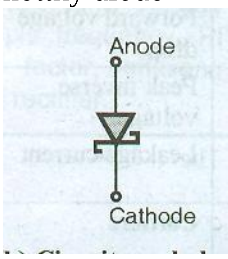
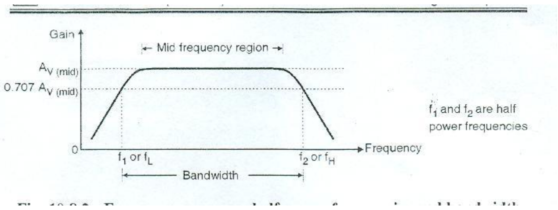
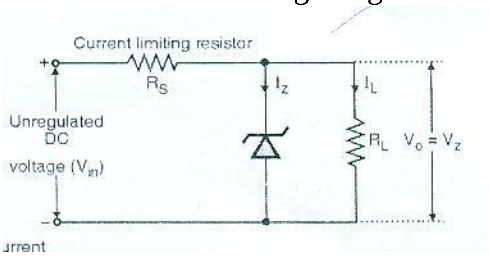
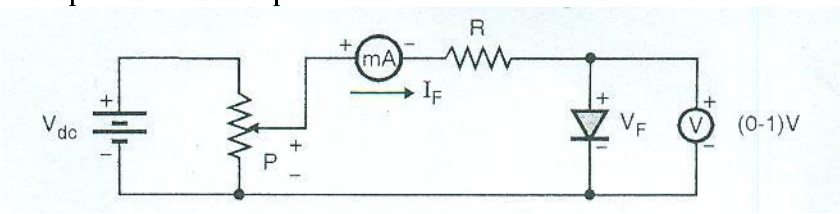
Q1 .	Attempt any Ten	20 Marks
Ans.a	PIV – Peak Inverse Voltage It is the maximum reverse voltage that a diode can withstand in the reverse direction without breaking down. TUF – Transformer Utilization Factor It is defined as the ratio of DC Power delivered to the load to the ac rating of the transformer secondary. $TUF = \frac{\text{DC power delivered to the load}}{\text{AC rating of transformer secondary}}$	1 1
Ans.b	i) Very good load regulation ii) Ripple factor is low iii) Filter is suitable for light as well as heavy load. iv) Diodes do not carry surge currents. v) Ripple factor does not depend on type of load. vi) LC filter provides continuous load current.	Any 4, each carrying ½ mark.
Ans.c	α - It is defined as the ratio of collector current Ic to the emitter current I_E $\alpha_{dc} = \frac{Ic}{I_E}$ or $\alpha_{ac} = \frac{\Delta I_C}{\Delta I_E}$ β – It is defined as the ratio of collector current I_C to the Base Current I_B $\beta_{dc} = \frac{Ic}{I_B}$ or $\beta_{ac} = \frac{\Delta I_C}{\Delta I_B}$	1 1
Ans. d	Regulator – The Voltage Regulator is a circuit that will give a constant output voltage inspite of changes in its input voltage or load current (I_L). Need of Regulator i) To maintain constant output voltage inspite of input voltage variation ii) To maintain constant output voltage inspite of I_L changes.	1 1
Ans. e	Typical Gain of Single Stage Amplifier is around 100-200. If gain more than 100-200 is required, then a multistage amplifier is used to provide higher gain.	2

Ans. f	**Intrinsic Semiconductor -** Intrinsic means 'pure', so intrinsic semiconductors are the semiconductors in the purest form. **Extrinsic Semiconductor -** Extrinsic means 'Impure' . These are obtained by adding impurities to the Intrinsic semiconductor.	1 1
Ans g.	Photo diode  Schottky diode 	1 1
Ans. h	Ripple factor $= \dfrac{1}{4\sqrt{3}\, f\, C R_L}$ $R_C = 50\,\Omega$, C=1000 μF $\dfrac{1}{4\sqrt{3} \times 50 \times 1000 \times 10^{-6} \times 50} \times 100 = 5.77\ \%$	1 1
Ans. i	i) Amplification factor – (μ) It is defined as the ratio of change in drain to source voltage (ΔV_{DS}) to change in the gate to source voltage (ΔV_{GS}) at a constant value of I_D. $\mu = \left.\dfrac{\Delta V_{DS}}{\Delta V_{GS}}\right\vert\ I_D$ constant. ii) Transconductance (g_m) : It is defined as ratio of change in drain current (ΔI_D) to the corresponding change in gate to source voltage (ΔV_{GS}) at a constant value of drain to source voltage (V_{DS}) $g_m = \left.\dfrac{\Delta I_D}{\Delta V_{GS}}\right\vert$ Constant V_{DS}	1 1

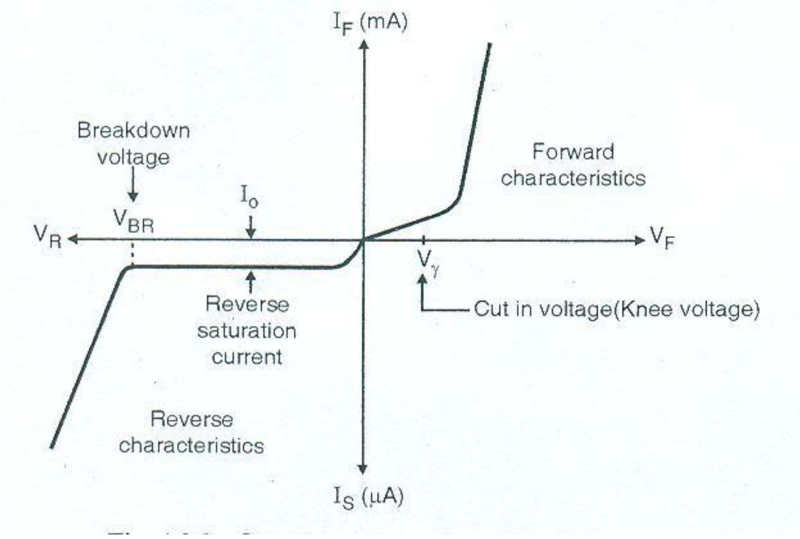
Ans j	4 specifications of Photo Transistor – i) Collector Current ii) Collector dark current iii) Peak Wavelength iv) Rise time v) Collector – Emitter Breakdown Voltage vi) Power dissipation vii) Responsivity viii) Spectral Response ix) Quantum Efficiency x) Gain	Any 4 points ½ mark each.
Ans k	Bandwidth – It is defined as the difference between the half-power frequencies. BW = $f_2 - f_1$ H_z $f_1 \longrightarrow$ lower cut off frequency $f_2 \longrightarrow$ upper cut off frequency OR It is defined as the frequency Range over which the voltage gain of the amplifier remains almost constant.  	2
Ans: l	Names of Regulator IC's 1) 78XX – fixed Positive Voltage Regulators. Eg. 7805, 7806, 7808, 7812, 7815, 7818, 7824. 2) 79XX – fixed Negative Voltage Regulators Eg. 7905, 7906, 7908, 7912, 7915, 7918, 7924. 3) IC 723 – General Purpose Regulator.	2 marks – any 2 regulator IC

