Q.1 Attempt any ten: **(2*10=20marks)**

a) Define Intrinsic & extrinsic semiconductor.

Ans: **(Intrinsic 1 mark, extrinsic 1 mark)**

Intrinsic semiconductor: A semiconductor in an extremely pure form is known as an intrinsic semiconductor.

Extrinsic semiconductor: In order to make intrinsic semiconductor more practical electrical conductivity have to be increased by adding certain amount of desired impurity. The resulting semiconductors are called the extrinsic semiconductors.

b) Define rectifier. State its types.

Ans: **(Definition 1 mark, Types 1 mark)**

Rectifier: it is an electronic device which is used for converting an alternating(AC)voltage Or current into a unidirectional (DC) voltage or current.

Types:

1) Half wave rectifier
2) Full wave rectifier:
   i) Centre tap full wave rectifier.
   ii) Full wave bridge rectifier.

c) State the different types of filters used in rectifiers.

Ans: **(each1\2 mark)**

Types of filters:

i) Series inductor filter or L filter.
ii) Shunt capacitor filter or C filter
iii) LC filter
iv) π or CLC type filter

d) Draw symbols of 2 types of bipolar junction transistor.

Ans: **(NPN- 1 mark, PNP 1 mark)**

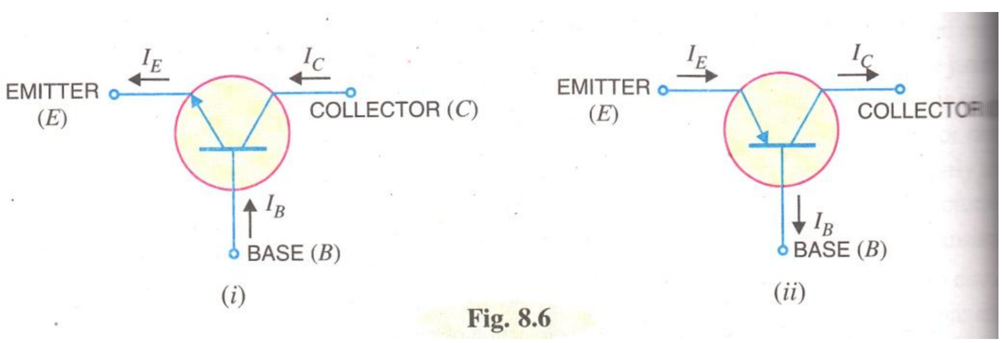


Fig. 8.6

NPN PNP

e) State different hybrid parameters for transistors in CE configuration

Ans: **(each ½ mark)**

$h_{11}=V_{be}\backslash i_b$ for $V_{ce}=0$ O\P short
$h_{21}=i_c \backslash i_b$ for $V_{ce}=0$ O\P short
$h_{12}=V_{be}\backslash C_{ce}$ for $i_b=0$ I\P open
$h_{22}=i_c\backslash V_{ce}$ for $i_b = 0$ I\P open

f) State the applications of direct coupled amplifier.

Ans: **(any-2 each 1)**

Applications:

1. In the operational amplifier
2. In the analog computation
3. In the linear power supplies(voltage regulators)

g) State need of heat sink

Ans: **(2 marks)**

A power transistor handle large currents, They always heat up during operation. Since transistor is temperature dependent device, the heat generated must be dissipated to the surrounding in order to keep the temperature within permissible limits. Most of the heat is produced at collector junction. The heat sink increases the surface area & allows heat to escape from collector junction easily. The result is that temperature is lowered. Thus heat sink is a direct practical means of combating the undesirable thermal effects.

h) Define voltage regulation factor

Ans: **(2 marks)**

The variation of O\P voltage with respect to the amount of load current drawn from the power supply is known as voltage regulation.

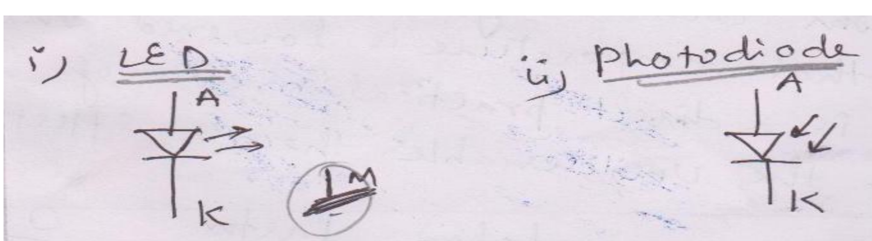
i) State the meaning of transistor amplifying action.

Ans: **(2 marks)**

The I\P circuit (i.e. emitter base junction) has low resistance because of forward bias whereas O\P circuit has high resistance due to reverse bias. A transistor transfers the input signal current from a low resistance to high resistance circuit. This is called as transistor amplifying action because it raises the strength of a week signal.

J) Draw symbols of: i) LED ii) Photodiode

Ans: **(LED 1 mark, Photodiode 1 mark)**



k) Define PIV of diode.

Ans: **(2 marks)**

The maximum reverse voltage which can be applied across a diode without damaging it is called as peak inverse voltage (PIV).

l) State different types of biasing circuits.

Ans: **(any 2, 1 mark each)**

1. Fixed bias circuit(base resistor method)
2. Collector to base bias
3. Voltage divider bias.

m) Give significance of bandwidth of multistage amplifier.

Ans: **(2 marks)**

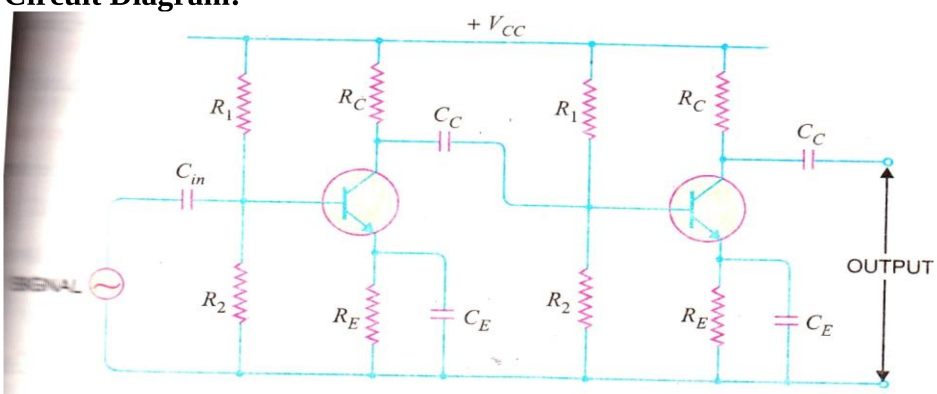
The range of frequency over which the gain is equal to or greater than 70.7% of the maximum gain is known as bandwidth. The voltage gain of an amplifier changes with frequency. Any frequency lying between F1 &F2, the gain is equal to or greater than 70.7% of maximum gain.

