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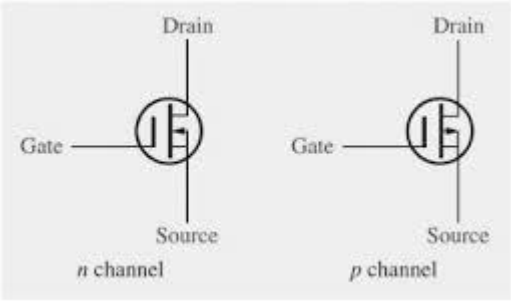
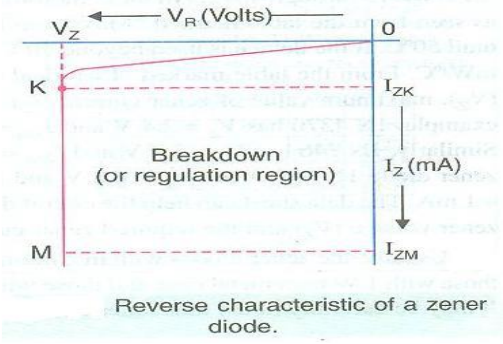
SUMMER– 18 EXAMINATION

Subject Name: Basic Electronics **Model Answer** Subject Code: 22216

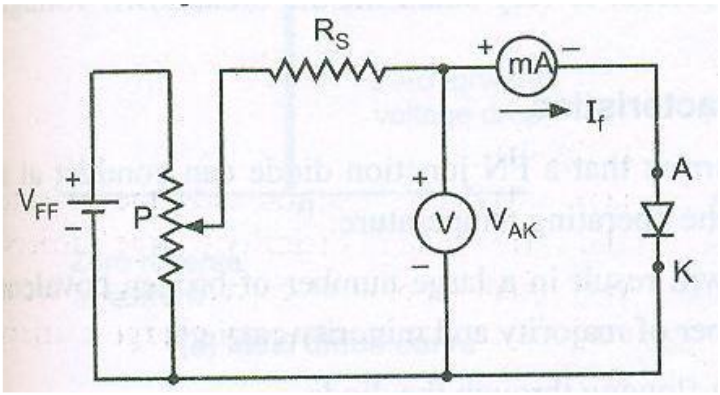
Important Instructions to examiners:

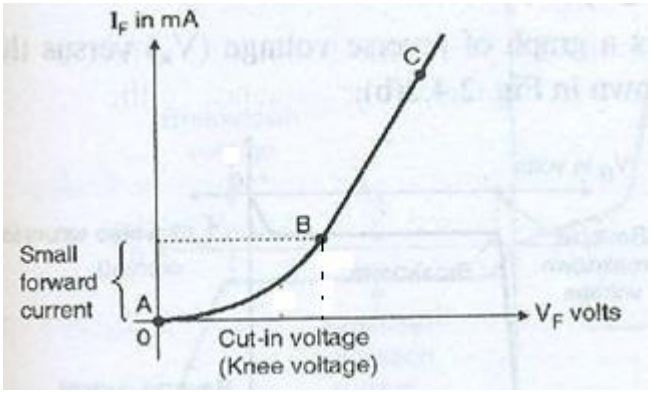
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

<table>
<tr><th>Q. No.</th><th>Sub Q. N.</th><th>Answers</th><th>Marking Scheme</th></tr>
<tr><td>1</td><td></td><td>Attempt any FIVE:</td><td>10- Total Marks</td></tr>
<tr><td></td><td>a</td><td>State materials used for LED's to emit different colour light.</td><td>2M</td></tr>
<tr><td></td><td>Ans:</td><td>
<table>
<tr><th>Sr. No.</th><th>Material used</th><th>Colour of the emitted light</th></tr>
<tr><td>1</td><td>Gallium arsenide (GaAs)</td><td>Infrared (IR)</td></tr>
<tr><td>2</td><td>Gallium arsenide phospide GaAsP</td><td>Red or Yellow</td></tr>
<tr><td>3</td><td>Gallium phospide (GaP)</td><td>Red or Green</td></tr>
<tr><td>4</td><td>Gallium nitrite $Ga(NO_2)_3$</td><td>Blue</td></tr>
</table>
</td><td>½ Mark for each correct answer</td></tr>
<tr><td></td><td>b</td><td>Sketch the symbol of P-channel and n-channel depletion type MOSFET.</td><td>2M</td></tr>
</table>

	Ans:		**1M each**
	c	**List any two BJT biasing circuits with respect to operating point.**	**2M**
	Ans:	1) Fixed bias 2) Base biased with emitter feedback 3) Collector to base bias 4) Voltage divider bias	**Any two 1M each**
	d	**State different methods of biasing of FET.**	**2M**
	Ans:	1) Fixed bias 2) Self bias 3) Voltage divider bias 4) Source bias	**½ M each**
	e	**Sketch reverse characteristics of zener diode with proper labelling.**	**2M**
	Ans:	 Reverse characteristic of a zener diode.	**1M diagram** **1M labeling**
	f	**Define line regulation. State the formula for its regulation.**	**2M**

	Ans:	**Line regulation:-**It is the ability of the power supply to maintain its specified output voltage over changes in the input line voltage. It is expressed as percent of change in the output voltage relative to the change in the input line voltage. **Formula:-** $$Line\ regulation = \left(\frac{\Delta V_{OUT}}{\Delta V_{IN}} \right) \times 100\%$$ Δ means "a change in" **(OR)** The change in output voltage with respect to per unit change in input voltage is defined as line regulation. It is mathematically expressed as, **Line regulation=$\Delta V_L/\Delta V_S$** Where, ΔV_L = The change in output voltage ΔV_S= The change in input voltage	
	g	**State cut in voltage value of diode for silicon and germanium.**	**2M**
	Ans:	The cut in voltage value of diode for silicon is 0.7 Volt and for Germanium is 0.3 Volt	**1M each**

Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any THREE:**	**12- Total Marks**
	a	**Describe experimental set-up for operation of P-N junction diode in forward bias. Draw its characteristics.**	**4M**
	Ans:	**Experimental set up Forward characteristics:-** 	**2M**
		Explanation:- • PN junction diode is forward biased when positive terminal of the power supply is connected to the P-type side, and the negative terminal of the power supply is connected to the N-type side. • When a PN junction is forward biased, the holes are repelled from the positive terminal of the battery and are moved towards the junction. • Similarly the free electrons are repelled from the negative terminal of the battery and move towards the PN junction. • Because of their acquired energy (from the battery V_{FF}), some of the holes and the free electrons enter into the depletion region and recombine themselves. • This reduces the potential barrier and the width of the depleting region. • The width of depletion region and the barrier potential reduces with the increase in forward bias. • As a result of this, more majority carriers diffuse across the junction. Therefore, it	**1M**

		causes a large current to flow through the PN junction. This is called forward current. • The point at which this sudden increase in current takes place is represented as the "knee" point • The PN junction does not permit the current to flow until the external bias voltage overcomes the barrier potential V_B. The external bias voltage should be greater than the barrier potential for the current to flow. **Forward characteristics:**  	**1M**
	b	**Define alpha and beta of a transistor and state the relation between them.**	**4M**
	Ans:	**Definition:** Alpha(**α)** is the current gain of CB configuration. It is defined as the ratio of collector current(I_C) to emitter current (I_E). Beta(**β)** is the current gain of CE configuration. It is defined as the ratio of collector current(I_C) to base current (I_B). **Relation between α & β:**	**1M each** **2M**