Q2.	Attempt any 4	16 marks
Ans a	Zener Diode as Voltage Regulator	
	 - A Voltage Regulator circuit provides constant O/P voltage inspite of changes in its i/p voltage or load current. - The Series Resistance Rs is connected to limit the total current drawn from the unregulated power supply. - Zener diode is a shunt type voltage regulator because the zener diode is connected in parallel with the load resistance and is connected in reverse biased condition. - If Vin is higher than Vz and if the Iz is between Izmin & Izmax then the voltage across zener will remain constant equal to Vz irrespective of any changes in Vin & IL. As output voltage is constant and equal to Vz, a regulated o/p voltage is obtained. - **When Vin varies** Assume R_L constant, Vin is varying So, I_L is also constant as $I_L = V_Z/R_L$ But Vin changes & supply current also changes $I = \frac{Vin - Vz}{R_S}$ Also $I = Iz + I_L$ If Vin is increased, then current I will increase. But as Vz is constant & R_L is also constant, the I_L will remain constant. - The increase in current I will increase Iz but Iz is less than Iz (max). - Thus the output voltage will remain constant. **When I_L varies** Assume Vin constant, R_L is variable. If R_L increases, I_L will decrease. But I is constant. $I = \frac{Vin - Vz}{Rs}$ Also $I = Iz + I_L$ Therefore with decrease in I_C, Iz will increase. This can be continued without damaging the Zener diode as long as I_Z is less than I_Z max., the O/P voltage will remain constant.	1 mark for dia. + 3 marks for explain-ation.

<table>
<tr><td>Ans. b</td><td>Experimental set up for Forward Bias condition of diode



V-I Characteristics of diode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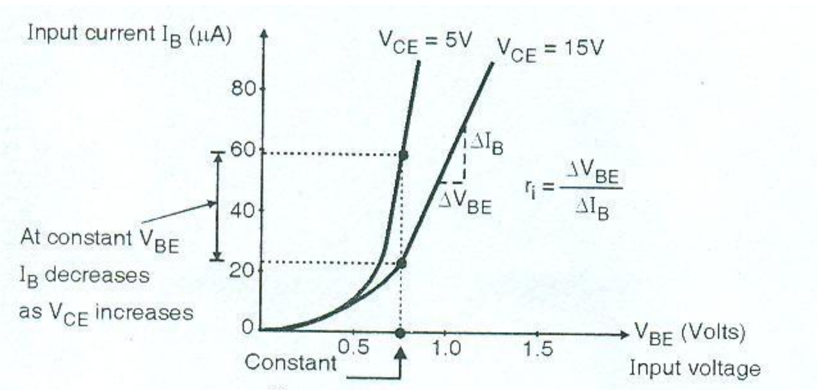
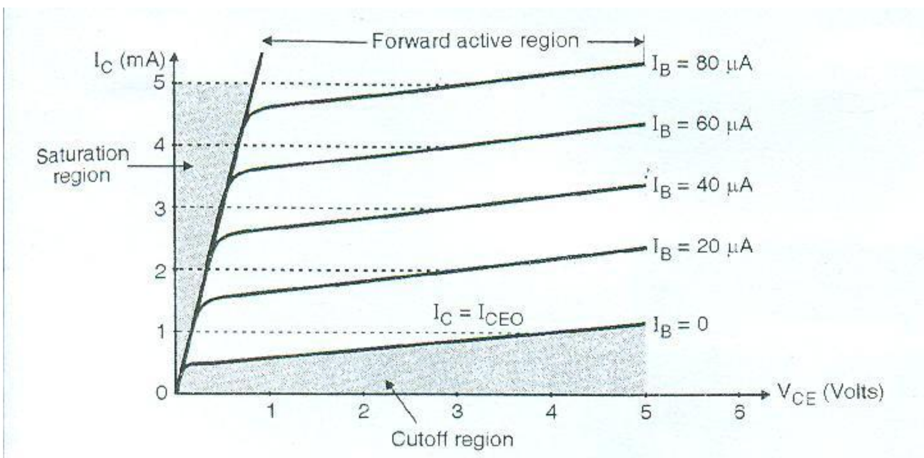
2</td></tr>
<tr><td>Ans : c</td><td>Input characteristics