Q.2 Attempt any two **(8*2=16)**

a) Draw & explain the working of 2 stages R-C coupled amplifier & discuss its frequency response.

Ans: (ckt of RC- 2 marks, explain. of ckt- 2 marks, freq. res.-2 marks, description-2 marks)

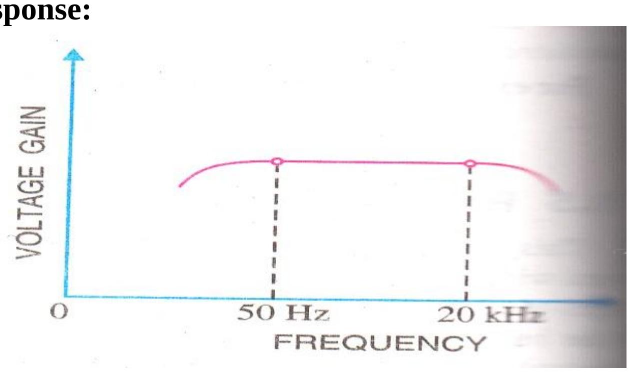
Circuit Diagram:



Explanation:

When ac signal is applied to base of first transistor, it appears in the amplified form across its collector load RC. The second stage amplifies further & overall gain increases in cascaded amplifier. The total gain is less than product of the gains of individual stages. It is because when a second stage is made to follow the first stage is reduced due to the shunting effect of the i\p resistance of second stage. The overall gain shall be equal to the product of the gains of 2 stages.

Frequency Response:



i) At low frequencies (<50Hz) the reactance of coupling capacitor Cc is high & hence small part of signal bases to the next stage. Moreover Ce cannot shunt the emitter resistor effectively because of its large reactance at low frequencies. These two factors cause a falling off voltage gain at low frequencies.

ii) At high frequencies(>20KHz), the reactance of Cc is small & it behave as short circuit. This increases the loading effect of next stage & reduces the voltage gain. Moreover, at high frequency capacitive reactance of base emitter is low which reduces current amplification factor. Due to these 2 reasons ,the voltage gain drop off at high frequency.

iii) At mid frequencies(50Hz to 20KHz), the voltage gain is constant. All factors cancel each other , resulting in uniform gain at mid frequency.

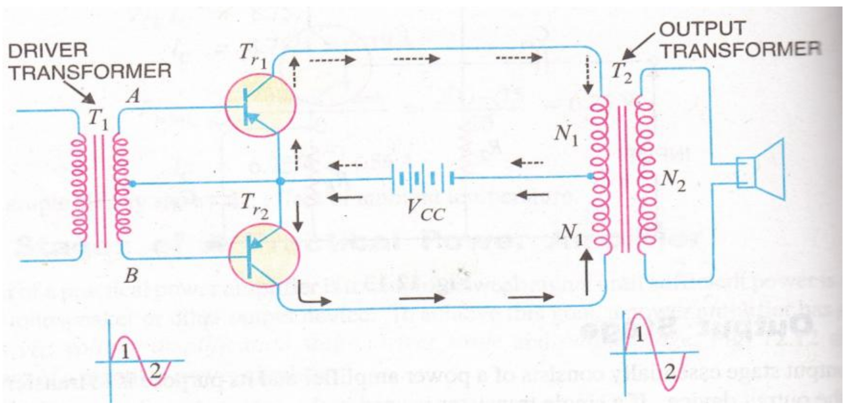
b) Explain class AB push pull amplifier with respect to following

i) Circuit operation

ii) I\P & O\P waveforms

ii) Efficiency

Ans: Circuit diagram: **(2 marks)**

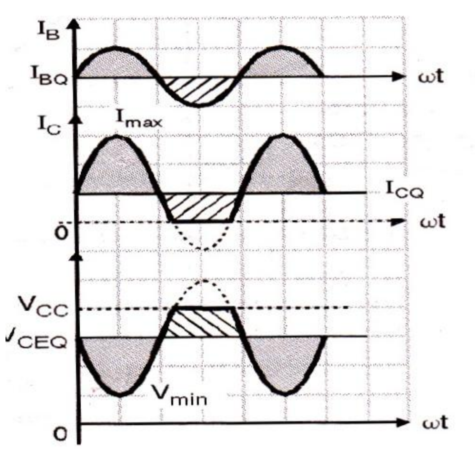


Explanation: **(2 marks)**

The I\P signal appears across the secondary AB of driver transformer during first half cycle, end A becomes positive and end B negative. This will make Tr1 reverse biased and Tr2 forward biased. The circuit will conduct current due to Tr2. Therefore this half cycle of the signal is amplified by Tr2 & appears in lower half of primary of O\P transformer.

In the next half cycle of the signal Tr1 is forward biased whereas Tr2 is reverse biased. The half cycle of the signal is amplified by Tr1 & appears in the upper half of the o\p transformer primary. The centre tapped primary of o\p transformer combines two collector currents to form a sine wave o\p in secondary. It permits a maximum transfer of power to the load through impedance matching.

I\P & O\P waveforms: **(3 marks)**

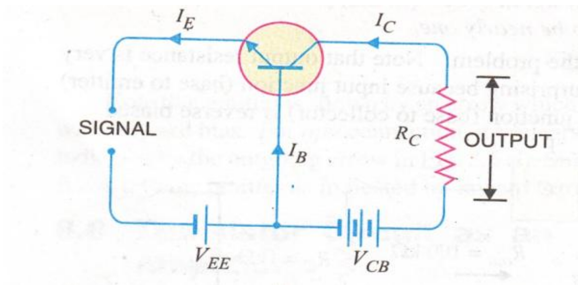


The efficiency of the circuit is high (~75%) **(1 mark)**

c) Explain CB configuration of transistor with I\P & O\P characteristics.