Current gain (α) of CB configuration $= \frac{I_C}{I_E}$

Current gain of (β) of CE configuration $= \frac{I_C}{I_B}$

We know that ;

$$I_E = I_B + I_C \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Dividing equation (1) by I_C

$$\frac{I_E}{I_C} = \frac{I_B}{I_C} + \frac{I_C}{I_C}$$

Therefore $\frac{1}{\alpha} = \frac{1}{\beta} + 1$ [since $\alpha = \frac{I_C}{I_E}$, $\beta = \frac{I_C}{I_B}$]

Therefore $\frac{1}{\alpha} = \frac{1+\beta}{\beta}$

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

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

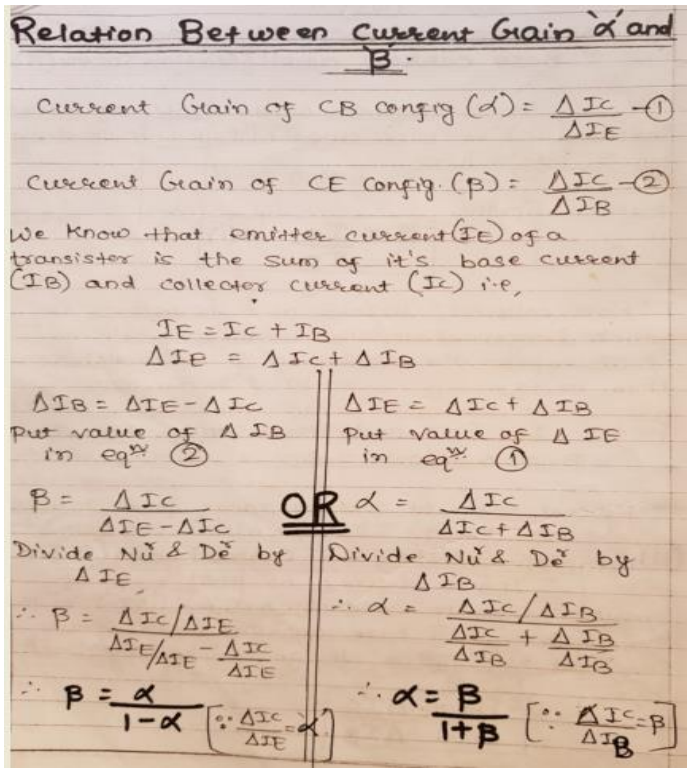
$\alpha = \beta - \alpha \beta$

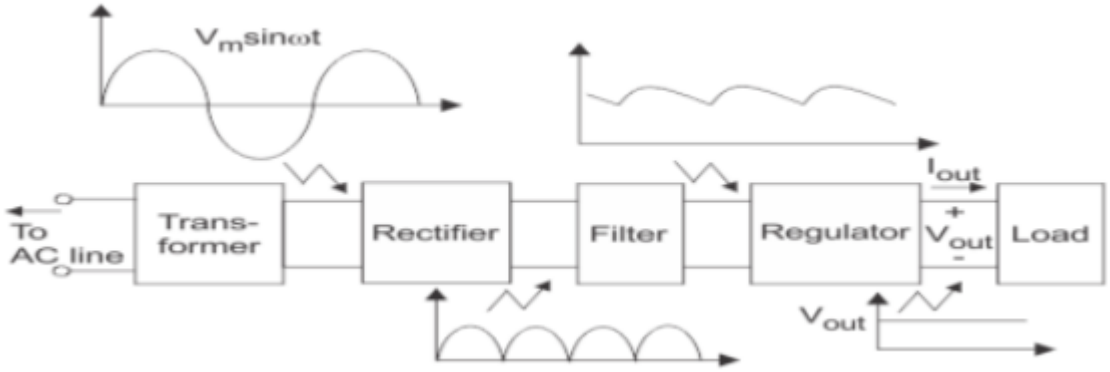
$\alpha = \beta(1 - \alpha)$

Therefore $\beta = \frac{\alpha}{1-\alpha}$ $\alpha = \frac{\beta}{1+\beta}$

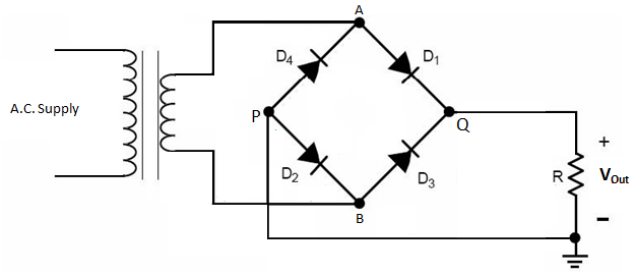
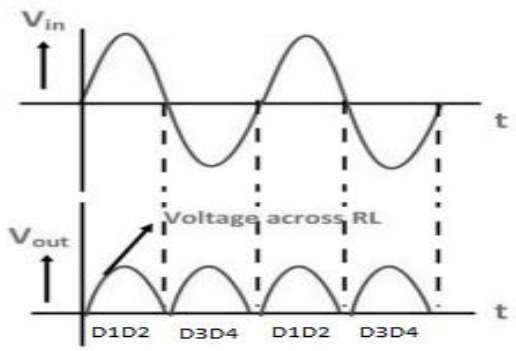
2M

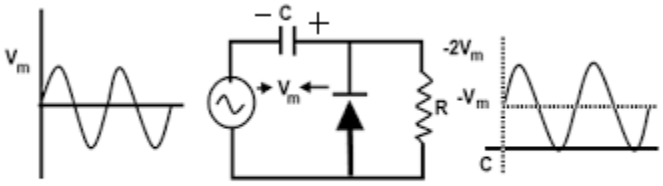
(OR)