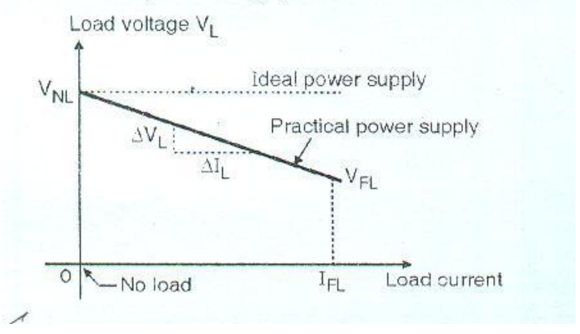


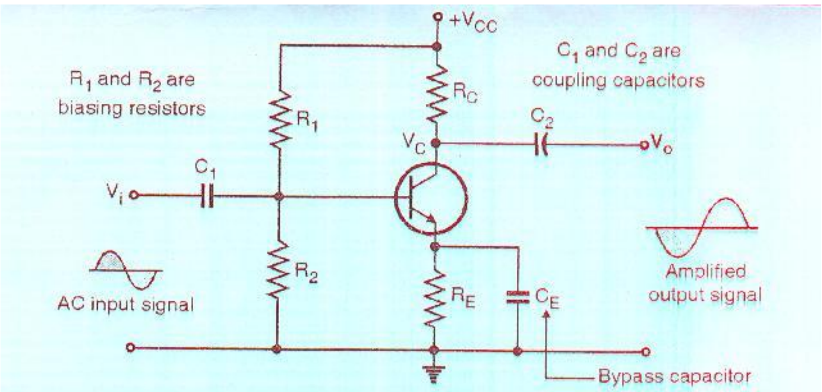
Output characteristics

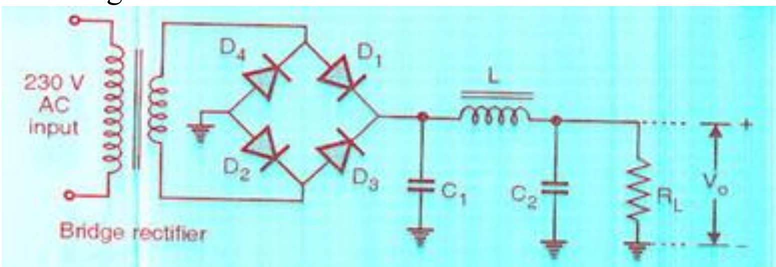
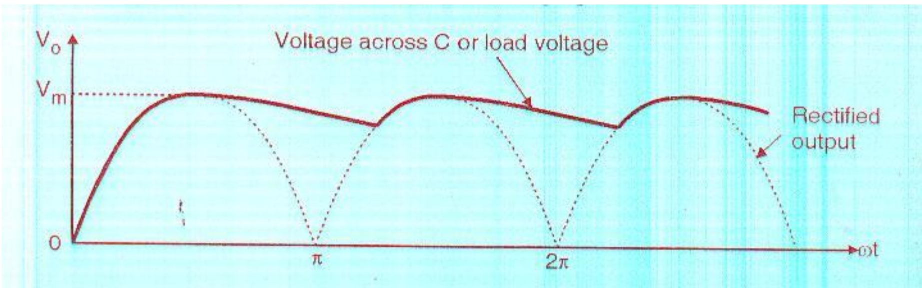
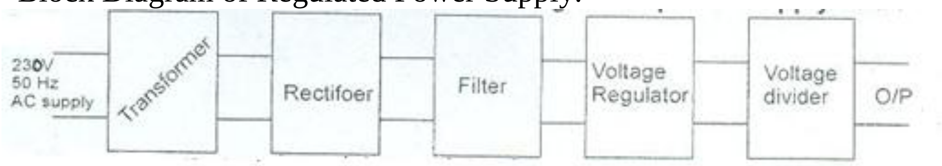

</td><td>2

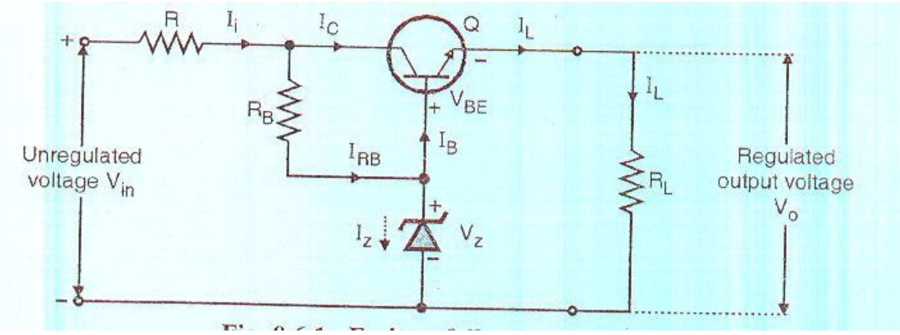
2</td></tr>
</table>

Ans : d	$\alpha_{dc} = \frac{I_C}{I_E}$ But $I_E = I_C + I_B$ $\alpha_{dc} = \frac{I_C}{I_C + I_B}$ But $I_E = I_C + I_B$: Divide numerator & denominator by I_B. $\alpha_{dc} = \frac{I_C/I_B}{I_C/I_B + I_B/I_B} = \frac{I_C/I_B}{1 + I_C/I_B}$ But $I_C/I_B = \beta$ dc $\alpha_{dc} = \frac{\beta_{dc}}{1+\beta_{dc}}$ **OR** $\beta\,dc = \frac{I_C}{I_B}$ But $I_B = I_E - I_C$ $\beta\,dc = \frac{I_C}{I_E - I_C}$ Divide Numerator & Denominator by I_E to get $\beta\,dc = \frac{I_C/I_E}{1 - I_C/I_E}$ But $I_C/I_E = \alpha_{dc}$ Therefore, $\beta\,dc = \frac{\alpha_{dc}}{1 - \alpha_{dc}}$	Any one – 2 marks
	$\gamma = \frac{I_E}{I_B} = \frac{I_C + I_B}{I_B}$ Divide Numerator & Denominator by I_B $\gamma = \frac{I_C}{I_B} + \frac{I_B}{I_B} = \frac{I_C}{I_B} + 1$ $\gamma = (1 + \beta_{dc})$ as $\frac{I_C}{I_B} = \beta_{dc}$ $\gamma = \frac{I_E}{I_E - I_C}$ Therefore, $1/\gamma = \frac{I_E - I_C}{I_E}$ $\frac{1}{\gamma} = \frac{I_E}{I_E} - \frac{I_C}{I_E} = 1 - \alpha$ $\gamma = \frac{1}{1-\alpha}$	2 marks.

Ans : e	**Load Regulation** - It 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 = $\frac{V_{NL} - V_{FL}}{V_{FL}}$ X 100 | Vin Constant Where V_{NL} = No load voltage ($I_L = 0$) V_{FL} = Full load voltage ($I_L = I_L$ Max) The percentage of Load Regulation of a power supply should ideally be equal to zero & practically it should be as small as possible. Load Regulation Diagram  **Line Regulation** : It is defined as the change in regulated load voltage for a specified range of line voltage with load R_L constant (I_L constant) Line Regulation = $V_{HL} – V_{LL}$ V_{HL} = Load voltage with high line voltage V_{LL} = Load voltage with low line voltage - Ideally the line Regulation should be zero & practically it should be as small as possible.	2 2

Ans : f	**SINGLE STAGE TRANSISTOR AMPLIFIER**  i) **Biasing Circuit** : The resistances R_1, R_2 & R_E, R_C, + V_{CC} & transistor form the dc biasing & stabilization ckts. The biasing ckt must establish a proper Q point otherwise a part of the –ve half cycle of the signal may be cut off in the o/p. ii) **Input Capacitor** (Cin) : An electrolytic capacitor C_{in} = 10µf is used to couple the signal to the base of transistor. If it is not used, then signal source resistance will come across R_2 & thus change the bias. The capacitor C_{in} allows only a.c. signal to flow but isolates the signal source from R_2. iii) **Emitter Bypass Capacitor C_E** : An emitter bypass capacitor $C_E \cong$ 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 o/p vg. iv) **Coupling Capacitor C_C** : The C_C coupling capacitor $\cong$ 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.	2 marks – circuit dia. 2 marks for expln.
Q3.	**Attempt any Four**	**16**
Ans a	Two different mechanism of breakdown are observed in Zener diode. They are 1) Zener breakdown 2) Avalanche breakdown **Zener breakdown** : Zener breakdown is observed for Zener diodes having breakdown voltage of less than 8 volts. Zener breakdown is observed in heavily doped zener diodes whenever reverse voltage is applied to a heavily doped zener diode, intense electric field is developed across the depletion layer of the zener diode. This heavy electric field breaks covalent bonds and generates large number of electron hole pairs. These large number of charge carriers causes the breakdown of junction of Zener diode. This type of breakdown is referred as zener breakdown and the effect is known as zener effect. **Avalanche breakdown** : 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.	2 2