Ans: **(dig.- 2 marks, expl.-2 marks, i\p char- 2 marks, o\p char- 2 marks)**

Circuit Diagram:

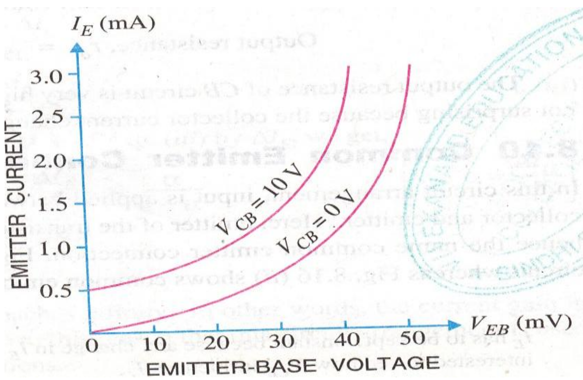


Explanation:

In this circuit arrangement I\P is applied between emitter & base and O\P is taken from collector and base. Base of the transistor is common to both i\p & o\p, and hence the name common base connection.

Input characteristics:

It is the curve between emitter current I_E & emitter base voltage V_{EB} at constant collector base voltage V_{CB}.



a) The emitter current I_E increases rapidly with small increase in emitter base voltage V_{EB}. It means i\p resistance is very small.

b) The emitter current is almost independent of collector voltage.

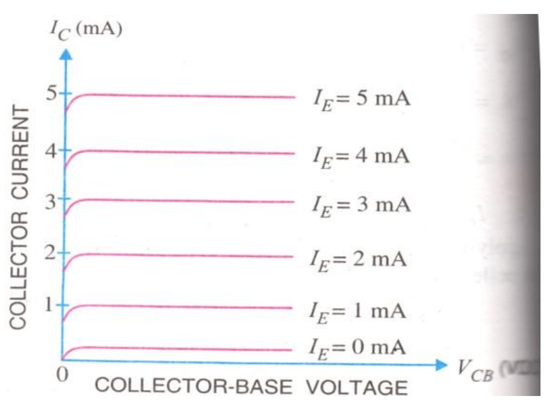
I\P resistance:

$R_i = \Delta V_{EB} \backslash \Delta I_E$ at constant V_{CB}

It is the ratio of change in emitter base voltage(ΔV_{EB}) to the resulting change in emitter current (ΔI_E) at constant collector base voltage i.e. V_{CB}. i\p resistant is small order of few ohms.

Output characteristics:

It is the curve between collector current I_C and collector base voltage V_{CB} at constant emitter current I_E.



i) The collector current I_C varies with V_{CB} only at very low voltage (<1V). the transistor is never operated in this region.

ii) When value of V_{CB} is raised above 1-2V the collector current becomes constant.it means I_C is independent of V_{CB}. The transistor is always operated in this region.

iii) A very large change in collector base voltage produces small change in collector current. This means o\p resistance is high.

O\P Resistance:

$R_o=\Delta V_{CB}\backslash\Delta I_C$ at constant I_E

It is the ratio of change in collector base voltage (ΔV_{CB}) to the resulting change is collector current(ΔI_C) at constant emitter current. The O\P resistance of CB is very high.

Q.3) Attempt any two: (2*8=16)

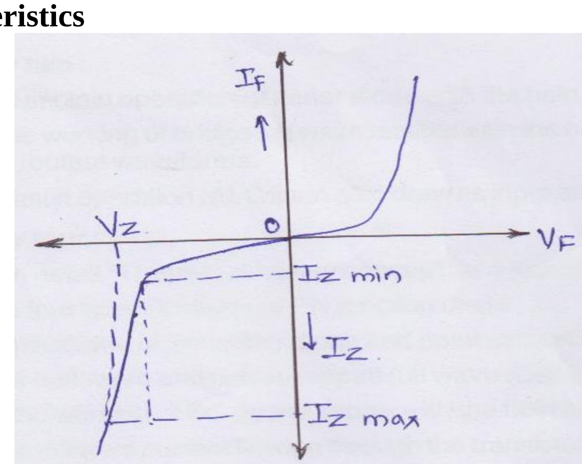
a) Draw and Explain operation of Zener diode with the help of V-I Characteristics.

Ans: (Diagram-4marks, Exp.-4marks)

Zener diode is a reversed biased heavily doped silicon P-N junction diode. It operates in reverse break down region. Zener Breakdown occurs due to breaking of covalent bonds by the strong electric field set up in the depletion region by the reverse voltage. It produces an extremely large electrons and holes which constitutes the reverse saturation current. This current called as Zener current (I_Z). This current increases sharply while voltage across Zener Diode (V_Z) remains constant. In forward Bias, the characteristics of Zener diode is simply as that of an ordinary forward bias junction diode.

V_Z= Zener breakdown voltage.
$I_{Z\,(min)}$= minimum current to sustain breakdown.
$I_{Z\,(max)}$ = maximum zener current.

V-I Characteristics



b) Explain the working of bridge full wave rectifier with the help of circuit diagram and input output waveform.

Ans: **(circuit diagram input output waveform- 5 marks, explaination-3 marks)**

Full wave Bridge Rectifier.