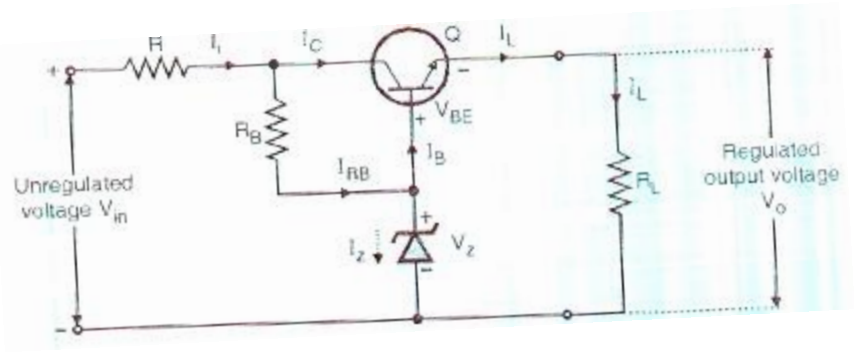
	c	**Explain basic block diagram of regulated DC power supply, draw its input and output waveforms.**	**4M**
	Ans:	**Block diagram of regulated DC power supply:-**  **Explanation** 1)Transformer 2) Rectifier 3) Filter 4) Voltage regulator. **1. Transformer:-** The AC main voltage is applied to a step down transformer. It reduces the amplitude of ac voltage to the desired level and applies it to a rectifier. **2. Rectifier:** The rectifier is usually a centre tapped or bridge type full wave rectifier. It converts the ac voltage into a pulsating dc voltage. **3. Filter:** The pulsating dc (or rectified ac) voltage contains large ripple. This voltage is applied to the filter circuit and it removes the ripple. The function of a filter is to remove the ripples to provide pure DC voltage at its output. The DC output voltage thus obtained will change with the changes in load current,input voltage, etc. So it is unregulated DC voltage. **4. Voltage Regulator :-** The unregulated DC voltage is applied to a voltage regulator. Output of the regulator circuit will be constant voltage under all operating circumstances.	**2M** **2M for explanation**

	d	**Explain the need of stabilization of Q point.**	**4M**
	Ans:	● Bias stabilization is a process of stabilizing the position of operating point "Q" ● The stabilization of Q-point is necessary to maintain the Q-point at the centre of load line because the bias point (Q-point) changes its position on the load line due to the factors such as temperature or device to device variations. ● If the Q-point gets shifted towards saturation or cut off regions, then amplified output waveform is distorted. In order to avoid such distortion it is necessary to stabilize the Q-point at the centre of the load line. ● So we need to design a biasing circuit which will keep the position of Q-point stable on the load line.	**4M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any four:**	**16- Total Marks**
	a	**Describe circuit diagram of bridge rectifier, draw its input and output waveforms.**	**4M**
	Ans:	**Circuit diagram:**  When input AC signal is applied across the bridge rectifier, during the positive half cycle diodes D_1 and D_2 are forward biased and conduct while the diodes D_3 and $D_4$are reverse biased and current flows through the load from point A-D_1-load-D_2-point B. During the negative half cycle diodes D_3 and D_4 are forward biased and conduct while diodes D_1 and D_2 are reverse biased and current flow through the load from point B-D_3-load-D_4-point A. As the current flowing through the load is unidirectional, the voltage developed across the load is also unidirectional as shown in the waveform.  	**Circuit diagram2M** **Explanation 1M** **Waveform 1M**

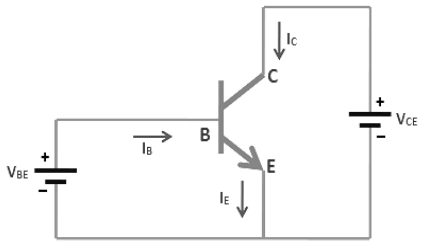
	b	**Explain the working of positive clamper with proper circuit diagram and draw the waveforms at input & output of clamper.**	**4M**
	Ans:	**Positive clamper circuit:**  Fig. 2 Positive Clamper • The circuit will be called a positive clamper, when the signal is pushed upward by the circuit. • During the positive half cycle, the diode is reverse biased. • During the negative half cycle, it is forward biased and current flows through it. It charges the capacitor to the negative peak voltage $-V_m$ • Once the capacitor is fully charged to $-V_m$, cannot discharge because the diode cannot conduct in the reverse direction. • Therefore the capacitor acts as a battery with e.m.f equal to $-V_m$. • This voltage gets added to the input signal, $V_m . sin\,\omega t$. • Therefore the output voltage is equal to , $v_0 = V_m . \sin \omega t + V_m$ • Thus a d.c voltage equal to V_m is added to input signal. It causes the waveform to clamp positively at 0 V.	**Circuit diagram2M** **Explanation 1M** **Waveform 1M**
	c	**A JFET has I_{Dss} = 10 mA, V_P = —5 volts, gmo = 2 ms. Calculate the trans-conductance and drain current of the JFET for V_{Gs} = —2.5 volts.**	**4M**
	Ans:	The expression for drain current ID, in the saturation region is, $I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$	**Formula-**

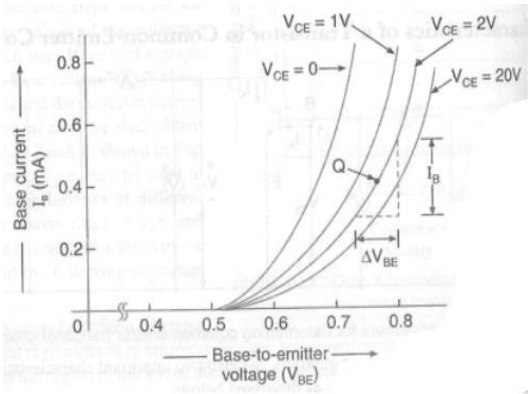
		$=10*10^{-3}\left(1-\frac{-2.5}{-5}\right)^2$ **=2.5mA** $g_m=\frac{I_D}{V_{GS}}$ $gm=\left\lvert\frac{2.5}{-2.5}\right\rvert$ **gm=1ʊ** **(or)** $g_m=g_{mo}\sqrt{\frac{I_D}{I_{DSS}}}$ $gm=2*\sqrt{\left(\frac{2.5}{10}\right)}$ **gm=1ʊ**	**1M each** **Correct answer-1M each**
	d	**Draw, the circuit diagram for transistor series regulator and explain functions of each component.**	**4M**

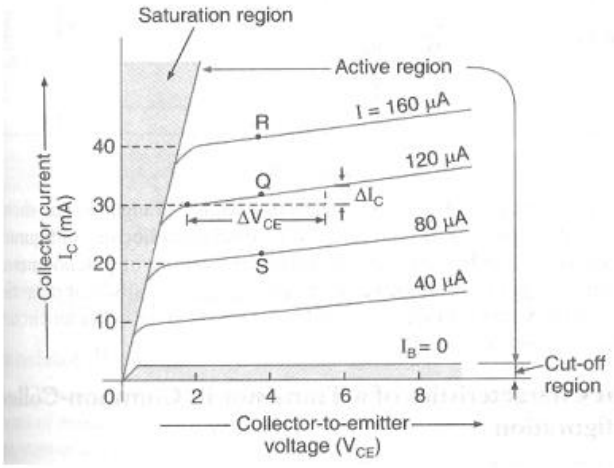
	Ans:	 Transistor (Q)- It acts as a control element and it is connected in series with the load resistor R_L. It also acts as a variable resistor to control the output voltage. Zener Diode- It provides reference voltage. Resistor (R)- It acts as a current limiting resistor. Base Resistor (R_B)-It provides biasing for transistor Q to keep the transistor in active region.	**Diagram- 2M** **Function of component- 2M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any THREE:**	**12- Total Marks**
	a	**State the values of following parameters for half wave and full wave rectifiers :** **(i) Number of diode used in circuit.** **(ii) Rectification efficiency (η)** **(iii) Transfer Utilization Factor (TUF)** **(iv) Ripple factor**	**4M**
	Ans:		**1M each**