Ans : b	Bridge Rectifier with π Filter.  Waveforms for filter circuit.  In bridge rectifier diodes D_1 & D_2 conduct in positive half cycle of ac input. During negative half cycle diodes D_3 & D_4 conduct. Rectified o/p of a bridge rectifier is shown in dashed wave forms. π Filter consists of two capacitors C_1 & C_2 and one inductor L. Capacitor filter bypasses unwanted ac through it and blocks dc through it as it is connected in parallel with the load R_L Inductor filter passes dc through it and blocks ac through it, as it is connected in series with the load R_L. π Type filter can be considered as combination of shunt capacitor filter and LC filter. Due to the use of three filtering elements (C_1, L & C_2) the ripple factor of π type filter is very low as compared to the other filters.	2 2
Ans : c	Block Diagram of Regulated Power Supply.  There are four basic blocks of a d.c. regulated power supply. They are 1) Step down transformer 2) Rectifier 3) Filter 4) Voltage Regulator. **Functions** of each block are as follows : **Step down transformer** : Reduces 230 volts 50Hz ac voltage to required ac voltage level. **Rectifier** : Rectifier converts ac voltage to dc voltage. Typically bridge full wave rectifier is widely used. **Filter** : Filter is a circuit used to remove fluctuations (ripple or ac) present in dc output. **Voltage Regulator** : Voltage regulator is a circuit which provides constant dc output voltage irrespective of changes in load current or changes in input voltage. **Voltage divider** is a passive circuit used for providing different dc voltages required by different electronic circuits.	Block dia – 2marks Expln. – 2

Ans : d	Transistorized Series Voltage Regulator  In this circuit transistor Q acts as a control element. This transistor Q is connected in series with the load hence the circuit is called as Series Voltage Regulator. Other components in the circuit are Zener diode (V_Z), and two resistors R & R_B. Zener diode V_Z is operated in breakdown region and provides constant voltage V_Z. Resistance R_B provides the limiting current to Zener diode. The total current in the circuit is decided by resistance R. As V_Z & V_{BE} of the transistor are constant, output voltage across RL will also be constant. To find output voltage V_O, Applying KVL to o/p loop of the circuit $V_{BE} + I_L R_L - V_Z = 0$ Therefore, $V_O = I_L R_L = V_Z - V_{BE}$ $\mathbf{V_O = V_Z - V_{BE}}$ As V_{BE} is constant (approx. 0.6V to 0.7V). Therefore output voltage of this circuit is decided by Zener diode V_Z. The voltage regulator action can be explained as follows If $V_O\uparrow \rightarrow V_{BE}\uparrow \rightarrow I_B\uparrow \rightarrow I_C\uparrow \rightarrow I_{RB}\downarrow \rightarrow I_B\downarrow$ $V_{BE}\downarrow \rightarrow V_O\downarrow$ Vo gets regulated If $V_O\downarrow \rightarrow V_{BE}\downarrow \rightarrow I_B\downarrow \rightarrow I_C\downarrow \rightarrow I_{RB}\uparrow \rightarrow I_B\uparrow \rightarrow V_{BE}\uparrow \rightarrow V_O\uparrow$ & V_O gets regulated.	Circuit dia. – 2marks Expln. - 2 marks

Ans : e	**Amplifier :** The circuit which amplifies input signal is called as an amplifier. Classification of amplifier is based on various factors as given below : 1. Classification based on purpose of amplification. 2. Classification based on frequency range. 3. Classification based on the position of Q point. 4. Classification depending on the type of coupling. **<u>1. Classification based on purpose of amplification</u>** : Based on the purpose of amplification, the amplifiers are classified as voltage amplifiers or power amplifiers. **Voltage amplifiers** : The amplifier which is used for amplifying input voltage is called as voltage amplifier. **Power amplifier** : Power amplifier delivers large power to the load. As $P = I^2 R$, therefore in a power amplifier boosting of current takes place to deliver large power. **<u>2. Classification based on frequency range</u>** : Based on frequency, amplifiers are classified as AF amplifiers and RF amplifiers. **AF amplifier** : AF amplifier amplifies audio range of frequency signals (20 Hz to 20 KHz) **RF amplifier** : RF amplifier is an amplifier used for amplifying radio frequency signals (typically more than 100 KHz) **<u>3. Classification based on the position of Q point</u>** : Based on the position of Q point amplifiers are classified as class A, class B, class C and class AB amplifier. **Class A amplifier** : In class A amplifier the operating point Q is in the centre of active region. This amplifier provides amplification of 360^o (both the half cycles). **Class B amplifier** : In class B amplifier the operating point Q is on the boundary of cut off and active region. This amplifier provides amplification of 180^o (one half cycle) **Class C amplifier** : In class C amplifier the operating point Q is in cut off region. This amplifier provides amplification of less than 180^o (less than one half cycle). **Class AB amplifier** : In class AB amplifier the operating point Q is between centre of active region and starting of active region. This amplifier provides amplification of more than 180^o & less than 360^o. **<u>4. Classification depending on the type of coupling</u>** : Based on type of coupling, the amplifiers are classified as direct coupled amplifier, RC coupled amplifier and transformer coupled amplifier. **Direct Coupled amplifier** : The different stages of direct coupled amplifier are directly connected together. Direct coupled amplifier is used for amplifying low frequency signals. **RC coupled amplifier**: The different stages of RC coupled amplifier are connected together using resistor & capacitor coupling. RC coupled amplifiers are used for amplifying audio frequency signals (20 Hz to 20 KHz) **Transformer coupled amplifier** : The different stages of transformer couple amplifier are connected together using transformers. Transformer coupled amplifiers are used for amplification of high frequency signals. (Typically more than 100 KHz)	Defn. of amp. 1 mark. Classi of amp – 3 marks

Ans : f

Differentiate between BJT & JFET

Any 4 point – 4 marks.

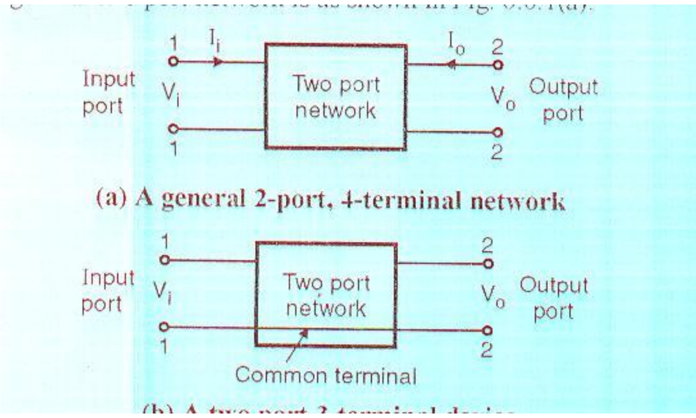
Sr. No.	**BJT**	**JFET**
1	Symbol of NPN or PNP transistor	Symbol of n-channel JFET or P-channel JFET.
2	BJT is a Bipolar device	JFET is a unipolar device
3.	Input impedance is low (In KΩ)	Input impedance is high (In MΩ)
4	AC voltage gain of BJT amplifier is high (100-300)	AC voltage gain of JFET amplifier is low (less than 50)
5	Transfer characteristics is linear.	Transfer characteristics of JFET is non linear.
6	Thermal runaway can damage the BJT.	Thermal runaway does not take place.
7.	Noise generated by BJT is high	Noise generated by JFET is low
8.	BJT is current controlled device.	JFET is a voltage controlled device.
9	BJT is more sensitive	JFET is less sensitive.
10	Size of BJT is bigger than JFET	Size of JFET is smaller than BJT.