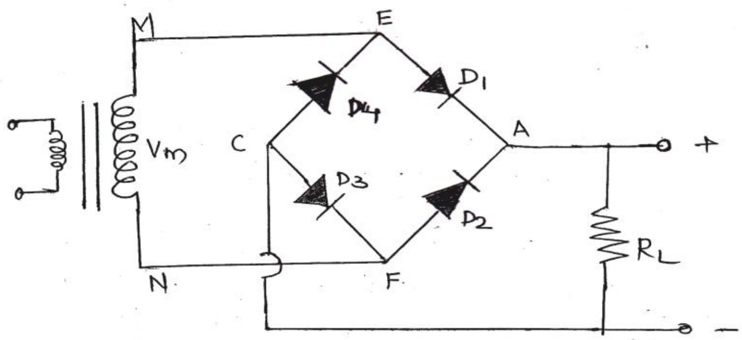


Fig. 3b.1

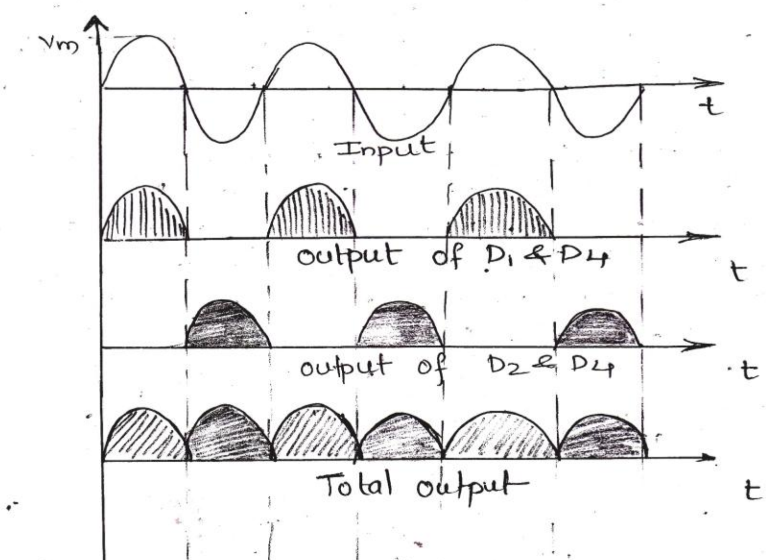


Fig 3b-2

It is the most used circuit this full wave rectifier requires four diode and step down transformer the diagram is as shown in fig.3.b.1.

During positive input half cycle, the terminal M of secondary is positive and terminal N is negative. Thus diode D1 and D4 are reversed biased. Thus current flows along MEABCFN producing a drop across R_L as shown in diagram 3b.2.

During negative half cycle, secondary terminal become positive and M negative, now D2 and D4 are forward biased. The ckt current flows along NFABCEM producing drop across R_L. We find current through R_L flows in the same direction. As shown in fig.3b.2. means point A acts as anode & point B acts as cathode. So we get pulsating DC output across R_L for full cycle of AC signal.

c) Explain circuit operations of LC filter also draw its input and output waveform.

Ans: **(Circuit diagram-2 marks, waveform-2 marks, explation-4 marks)**

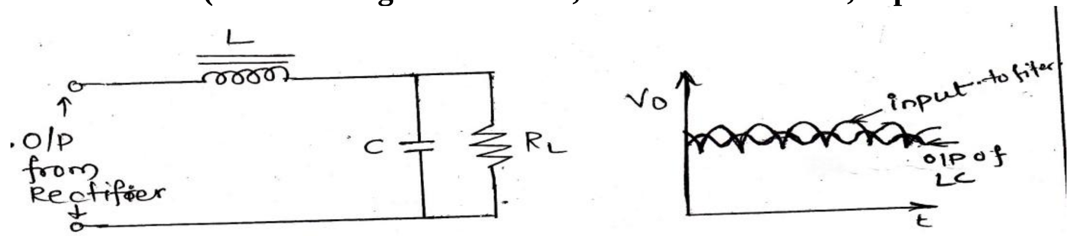


Fig 3C.1

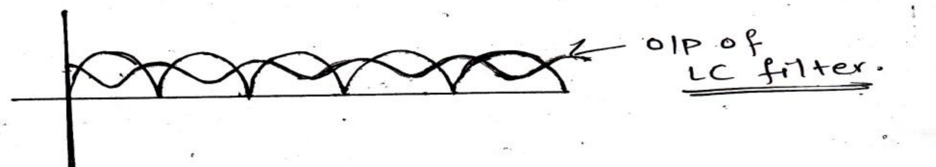


Fig. 3b.2

The circuit diagram of LC filter is as shown in fig. 3c.1. The main function of filter is to minimize the ripple content in the rectifier output. The LC filter is also known as tank filter. In this a choke coil is inserted in series to rectifier output and capacitor C in parallel to rectifier output. Inductor provides high impedance to AC variation whereas capacitor charges by only DC components of rectifier output. Thus very little ripple is produced at output of rectifier. Most of the ripple get grounded. Thus we could get very less ripples as shown in fig.3C.2.

Q.4) Attempt any four: **(4*4=16)**

a) Explain in detail "Thermal runaway concept" in a transistor.

Ans: **(4 marks)**

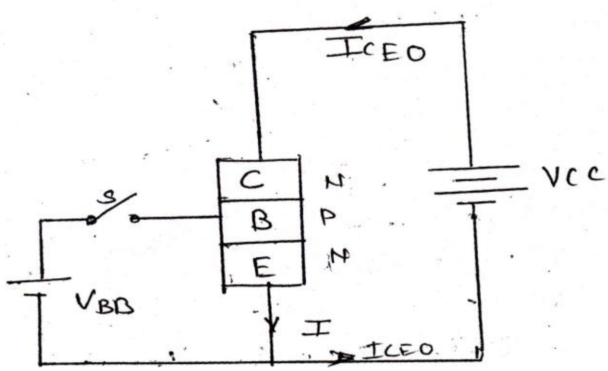


Fig. 4.1

As per diagram 4.1, the base of CE Ckt is open. So $I_B=0$, There is a leakage current form collector to Emitter. It is called I_{CEO} standing for collector to Emitter with base open.

Now

$I_C= \beta I_B + (1+\beta)\ I_{CEO}$

The leakage current is extremely temperature dependent. It doubles for every 6°c rise in temperature. Any increase in I_{CEO} is magnified (Hβ) times. So small change in I_{CEO} will affect I_C tremendously. As I_C increases, Collector power dissipation increases which raises the operating temperature that leads to further increase in IC. So soon IC increases beyond safe value, thereby damaging the transistor itself. This condition is known as "Thermal Runaway".

b) Write four specification of PN junction diode.

Ans: **(any 4 specification) (for each specification-1 marks).**

1. Peak Inverse Voltage: it is maximum reverse voltage that can be applied to diode without destruction.
2. Average forward current: the forward current through diode at normal temp usually at 25°c.
3. Maximum forward voltage: maximum forward voltage that can applied to diode without burnout.
4. Reverse current: it is the maximum reverse saturation current at the maximum reverse voltage at a given temp.
5. Reverse Recovery Time: it is time taken by device to switch from to ON OFF.
6. Power dissipation: maximum power that the diode can safely dissipate on continuous basis in free air at 25°c

c) State the applications of schottkey diode and point contact diode.