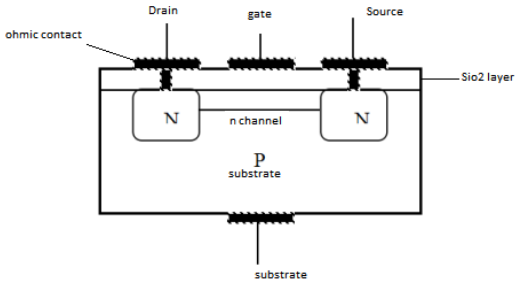
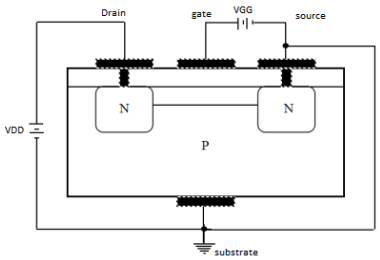
Parameters	Half wave	Full wave	
		Center-tapped	Bridge
No of diodes	1	2	4
Rectification Efficiency	40.6%	81.2%	81.2%
TUF	0.287	0.693	0.812
Ripple factor	1.21	0.482	0.482

	b	**Explain the operation of NPN transistor in the active region.**	**4M**
	Ans:	 **Operation of NPN transistor in active region:-** Active region is one in which base emitter junction is forward biased and base collector junction will	**Diagram-2M** **Operation-2M** **Note: Any other configuration can be consider**

		be reverse biased in a transistor. Due to forward bias at base emitter junction, the barrier potential is reduced and results in electron flow from emitter to base or current I_E. Some of the electrons entering base region will combine with holes in the base region and result in base current I_B . Remaining large number of electrons will pass to the collector circuit and represent the collector current I_c . In the active region, the collector current increases slightly(nearly constant) as collector-emitter voltage V_{CE} increases. The value of the collector current I_C increases with the increase in I_B. In the active region $I_C = \beta I_B$.	**ed**
	c	**Draw the input and output characteristics of CE configuration with proper labelling of various regions.**	**4M**
	Ans:	 **Input characteristics of common emitter transistor**	**2M each**



Output characteristics of common emitter transistor

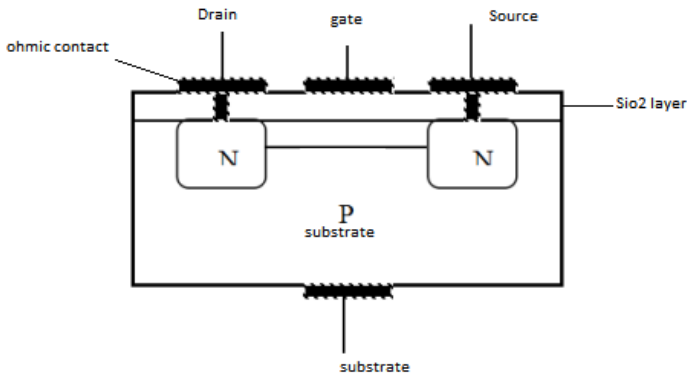
	d	**Draw the constructional details of n-channel MOSFET. State its working principle.**	**4M**
	Ans:	Depletion type MOSFET:-  Circuit Operation:-  The gate to source voltage is set to zero volts by the direct connection from one terminal to the other. & voltage V_{DS} is applied across the drain to source terminals. This results the attraction by the free electrons of the n channel due to positive drain & I_{DSS} establish in the circuit. For negative voltage at gate, electrons are repelled towards P type substrate and holes are attracted towards insulated layer. Recombination occurs between electron & holes that	Construc tional diagram- 2M Working principle- 2M

will reduce the number of free electrons in the channel for conduction. So drain current reduces. The value of V_{GS} at which drain current is nearly equal to zero is called cut off voltage.

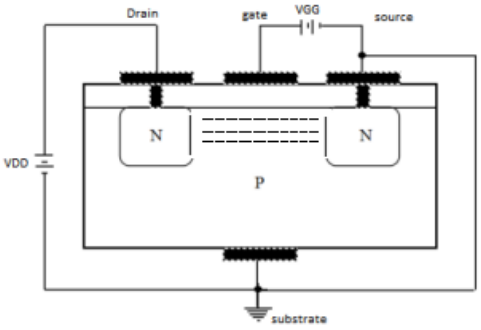
When gate is positive with respect to source, then positive V_{GS} draws additional electrons from the P type substrate. Thus drain current (I_D) increases as increase in positive V_{GS}.

OR

Enhancement – Type MOSFET:-

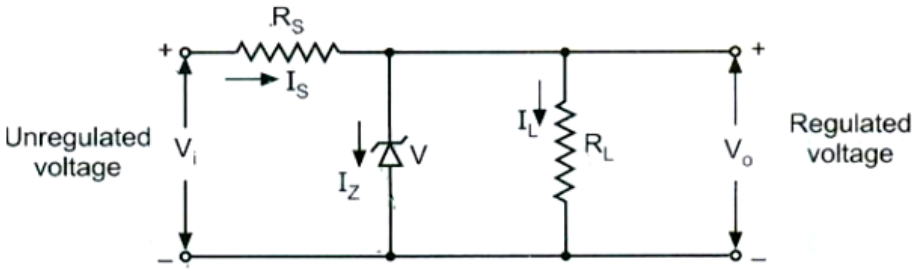


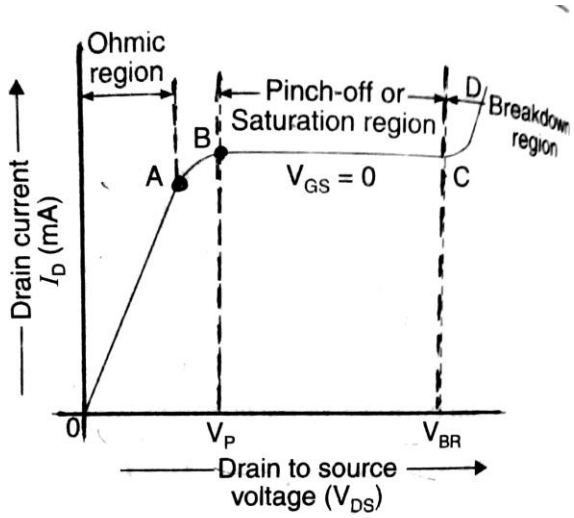
Circuit Operation:

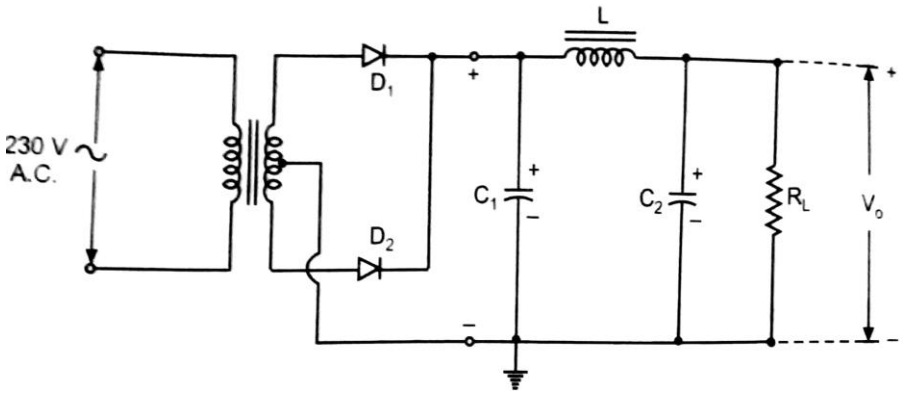


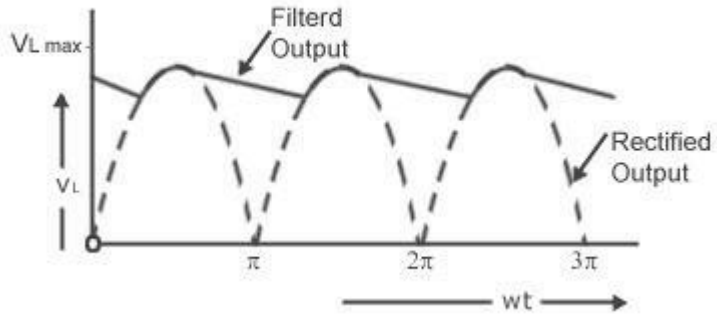
In fig. both V_{GS} & V_{DS} have been set at positive with respect to the source. The positive potential at the gate will attract the electrons from the P substrate & accumulate in the region near to the surface of SiO_2 layer. The SiO_2 layer & its insulating qualities will prevent the negative carriers (i.e. electrons) from being absorbed at the gate.

As V_{GS} increases, the concentration of electrons near the SiO_2 surface increases & there is formation of channel & the current starts following through the circuit for further applied voltage.

	e	**Describe the working of zener as a voltage regulator.**	**4M**
	Ans:	 **Zener regulator** Working For proper operation, the input voltage V_i must be greater than the Zener voltage V_z. This ensures that the Zener diode operates in the reverse breakdown condition. The unregulated input voltage V_i is applied to the Zener diode. Suppose this input voltage exceeds the Zener voltage. This voltage operates the Zener diode in reverse breakdown region and maintains a constant voltage across the load inspite of input AC voltage fluctuations or load current variations. The input current is given by, $I_S = (V_i – V_z) / R_s = (V_i – V_o) / R_s$ We know that the input current I_S is the sum of Zener current I_z and load current I_L. Therefore, $I_S = I_z + I_L$ or $I_z = I_s - I_L$ As the load current increase, the Zener current decreases so that the input current remains constant. According to Kirchhoff's voltage law, the output voltage is given by, $V_o = V_i – I_s . R_s$ As the input current is constant, the output voltage remains constant. The reverse would be true, if the load current decreases. This circuit is also correct for the changes in input voltage. As the input voltage increases, more Zener current will flow through the Zener diode. This increases the input voltage Is, and also the voltage drop across the resistor Rs, but the load voltage Vo would remain constant. The reverse would be true, if the decrease in input voltage is not below Zener voltage. Thus, a Zener diode acts as a voltage regulator and the fixed voltage is maintained across the load resistor R_L.	**Diagram 2M** **Working** **2M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
5		**Attempt any TWO:**	**12- Total Marks**
	a	**Explain drain characteristics of JFET with ohmic region, saturation region, cut-off region and break down region.**	**6M**
	Ans:	 The drain characteristics of JFET can be explained as follows: Ohmic Region: This region is represented by curve OA in the figure. In this region, the drain current increases linearly with the increase in drain-to-source voltage, obeying Ohm's law. The linear increase in drain current is due to the fact that N-type semiconductor bar acts like a simple resistor. Curve AB: In this region, the drain current increases at the reverse square law rate with the increase in drain-to-source voltage. It means that drain current increases slowly as compared to that in ohmic region. It is because of the fact, that with the increase in drain-to-source voltage, the drain current increases. This in turn increases the reverse	**3 Marks for characteristics** **1 Mark for Each region**

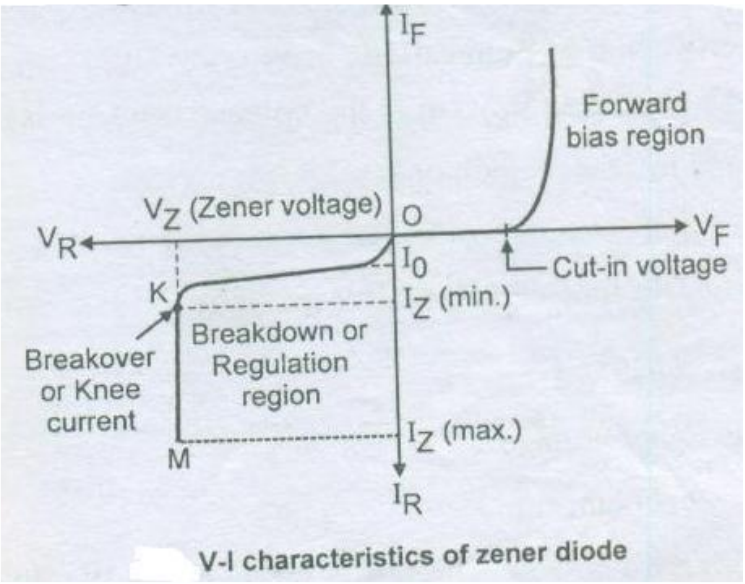
		bias voltage across the gate-source junction. As a result of this, the depletion region grows in size, thereby reducing the effective width of channel. At the drain-to-source voltage, corresponding to point B, the channel width is reduced to a minimum value and is known as pinch off. The drain-to-source voltage, at which the channel pinch-off occurs is known as pinch-off voltage (V_p) Pinch off region: This region is shown by the curve BC. It is also called saturation region or constant current region. Here the drain current remains constant at its maximum value (i.e. I_{DSS}). The drain, current in the pinch off region, depends upon the gate-to-source voltage and is given by the relation $I_D = I_{DSS}(1 - \frac{V_{GS}}{V_p})^2$ The above relation is known as Shockley's equation. The pinch off region is the normal operating region of JFET, when used as an amplifier. Breakdown region: This region is shown by the curve CD. In this region, the drain current increases rapidly as the drain-to-source voltage are increased. It happens because of the breakdown of gate-to-source junction due to avalanche effect. The drain-to-source voltage corresponding to point C is called breakdown voltage.	
	b	**Draw circuit diagram and input and output waveforms of full wave rectifier connected with π filter.**	**6M**
	Ans:	**Circuit diagram of full wave rectifier connected with π filter:**  **Input and Output waveforms of full wave rectifier connected with π filter**	**3Marks for Circuit diagram**



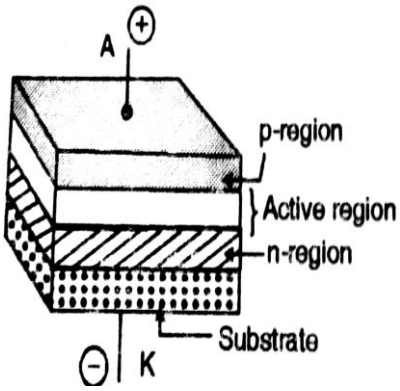
Note: In the above waveform Rectified output is Input waveform.