Q4. Attempt any FOUR **16**

Ans : a

Two port network

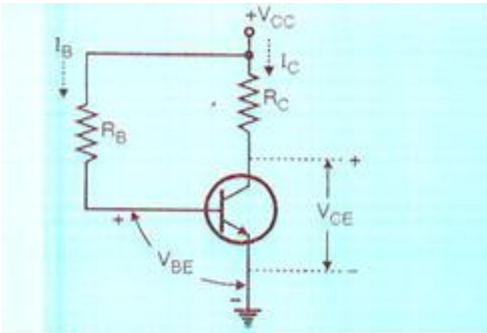
Any 1 dia. for 2 marks

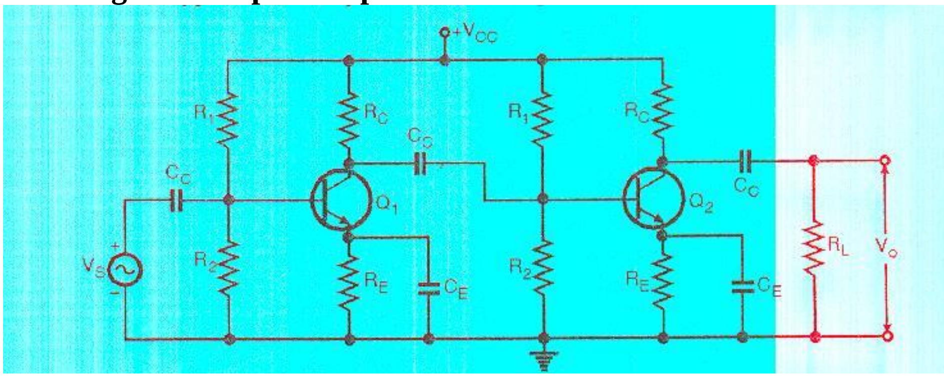


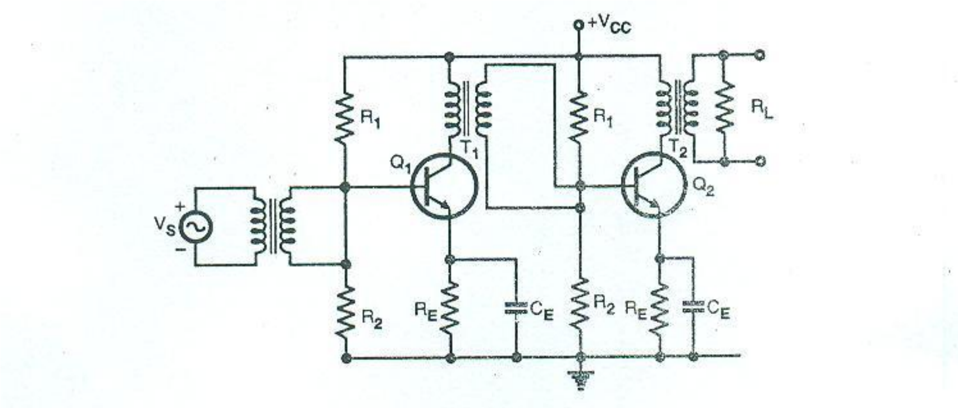
This network has an input port and an output port. Therefore total number of terminals are four.

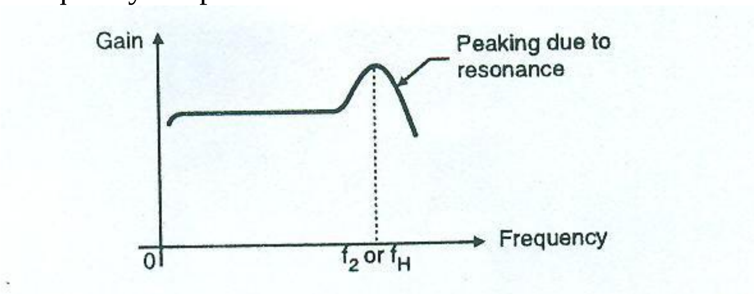
- The two port network model is used in mathematical circuit analysis techniques to isolate portions of larger circuits.
- For example transistors are often regarded as 2 ports, characterized by their h – parameters.
- Transistor consists of 3 terminals. So, one of the three terminals is common to the 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

Expln. – 2 marks.

Ans : b	**Working principle** The PN junction diode which emits light when forward biased is known as light emitting diode or LED. N-type semiconductor is grown on a P type by a diffusion process. Then a thin P-type layer is grown on the N-type layer. The metal connections to both the layers make anode and cathode terminals. When the LED is forward biased, the electrons and holes move towards the junctions and the recombination take place. After recombination, the electrons, lying in the conduction band of N-region, fall into the holes lying 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.	Expln. – 4 marks
Ans : c	**Fixed Bias Circuit**  ➢ R_B is the Base biasing resistor. ➢ V_{CC} provides supply to collector & base. Operation **i) Base Circuit** Apply KVL to the base circuit : $V_{cc} - I_B R_B - V_{BE} = 0$ Therefore, $I_B = \frac{V_{CC} - V_{BE}}{R_B}$ For Silicon transistors $V_{BE} = 0.7V$ Germanium transistors $V_{BE} = 0.3V$ So, $V_{BE} < V_{CC}$ Therefore $I_B = \frac{V_{CC}}{R_B}$ In the above equation both are fixed value. Therefore, I_B also remains constant. Therefore the name “fixed bias circuit.” **ii) Collector Circuit** Apply KVL to collector circuit $V_{CC} - I_C R_C - V_{CE} = 0$ Rearranging the equation $I_C = \frac{V_{CC} - V_{CE}}{R_C}$, $V_{CE} = V_{CC} - I_C R_C$ So, $R_C = \frac{V_{CC} - V_{CE}}{I_C}$ ➢ I_C (Collector Current) can be calculated by $I_C = \beta_{dc} I_B + I_{CEO}$. ➢ No stabilization is provided by the fixed bias circuit as I_C keeps varying with change in temperature. ➢ Fixed bias circuit is easy to design but the operating point is not stable for β variations & temperature variations. Hence this is not a good biasing circuit.	1 mark – Diag. Expln. - 3marks