Ans: (Any two applications of schottkey diode-2 marks, Any two applications of point contact diode-2 marks)

Application of Schottkey diode:

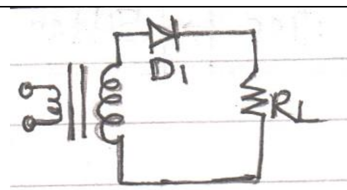
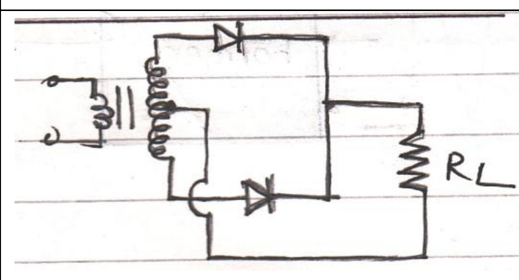
1) It is used in clipping and clamping circuit.
2) It is used in computer gating, mixing & detecting networks used in communication system.
3) It is used in switching power supplies that operate at frequencies 20 GHz

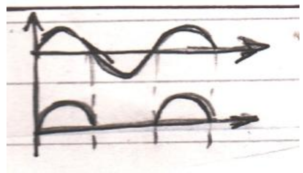
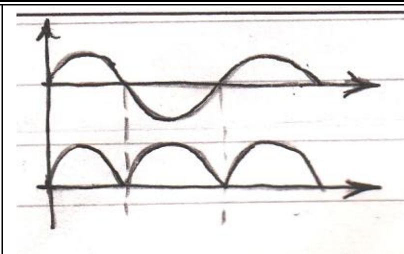
Application of Point Contact diode:

1) It is used in Video-detectors.
2) Micro-wave mixers.
3) R-F signal detection.
4) Frequency conversion.

d) Compare half wave and full wave centre tapped rectifier.

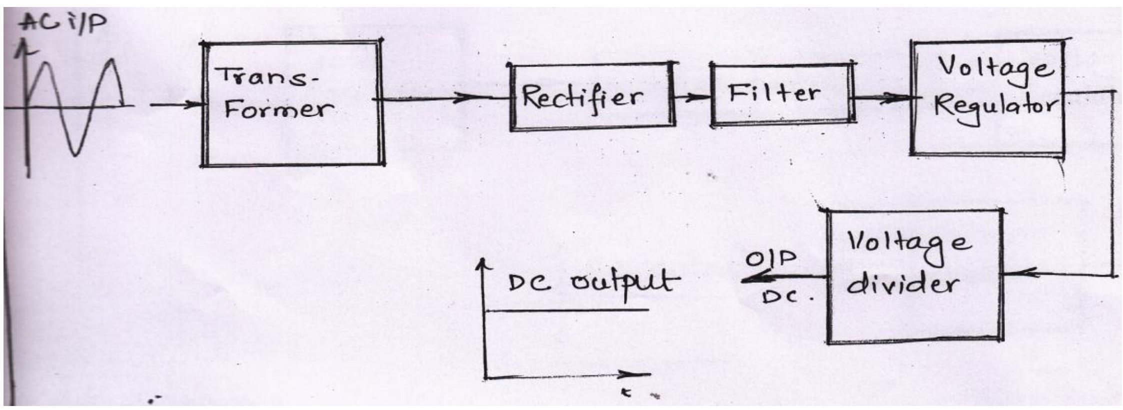
Ans: **(any 4 points, each one valid point- 1 marks)**

Parameter	Half wave Rectifier	Full wave Rectifier
Construction		
Concept	It converts only one half cycle of AC input to DC signal.	It converts full AC input to pulsating DC.

Output waveform		
Ripple Factor	1.21	0.48
Rectification efficiency	40.61%	81%
Peak inverse voltage	V_M	$2V_M$

e) Explain the working of DC power supply with the help of basic block diagram.

Ans: **(block digram-2 marks, Explanation - 2 marks)**



As shown in above an unregulated supply can be converted into regulated power supply. This basic DC power supply consists of

1. Transformer: it is used to step up or step down the applied AC signal voltage as per requirement. It also provide isolation from the supply line.
2. Rectifier: This circuit converts the AC voltage received from secondary of transformer into pulsating DC voltage.
3. Filter: Filter circuit is used to remove fluctuations i.e. ripples present in the voltage supplied by rectifiers.
4. Voltage Regulator: The main function is to keep the terminal voltage constant even when AC input at transformer varies or load varies. Generally zener diode voltage regulator circuits are used.
5. Voltage divider circuit: Its function is to provide different DC voltages needed by different electronic circuits. It consists of a number of resistors connected in series across the output terminals of voltage regulator.

   Note: Voltage divider block is optional

f) Name the different current flowing through the transistor and state the relation between them.

Ans: **(4 marks)**

The three primary currents which flow in a properly biased transistors are I_E, I_B and I_C

I_E - Emitter current

I_B – current through base.

I_C -current through collector.

Relation between transistor currents

Forward current transfer ratio=$\propto$

$\propto= I_C \backslash I_E$

Common emitter DC forward transfer ration

$\beta= I_C \backslash I_B$

Also $\propto=\beta\backslash(1+\beta)$ and $\beta=\propto\backslash(1-\propto)$

$\therefore\ I_C =\beta\ I_B =\propto\ I_E =\beta\backslash1+\beta.\ I_E$

$I_B = I_C \backslash\beta= I_E \backslash (1+\beta)=(1-\propto)\ I_E$

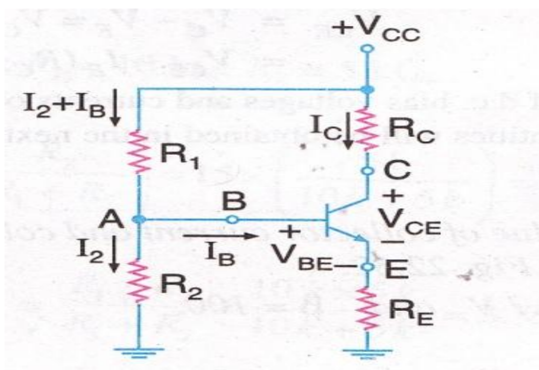
$I_E= I_C \backslash\propto= (1+\beta\backslash\beta).\ I_C =(1+\beta)\ I_B = I_B \backslash(1-\propto)$.