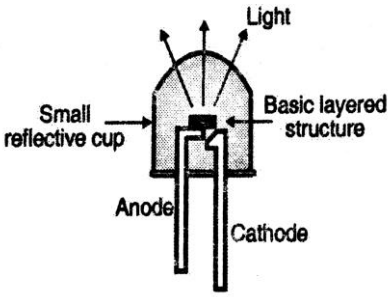
Filtered output is Output waveform.

3Marks for Input and Output waveforms

c	**Describe V-I characteristics of zener diode.**	**6M**
Ans:	 V-I characteristics of zener diode The V-I characteristics of Zener diode can be divided into two parts. 1. Forward characteristics 2. Reverse characteristics Forward characteristics : Forward characteristics of a Zener diode is similar to that of an ordinary silicon p-n junction diode.	**2 Marks for characteristics**

		It indicates that forward current is very small for voltages below knee (cut-in) voltage and large for voltages above knee voltage. Reverse characteristics : Zener diode is silicon p-n junction device which differs from a rectifier diode, in the sense, that it is operated in the reverse breakdown region. When the reverse voltage across a diode is increased a critical voltage called breakdown voltage, the reverse current increases sharply as shown in the curve KM. This is an indication that the breakdown has occurred. This breakdown voltage is called as Zener breakdown voltage or Zener voltage and it is denoted by V_Z. The breakdown voltage of Zener diode is set by carefully controlling the doping level during manufacture. After breakdown has occurred, the voltage across Zener diode remains constant equal to V_Z. Any increase in the source voltage will result in the increase in reverse Zener current.	**4 Marks for description**
Q. No.	**Sub Q. N.**	**Answers**	**Marking Scheme**
6		**Attempt any TWO:**	**12- Total Marks**
	a	**Show constructional details of LED. Give any two applications of LED.**	**6M**
	Ans:	Constructional details of LED: A pn junction diode, which emits light when forward biased, is known as a light emitting diode (LED). This emitted light may be visible or invisible. The amount of light output is directly proportional to the forward current. Thus higher the forward current, higher is the light output. Here, an N-type layer is grown on P-type substrate by a diffusion process. Then a thin P-type layer is grown on N-type layer. It has two electrodes namely Anode and Cathode. The light energy is released at the junction, when the recombination of electrons with the holes takes place. After passing through the P-region, the light is emitted through the window provided at the top of the surface.	**2 Marks for Construction**





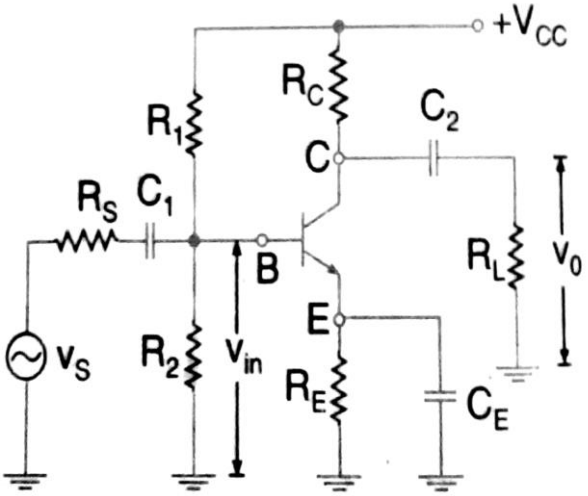
2 Marks for diagram(any one)

Applications of LED:

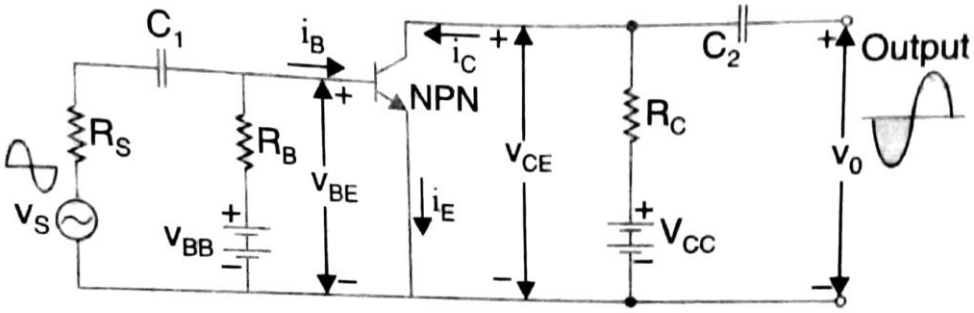
1. It is used in opto couplers.
2. It is used in optical communication systems.
3. It is used in infrared remote control.
4. It is used in 7- segment,16- segment, alphanumeric displays.
5. It is used as indicators in various electronic circuits.
6. It is used in optical switching applications.
7. It is used in burglar alarm systems.
8. It is used to indicate digital logic state.
9. Used for traffic signal management
10. Used in aviation lighting, automotive lighting, advertising and general lighting

2 Marks for any 2 Applications

b	**Describe the working of single stage CE amplifier with neat circuit diagram.**	**6M**
Ans :	**Single stage CE amplifier Circuit diagram:**	**3 Marks for any diagram**



(OR)



3 Marks for working

Working of single stage CE amplifier :

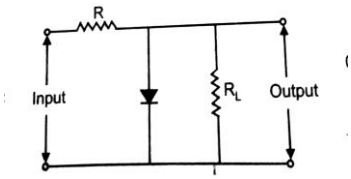
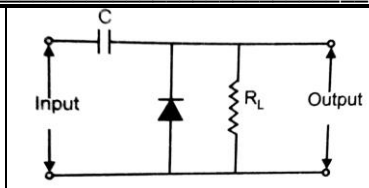
The circuit diagram of a voltage amplifier using single transistor in CE configuration is shown in above figure.

It is also known as a small-signal single-stage CE amplifier or RC coupled CE amplifier. It is also known as a voltage amplifier.