Ans : d	**Two stage RC coupled amplifier**  **Advantages of two stage RC coupled amplifier.** 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.	2 Any 4 points – 2 marks.
Ans : e	**β**= 99, I_{CEO} = 50 µA, I_B = 0.5 mA, = 500 µA Find I_C & I_E $I_C = \beta\, I_B + I_{CEO}$ Therefore, I_C = 99 x 500 + 50 = 49550µA **Therefore, I_C = 49.55 mA** $I_E = I_C + I_B$ = 49.55 mA + 0.5 mA = 50.05mA **I_E = 50.05 mA**	Correct formula – 1 mark. Cal. & Ans. 3 marks.
Ans : f	The Bandwidth will decrease with coupling and emitter bypass capacitor. 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. ➢ The voltage drop increases with decrease in frequency that in turn reduces the output voltage & gain of the amplifier. Effect of Bypass capacitor :- ➢ Bypass capacitor is connected across emitter resistance R_E in BJT. ➢ At low frequencies, reactance X_{CE} is not equal to zero, but it has some finite value. Therefore, parallel combination of R_E & C_E will offer a finite impedance. ➢ Due to this some of the amplified ac voltage will drop across it. This will reduce gain of amplifier in the low frequency region. ➢ At medium & high frequencies, the bypass capacitor C_C & C_E offers low reactance. So C_E & C_C has no effect no frequency response of amplifier at medium & high frequencies.	C_C expln. 2 marks C_E – 2 marks .

<table>
<tr><th>Q5</th><th>Attempt any FOUR of the following</th><th>16</th></tr>
<tr><td>Ans : a</td><td>Two stage Transformer Coupled Amplifier.


Frequency Response.

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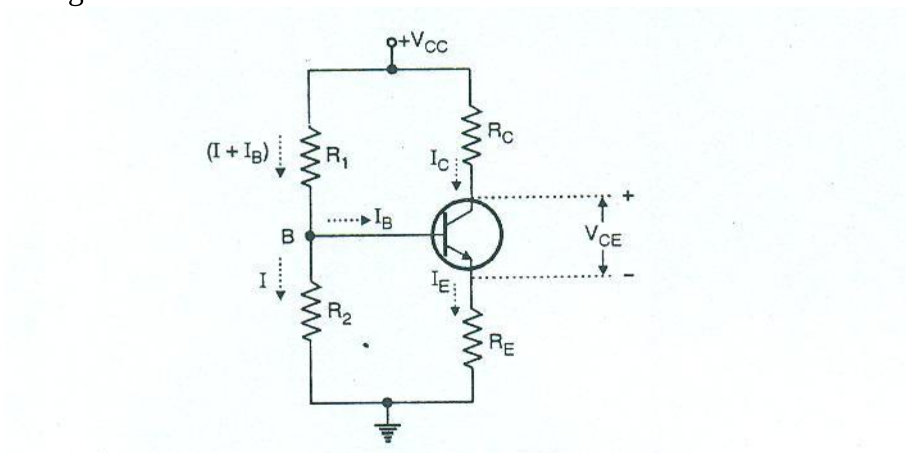
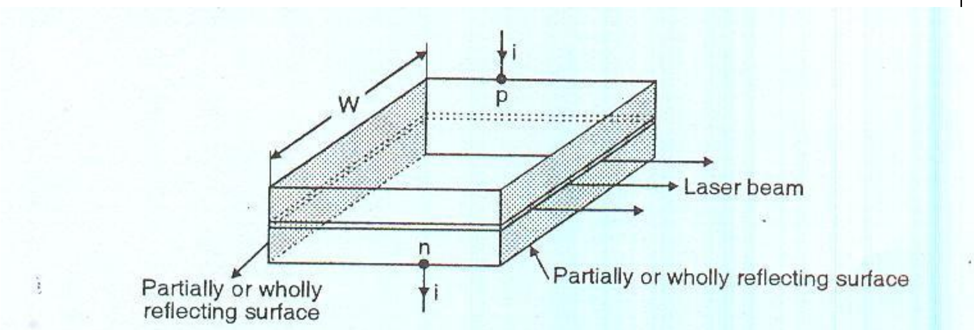
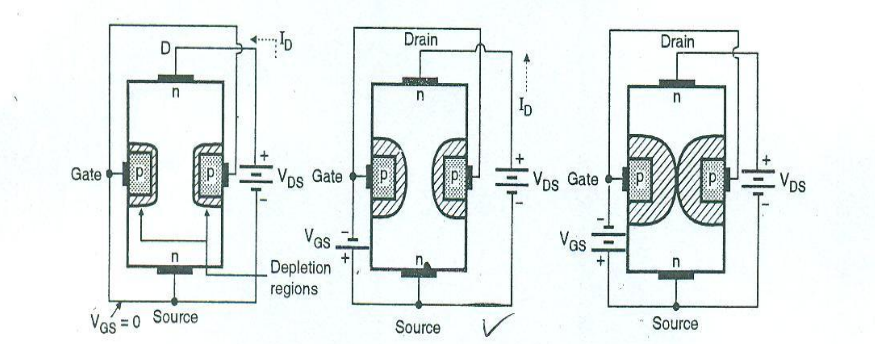
2</td></tr>
<tr><td>Ans : b</td><td>Voltage Divider Bias.


Working : -
Figure shows the circuit of a voltage divider bias. It is the most widely used DC biasing circuit. It is commonly known as voltage divider bias or self bias. The name voltage divider is derived from the fact that resistors R_1 and R_2 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. 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 .
To set the operating point Q, first determine the base current. To get more accurate value of base current, Thevenin's Theorem is used.
Now applying the Thevenin's theorem, we get the voltage,