Que 5. Attempt any four: **(4*4=16 marks)**

a) Draw circuit diagram of voltage divider biasing of transistor and explain its working.

Ans: - Voltage divider biasing:- **(ckt diag 2marks, explanation 2marks)**

Circuit Diagram:-



a) Voltage divide bias circuit.

This is the most widely used method of providing biasing and stabilization to a transistor.
In this method, two resistors R_1 and R_2 are connected across the supply voltage V_{cc} .and provide biasing.
The emitter resistor R_E provides stabilization.
The name voltage divider comes from the voltage divide formed by R_1 and R_2.
The voltage drop across R_2 forward biases the base emitter junction (input section). This causes the required (zero signal) base current and hence the collector to flow in the circuit.
Above fig. shows the circuit of voltage divider bias. In this circuit the required collector current is calculated by following way.
Suppose that the current flowing through resistance R_1 is I_1 As base current I_B is very small therefore, it can assumed with reasonable accuracy that current flowing through R_2 is also I_1 .

$$V_2 = I_1 R_2$$
$$= (V_{cc}/ R_1 + R_2)\ R_2$$

By applying KVL to the base circuit we get,

$$V_2 = V_{BE} +I_E R_E \qquad \ldots\ldots\ldots\ldots (1)$$

$I_E = V_2 - V_{BE} / R_E$

Since I_E is nearly equal to I_C

$I_C = V_2 - V_{BE} / R_E$

Equation (1) can also be written as

$V_2 = V_{BE} + I_C R_E$

Here excellent stabilization is provided by R_E and suppose the collector current I_c increases due to rise in temperature, this will cause the voltage drop across R_2 (i.e. V_2) is independent of I_c, therefore V_{BE} decreases. This in turn causes I_B to decrease. The reduced value of I_B tends to restore I_C to the original value.

b) Explain need of biasing and explain the concept of DC load line.

Ans:- **(Need of biasing 2 marks, concept of DC load line 2 marks)**

Need of biasing:- The biasing deals with setting a fixed level of the current, which should flow through the transistor with a desired fixed voltage drop across the transistor junction. Usually I_C, I_B, V_{CE}, V_{BE}, which are required to be set by the biasing circuit. The proper value of these currents and voltages allow a transistor to amplify the weak signals faithfully.

The usual reason for biasing is to turn the device ON and to place it in a region, where it operates linearly and provides a constant amount of voltage gain.

concept of DC load line:- The DC load line gives us the information about following two points

1) The load line intersects the horizontal axis at a point marked V_{CC}, this point is called transistor cut off point or lower end of the load line at this point the values of I_B and I_C are zero (ideally).

2) the load line intersects the vertical axis at a point marked I_C, this point is called transistor saturation point or upper end of the load line at this point collector current is maximum and V_{CE} voltage is very small equal to $V_{CE\ (SAT)}$.

The collector current at saturation point is given by $I_C = V_{CC} / I_C$.

And $V_{CE} = V_{CC}$

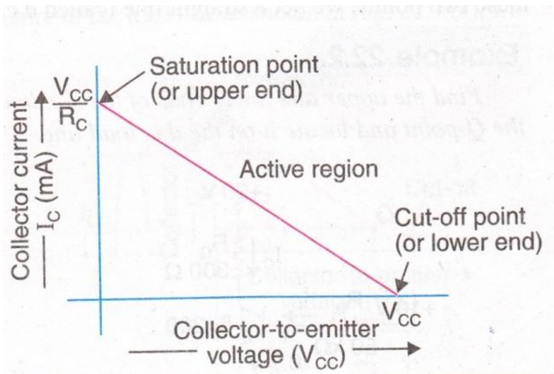


Fig. 22.4. D.C. load line.

c) Explain the need of cascade amplifier. Comment on the gain of the cascaded amplifier.

Ans: - **(Need of cascade amplifier 2 marks, Gain of the cascaded amplifier 2 marks)**

Need of cascade amplifier:- The output from single stage amplifier is usually insufficient to drive an output device. In other words, the gain of a single amplifier is inadequate for practical purposes. Consequently additional amplification over two or three stage is necessary. To achieve this, the output of each amplifier stage is coupled in some way to the input of the next stage. The resulting system is referred as multistage amplifier or cascaded amplifier.

The total gain in multistage amplifier is given by:

$G = G_1 * G_2 * G_3$

G= Total gain.

G_1 = Gain of 1st stage.

G_2 = Gain of 2nd stage.

G_3 = Gain of 3rd stage.

d) State merits, demerits and application of transformer coupled amplifier.

Ans: - (merits any 3- ½ mark each, demerits any 3- ½ mark each, application any 2- ½ mark each)

Advantages:-

1. Provides higher gain
2. An excellent impedance matching
3. No signal power loss in the collector or base resistor
4. DC biasing of individual stages will remain unchanged even after cascading

Disadvantages:-

1. It has poor frequency response.
2. Circuit becomes bulky due to use of transformer.
3. Frequency distortion is higher.
4. It is fairly expensive.
5. It produces hum in the output.
6. There is possibility of core saturation.
7. Low efficiency due to losses in transformer.

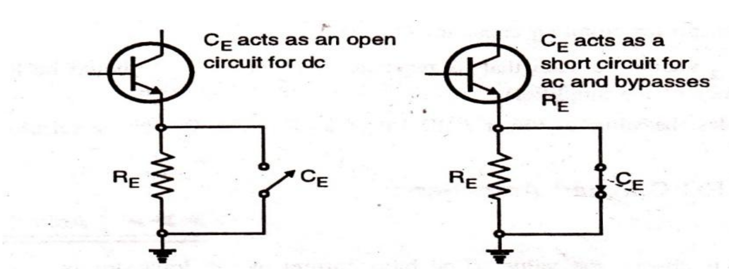
Applications:-

1. For impedance matching .
2. For amplification of radio frequency signal.
3. In power amplifiers.
4. For transferring power to a load impedance. Such as a loudspeaker.

e) Explain function of emitter bypass capacitor and its value selection in CE amplifier.

Ans: - **(Function 2 marks, Value selection 2 marks)**

- The capacitor connected in parallel with the emitter resistor R_E is called as the emitter bypass capacitor.
- Resistance R_E should be as high as possible for very good, Q point stability under dc condition but R_E should be as small as possible for the ac voltage gain to be high.
- There are contradicting requirements. But use of C_E fulfills both of them satisfactorily. The function of C_E is as explained below. Refer fig.