- The input a.c. signal is applied across the base emitter terminals of the transistor & output is taken across collector emitter terminals of the transistor.
- The potential divider biasing is provided by resistors R_1, R_2 and R_E. It provides good stabilization of the operating point.
- The capacitors C_1 and C_2 are called the coupling capacitors used to passes the AC voltage signals from one side to the other. At the same time, it does not allow the

		dc voltage to pass through .Hence it is also known as blocking capacitors. • The capacitor C_E works as a bypass capacitor. It bypasses all the AC currents from the emitter to the ground and avoids the negative current feedback. It increases the output AC voltage. • The resistance R_L represents the resistance of whatever is connected at the output. It may be load resistance or input resistance of the next stage.	
	c	**Differentiate clipper and clamper with following points:** **(i)** Components used in circuit. (ii) Function (iii) Application (iv) Configuration	**6M**
	Ans:		**2 Marks for Components used in circuit** **1 Mark for Function** **1 Mark for Application** **2 Mark for Configuration**

Sr.No.	Parameter	Clipper	Clamper
1	Components used in circuit	Diode, resistor	Diode, resistor, capacitor
2	Function	To remove a part of input signal voltage above or below a certain level.	To add a DC shift to the input signal
3	Application	• Digital computers, • radars, • radio and television receivers, • to limit the amplitude of the input signal voltages required in several applications.	• Used in Television receivers to restore the original dc reference signal to the video signal, • voltage multipliers.

		4	Configuration			

Note: Any related configuration can be considered for clipper and clamper

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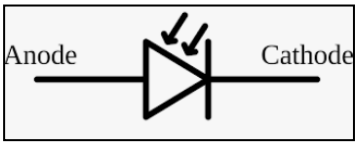
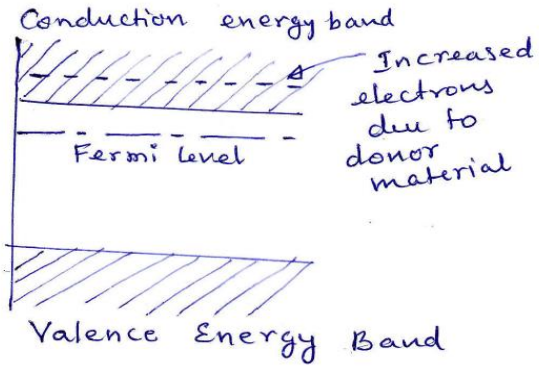
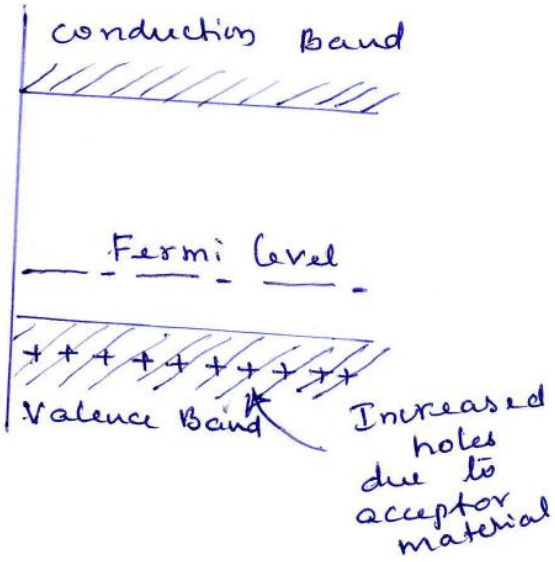
MODEL ANSWER
WINTER– 18 EXAMINATION

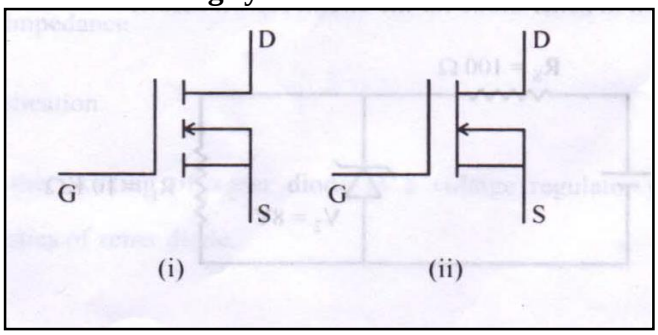
Subject Title: Basic Electronics (BEL) Subject Code: 22216

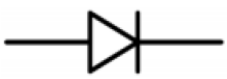
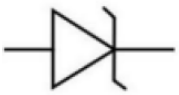
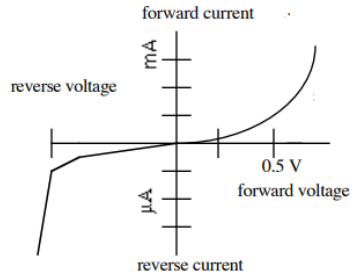
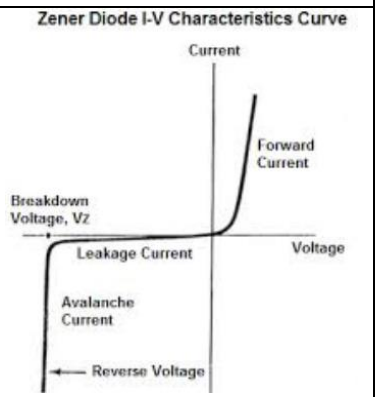
Important Instructions to examiners:

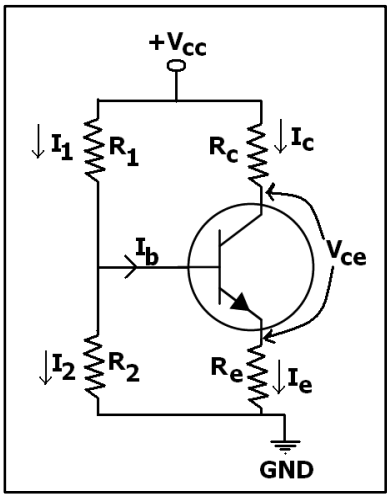
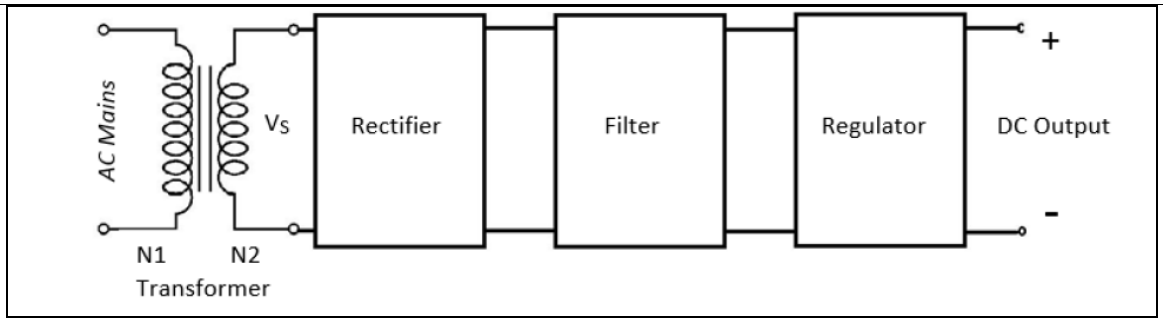
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 anyequivalent 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.