(contd..pg.16)</td><td>2

2</td></tr>
</table>

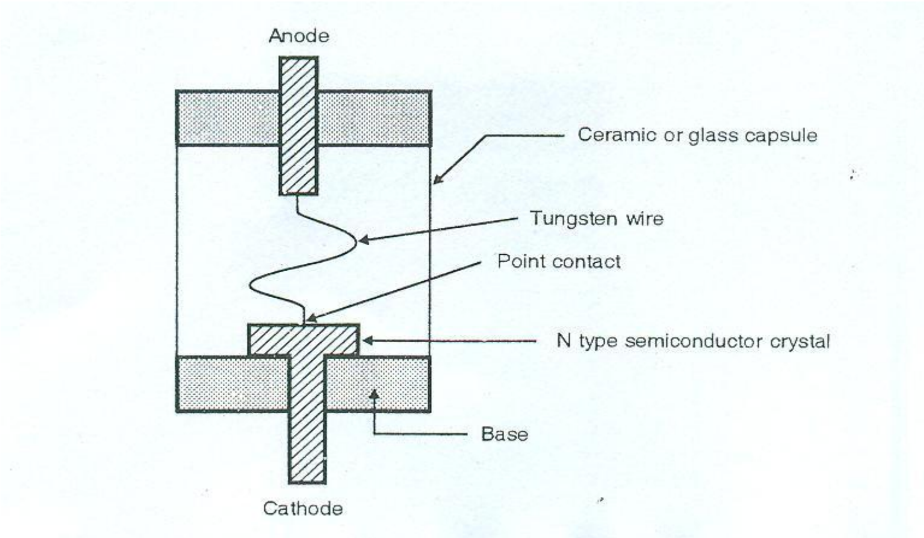
	$V_{TH} = \left(\frac{R_2}{R_1 + R_2}\right) . V_{CC}$ And the equivalent resistance. $R_{TH} = R_1 \| R_2 = \frac{R_1 . R_2}{R_1 + R_2}$ Applying KVL to the base emitter loop of this circuit, $V_{TH} = I_B R_{TH} + V_{BE} + I_E R_E$ $I_B = \frac{V_{TH} - V_{BE}}{R_{TH} + (\beta +1) R_E}$ ($I_E = (\beta +1) I_B$) $I_B = \frac{V_{TH}}{R_{TH} + \beta R_E}$ ($V_{TH} >> V_{BE}, (\beta + 1) = \beta$) $I_C = \beta I_B$ $I_C = \frac{V_{TH}}{R_E + R_{TH} / \beta}$ $I_C = V_{TH}/R_E$ ($R_E >> R_{TH}/ \beta$) Applying KVL to the output section, we get $V_{CC} = I_C R_C + V_{CE} + I_E R_E$ $V_{CE} = V_{CC} - I_C (R_C + R_E)$	
Ans : c	Laser Diode  **Operating Principle** : ➢ When current is passed through a diode junction light is emitted due to spontaneous emission. ➢ When a critical level is exceeded, the population of minority carries on either sides of the junction increases. This will increase the number of recombinations of electrons and holes and hence the number of Photons emitted. ➢ Thus the density of photons increases to such a level that they start colliding with the already emitted minority carriers. This is called stimulation of the emitted minority carriers. ➢ This gives rise to the so called stimulated emission in which two photons are released instead of one. Both have the same frequency and energy level. ➢ The laser action of the semiconductor diode can be enhanced by placing a reflecting surface on each side of the junction. ➢ It is important to understand that the stimulated emission will take place only when the forward diode current exceeds a minimum level called threshold level.	2 2

Ans : d	N-Channel JFET  (a) Operation with no bias voltage (b) Operation with a small negative gate source bias (c) Operation with a large negative gate source bias	2
	Operation of n channel JFET : i) Operation of n-channel JFET with $V_{GS} = 0$ ➢ Due to the supply voltage V_{DS}, current starts flowing through the channel. ➢ The n-type material has a finite resistance. Therefore the drain current flow, causes a voltage drop along the channel. ➢ This voltage drop will reverse bias the gate to source p-n junction. ➢ The depletion region of the reverse biased p-n junction penetrates more into the n-type bar because it is lightly doped as compared to the heavily doped p-type gate. ➢ The penetration of the depletion region into n-type bar depends on the reverse bias voltage. Due to the depletion regions the width of the channel available for conduction is reduced. ii) Operation of a n-channel JFET for small negative V_{GS} :- ➢ Due to the reverse voltage applied across the gate source junction, the penetration of the depletion region into n-type material increases further. ➢ This will reduce the channel width further. Due to reduced channel width less number of electrons can pass through to drain from source. Therefore, drain current I_D reduces with increase in $– V_{GS}$. iii) Operation of n-channel JFET for large value of negative V_{GS} : ➢ As the negative voltage V_{GS} is further increased, the depletion region spread more inside the n-type bar. ➢ At a certain value of negative V_{GS}, the depletion regions touch each other. ➢ The channel width is therefore zero and therefore the drain current $I_D = 0$. ➢ Thus with increase in the negative gate to source voltage, the channel becomes more and more narrow and drain current I_D reduces.	2

Ans : e	First stage voltage gain in dB = 20 log 100 = 40 dB Second stage voltage gain in dB = 20 log 200 = 46.02 dB Third stage voltage gain in dB = 20 log 300 = 49.54 dB The total voltage gain in dB = 40 + 46.02 + 49.54 = 135.56 dB	4
Ans : f	Comparison between CB, CE and CC	4 (Any 4 points)

Sr. No.	Parameters	CB	CE	CC
1	Common terminal between input and output	Base	Emitter	Collector
2	Input Current	I_E	I_B	I_B
3	Output Current	I_C	I_C	I_E
4	Current gain	α dc = I_C/I_E	β dc = I_C/I_B	$\gamma = I_E/I_B$
5	Input Voltage	V_{EB}	V_{BE}	V_{BC}
6	Output Voltage	V_{CB}	V_{CE}	V_{EC}
7	Voltage gain	Medium	Medium	Less than 1
8	Applications	As preamplifier	Audio Amplifiers	For impedance matching.

Q6.	**Attempt any FOUR of the following**	**16**
Ans : a	Point Contact Diode	2



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.

Ans : b

Comparison between half wave rectifier and Full wave rectifier

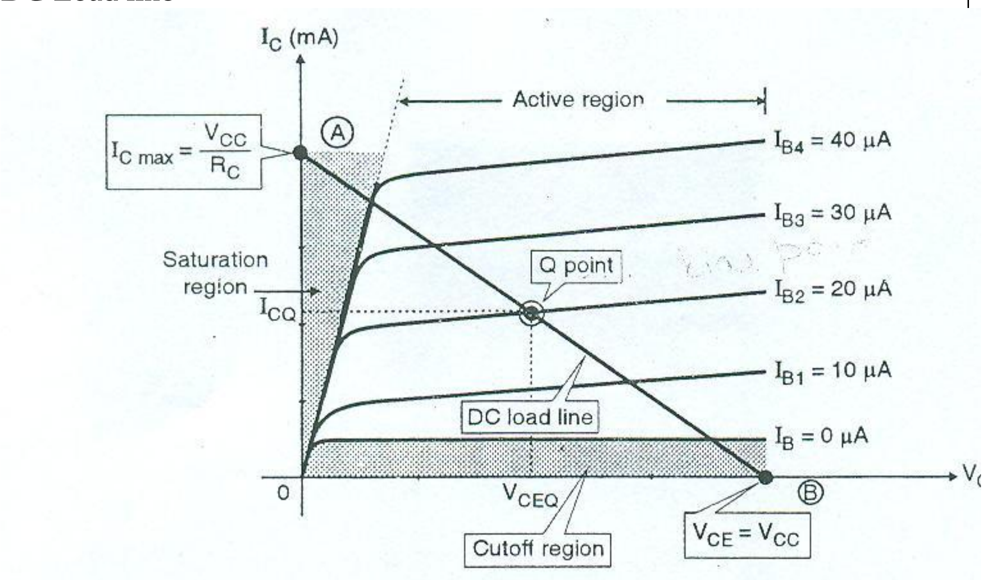
Sr. No.	Parameter	Half wave rectifier	Full wave rectifier
1	TUF	28.7 %	69.3 %
2	Ripple factor	121 %	48 %
3	Ripple frequency	50 Hz	100 Hz
4	Number of diodes used	One	Two or Four
5	PIV	Vm	2 Vm
6	RMS load voltage V_{Lrms}	Vm / 2	Vm / √ 2
7	RMS load current I_{Lrms}	Im / 2	Im / √ 2
8	DC load current $I_{L\,dc}$	Im /π	2 Im /π