(a) Under dc conditions (b) Under ac conditions

- This capacitor offers a low reactance to the amplified ac signal. Therefore the emitter resistor R_E gets bypassed through C_E for only the ac signals this will increase the voltage gain of the amplifier.
- C_E acts as an open circuit for dc voltages, does not bypass R_E for dc conditions. So R_E is present in the circuit only for dc conditions and Q point stability is obtained.

Selection criteria for C_E : -

In order to successfully bypass R_E , the reactance X_{CE} of the bypass capacitor should be very small as compare to R_E even at the lowest input frequency $f=f_{min}$.

$X_{CE} \leq R_E / 10$ at $f=f_{min}$ OR

$X_{CE} \leq 0.1R_E$ at $f=f_{min}$

$1 / 2\pi f_{min} C_E \leq 0.1 R_E$

$C_E \geq 1 / 2\pi f_{min} R_E$

This is the expression for bypass capacitor.

f) Comment on the efficiency of class A , class B, class C and class AB power amplifier.

Ans: - **(class A - 1 mark, class B - 1 mark, class C -1 mark, class AB -1 mark)**

Class A amplifier: -

The efficiency of class A amplifier is lowest (25% to 50%).

Class B amplifier: -

The efficiency of class B amplifier is higher (78.5%).

Class C amplifier: -

The efficiency of class C amplifier is very high(95%).

Class AB amplifier: -

The efficiency of class AB amplifier is in between 50% and 78.5%.

Q.6) Attempt any FOUR: (4*4=16)

a) State advantages of push pull amplifier.

Ans: - **(1 mark each)**

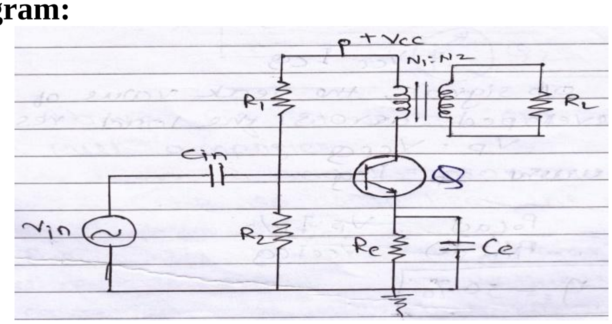
Advantages of push pull amplifier: -

1. The DC component of load current and input current is zero. Therefore there is no possibility of transformer core saturation.
2. For a given power, the output distortion is less in push pull amplifier.
3. The output power per transistor is more as compared to single ended transformer coupled amplifier.
4. The use of push pull system eliminates even order harmonics in the AC output signal.

b) Explain circuit operation on transformer coupled resistive load single stage class A power amplifier.

Ans: - **(circuit - 2 marks, operation - 2 marks)**

Circuit diagram:



Operation:

Above fig. shows the circuit for transformer coupled resistive load single stage class A power amplifier. Instead of connecting the load directly, we can connect it through an output transformer.

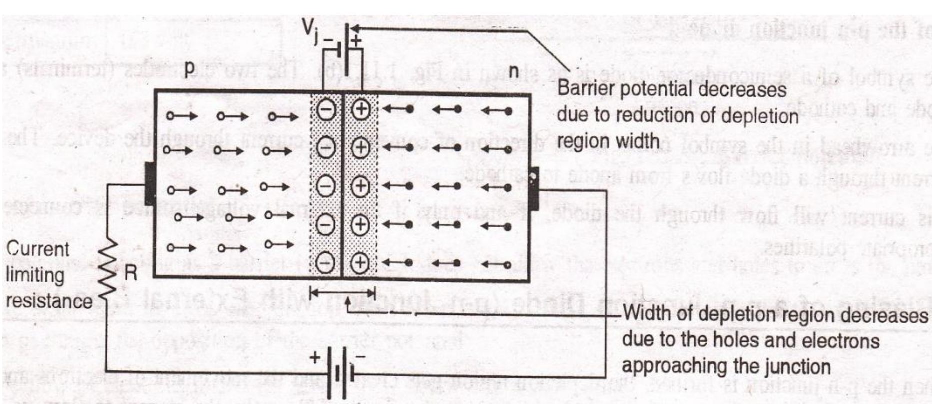
The function of transformer is to match the low impedance load (such as load speaker) to

that of the output impedance of the amplifier. Impedance matching is done by adjusting the turns ratio of transformer (N_1: N_2)
Resistors R_1, R_2 and R_e forms the biasing circuit.
C_E is the emitter bypass capacitor.

c) Compare CE and CC transistor configuration.
Ans: - **(Any 4 points - 1 mark each)**

Sr. No.	Parameter	CE configuration	CC configuration
1.	Common terminal between i/p and o/p	Emitter	Collector
2.	o/p current	I_C	I_E
3.	I/p resistance	Low	Very high
4.	o/p resistance	high	Low
5.	Current gain	$\beta= I_C / I_B$	$\Upsilon= I_E / I_B$
6.	Voltage gain	medium	Less than one
7.	applications	As audio amplifier	For impedance matching
8.	I/p voltage	V_{BE}	V_{BC}

d) Draw and explain forward and reverse biasing of P-N junction diode.
Ans: - **(forward 2 marks, reverse 2 marks)**
Forward biasing of P-N junction diode:
When external DC voltage applied to the junction is in such a direction that it cancels the potential barrier, thus permitting current flow is called forward biasing.
To apply forward bias connect positive terminal of the battery to P type and –ve terminal to N type as shown in below fig.

