 mA and I_E = 5.5 mA. Calculate the value of α of CB. Also calculate I_B.

Ans : Given :-

I_C = 5.2 mA, I_E = 5.5 mA

Solution :

$\alpha = \frac{I_C}{I_E}$ (1)

$= \frac{5.2 \text{ X } 10^{-3}}{5.5 \text{ X } 10^{-3}}$

$\alpha = 0.945$

$I_B = I_E - I_C$ (1)

$= (5.5 \text{ X } 10^{-3}) - (5.2 \text{ X } 10^{-3})$

$I_B = 0.3$ mA