4 (Any 4 points)

Ans : c

DC Load line

2



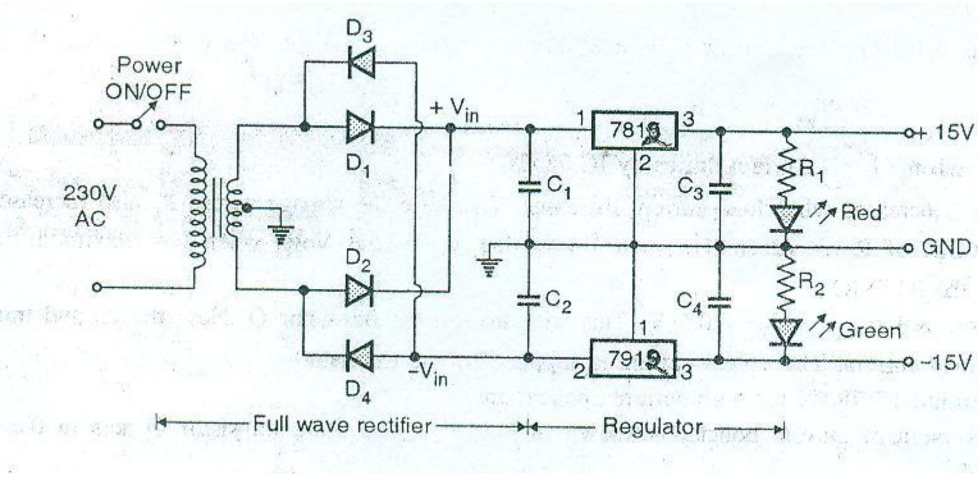
DC load line

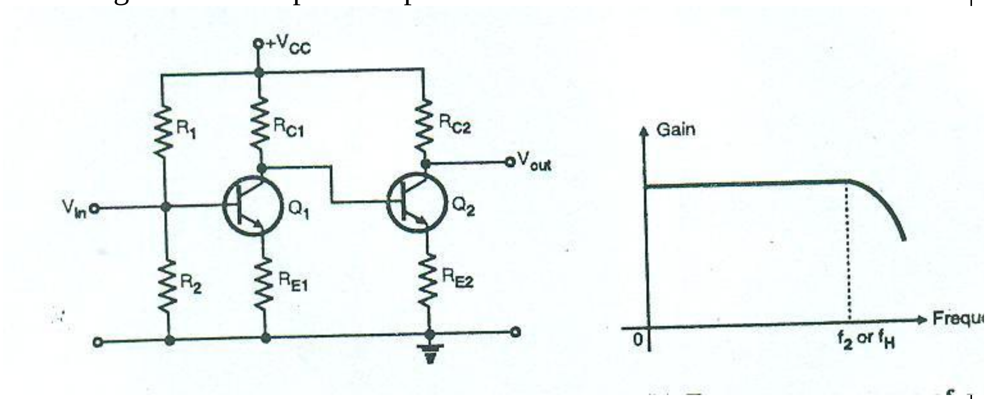
- The DC word indicates that this line is drawn under the dc operating conditions without any ac signal at the input.
- And the word load line is used because the slope of this line is –1/R_C where R_C is the load resistance.

2

Operating Point

- It is the point on the load line which represents the dc current through a transistor (I_{CQ}) and the voltage across it (V_{CEQ}) when no ac signal is applied.
- The dc load line is a set of infinite number of such operating points and the user or designer can choose any point on the dc load as the operating point.
- The position of operating point on the load line is dependent on the application of the transistor.
- The factors affecting the stability of Q-point are : 1. Changes in temperature 2. Changes in the value of β_{dc} .

Ans : d	Dual Power Supply 	4

Ans : e	Two stage Direct Coupled Amplifier 	2

Advantages : (any 2)

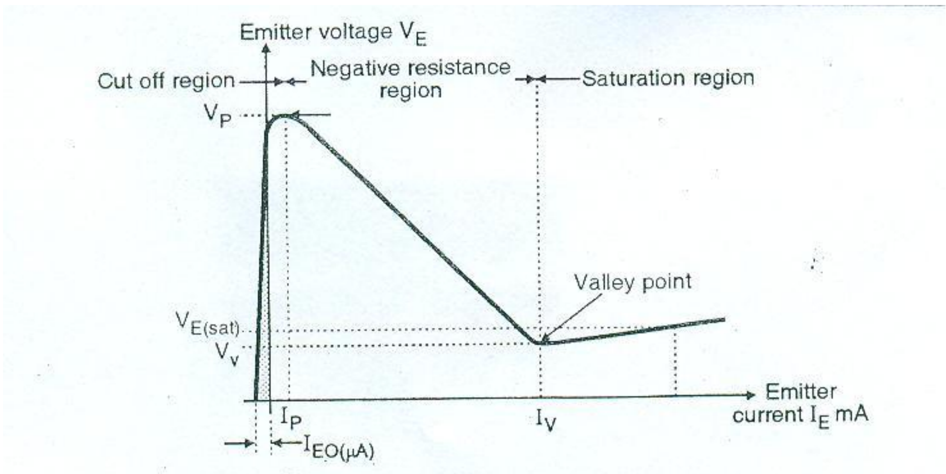
1) Wide frequency response (large Bandwidth)
2) Reduced cost and complexity due to absence of coupling capacitors.
3) This amplifier can amplify even the dc signals.

1

Disadvantages : (any 2)

1) The output waveform has a dc shift.
2) Poor frequency response at higher frequencies.
3) Poor temperature stability.

1

Ans : f	UJT Characteristics 	2

(Contd pg. 21)

	V_P (Peak Point Voltage) The emitter voltage, at which the emitter current suddenly increases, is called the Peak Point Voltage. **OR** The emitter voltage at which the UJT turns ON is called as the Peak Voltage. **V_V (Valley Point Voltage)** The emitter voltage, at which the emitter current is driven into saturation is called Valley Point Voltage.	1 1