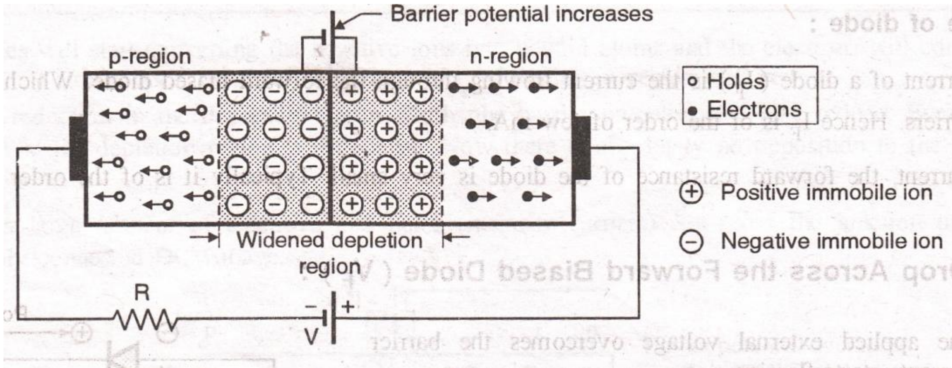


When P-N junction is forward biased, the holes are repelled by the +ve terminal of the battery and are forced to move towards the junction, similarly the electrons are repelled by the –ve terminal of the battery and move towards the junction. Because of their acquired energy, some

of the holes and electrons enter into the depletion layer and recombines themselves.
This reduces the depletion region width as well as height of potential barrier. As a result of this more majority carriers defuse across the junction. Therefore it causes a large current to flow through the P-N junction.

Reverse biasing of P-N junction diode:

When the external voltage applied to the junction is in such a direction that potential barrier is increased, it is called reverse biasing to apply reverse bias, connect the –ve terminal of the battery to P-type and +ve terminal of the battery to N-type as shown in fig. below,



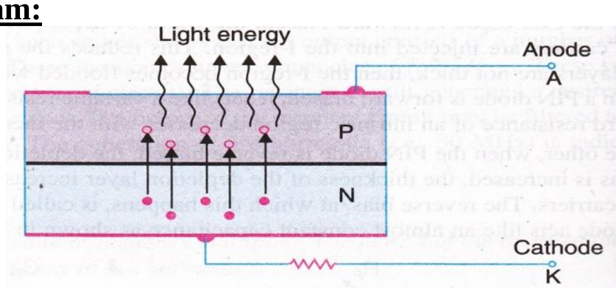
When a P-N junction diode is reverse biased the holes in the P region are attracted towards the –ve terminal of the battery and the electrons in the N region are attracted towards the +ve terminal of the battery. Thus the majority charge carriers are drawn away from the junction. This widens the depletion region and increases the barrier potential, this makes very difficult for the majority carrier to defuse across the junction. Thus there is no current due to majority charge carriers in reverse biased.
However this barrier potential is helpful to minority carriers in crossing the junction. Minority carrier drifted across the junction and rate of generation of minority carriers depends on the temperature and no0t on the applied voltage. Hence it is called reverse saturation current and it is of the order of several µamp.

Note: If student have drawn V-I characteristics give 1mark

e) State operating principle of LED and states its two applications.

<u>**Ans:**</u> **- (Operating principle - 2 marks, Diagram - 1 mark, any 2 applications – ½ mark each)**

<u>**Diagram:**</u>



<u>**Operating principle of LED:-**</u>

A P-N junction diode which emits lights when forward biased is known as light emitting diode. The amount of light output is directly proportional to the forward current. Thus higher the forward current, higher is the light output.
When the LED is forward biased, the electrons and the holes move towards the junction and the recombination takes place. After recombination, the electrons laying in the conduction

band of N- region falls into the holes laying in the valence band of a P-region. The difference of energy between the conduction band and valence band is radiated in the form of light energy in ordinary diodes this energy is radiated in the form of heat.
The materials used for the manufacturing of LED's are gallium phosphide, gallium arsenide, gallium arsenide phosphide.

Applications of LED: -

1. In Optical switching applications.
2. For solid state video display.
3. In burglar alarm systems.
4. For indicating power ON/OFF conditions, power level indicators.
5. In seven segments, 16-segment and dot matrix displays.

f) Define α and β. Give relation between them.

Ans:- **(Definition of α - 1 mark, β - 1 mark, relation - 2 marks)**

α: - It is the current gain in common base configuration. It is the ratio of change in output collector current (I_c) to the change in emitter current (I_E)at constant V_{CB}.

$\alpha = \Delta I_C / \Delta I_E$ OR

$\alpha = I_C / I_E$

β: - It is the current gain in common emitter configuration. It is the ratio of change in output collector current (I_c) to the change in base current(I_B) at constant V_{CE}.

$\beta = \Delta I_C / \Delta I_B$ OR

$\beta = I_C / I_B$

Relation between α and β: -

We know that, $I_E = I_B + I_C$

Dividing both sides by I_C,

We get, $I_E / I_C = I_B / I_C + I_C / I_C$

$I_E / I_C = I_B / I_C + 1$

We know that, $\alpha = I_C / I_E$ and $\beta = I_C / I_B$ by putting these values in above equation we get

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

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

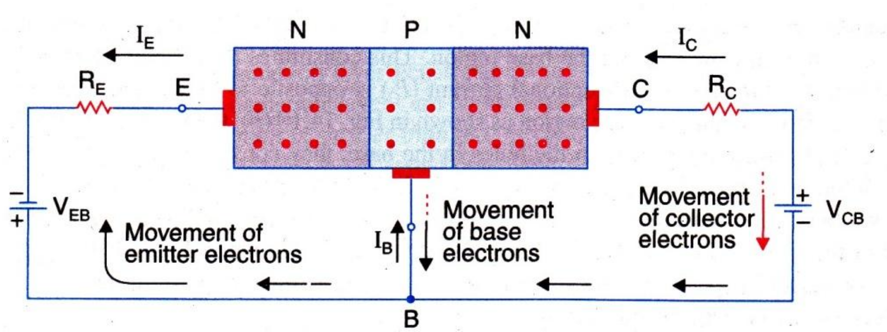
$\alpha = \beta / (1 + \beta)$

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

g) Explain transistor operation for NPN transistor with the help of constructional sketch.

Ans: - **(digram-2 marks, Explanation - 2 marks)**

operation of NPN transistor: -



Above fig. shows NPN transistor with forward bias to emitter base junction and reverse bias to collector base junction. The forward bias causes the electrons in the N-type emitter to flow towards the base. This constitutes the emitter current I_E.
As these electrons flow through the P-type base they tend to combine with holes. As the base

is lightly dopped and very thin therefore only a few electrons (about 2%) combine with holes to constitute base current I_B .

The remainder (more than 98%) cross over into the collector region to constitute collector current I_C.

In this way almost the entire emitter current flows in the collector circuit. It is clear that emitter current is the sum of collector and base current.

$$I_E = I_B + I_C$$