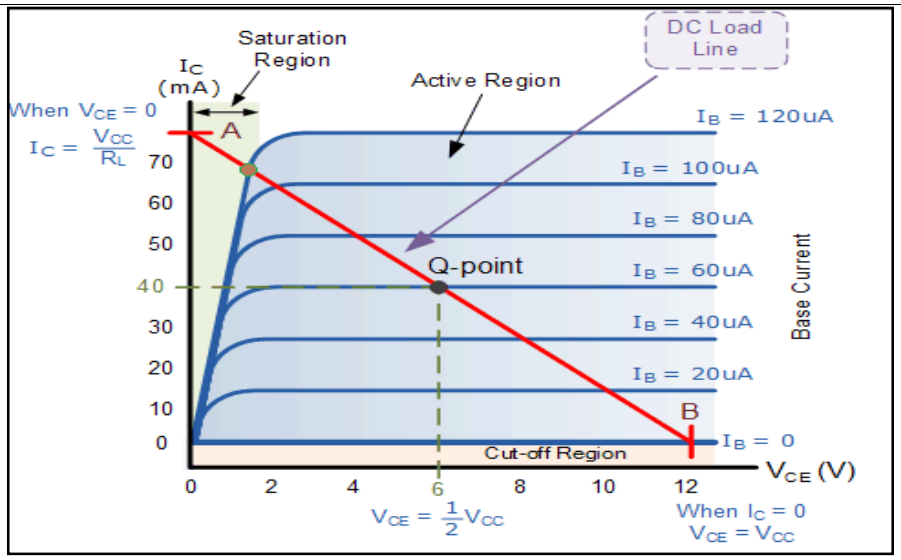
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		**Attempt any FIVE :**	**10-Total Marks**
	a)	**Draw the symbol of photodiode.**	**2M**
	Ans:		Correct symbol -2M
	b)	**Define Transistor. State its type.**	**2M**
	Ans:	Transistors are active electronic components made of semiconducting materials, which can amplify the electric signals by the application of a small input signal. Types of transistors: 1. Unipolar Junction Transistors 2. Bipolar Junction Transistors	Definition - 1M; Types - 1M
	c)	**Define load and line regulation.**	**2M**
	Ans:	**Load regulation** is the ability of the power supply to maintain its specified output voltage given changes in the load. **Line regulation** is the ability of the power supply to maintain its specified output voltage over changes in the input line voltage.	Each definition - 1M

d)	**State application of FET.**	**2M**
Ans:	***(NOTE : Any other relevant Application mark shall be given)*** **Applications of FET :** i. As input amplifiers in oscilloscopes, electronic voltmeters and other measuring and testing equipment because high input impedance reduces loading effect to the minimum. ii. Constant current source. They are used to build RF amplifiers in FM tuners and other communication circuits. Because of low noise. iv. FETs are used in mixer circuits of FM and TV receivers as it reduces inter modulation distortion. v. Used as Analogue switch. vi. As a Voltage Variable Resistor (VVR) in operational amplifiers.	**Any two applications** (1M each)
e)	**Sketch energy band diagram of semiconductor.**	**2M**
Ans:	**Energy band diagram for N type semiconductor:**  **Energy band diagram for P type semiconductor:**  	Any one correct diagram - 2M

	f)	**State the need of DC regulated power supply.**	**2M**
	Ans:	**Need of DC regulated power supply :** **1.** To convert unregulated AC into constant DC. 2. To convert fluctuating main supply into regulated constant DC.	Any one relevant need - 2M
	g)	**Name the components of following symbol:**  	**2M**
	Ans:	(i) N-channel Enhancement type MOSFET (ii) N-channel Depletion type MOSFET	Each correct answer -1M
Q. 2		**Attempt any THREE of the following :**	**12-Total Marks**
	a)	**Compare PN junction diode & Zener diode. (four points).**	**4M**
	Ans:	See table below	Each point - 1M

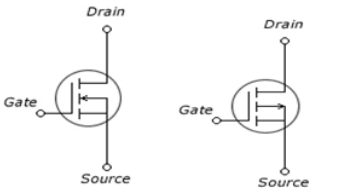
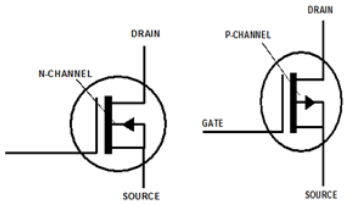
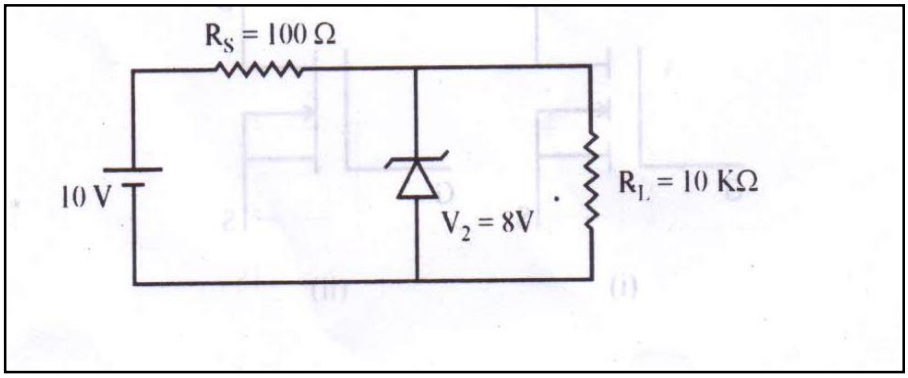
Parameter	**PN junction diode**	**Zener diode**
Symbol		
Direction of Conduction	Conducts only in one direction	Conducts in both directions
Reverse breakdown	It has no sharp reverse breakdown	It has quite sharp reverse breakdown
Application	Used in rectification	Used in regulation
Resistance in reverse biased condition	Very high	Very small
Characteristics	 	

b)	**Explain with a neat circuit diagram of voltage divider bias method for biasing a transistor.**	**4M**
Ans:	The voltage divider is formed using external resistors R_1 and R_2. The voltage across R_2 forward biases the emitter junction. By proper selection of resistors R_1 and R_2, the operating point of the transistor can be made independent of β. In this circuit, the voltage divider holds the base voltage fixed independent of base current provided the divider current is large compared to the base current. The voltage at transistor base, $V_B = V_{CC} \ X \ \frac{R_2}{R_1+R_2}$ Neglecting V_B, The emitter current = $I_E = \frac{V_E}{R_E}$ $V_{CE} = V_{CC} - I_C . R_C - I_E . R_E$ 	Explanation - 2M Diagram - 2M
c)	**Draw the block diagram of DC power supply. Explain the function of each block.**	**4M**
Ans:	 **Transformer** : It reduces the amplitude of ac voltage to the desired level and applies it to a rectifier circuit. **Rectifier :** This circuit converts the voltage at the secondary of the transformer into a pulsating dc voltage. **Filter:** This circuit reduces the ripple content in the pulsating dc, producing unregulated dc voltage. **Regulator:** This circuit converts the unregulated dc voltage into regulated constant dc voltage.	Diagram - 2M Functions - 2M
d)	**Explain the concept of DC load line and oprating point.**	**4M**
Ans:	**DC load line**: The straight line drawn on the characteristics of a BJT amplifier which give the DC values of collector current I_C and collector to emitter voltage V_{CE} corresponding to zero signal i.e. DC conditions is called DC load line. To plot $I_{C(MAX)}$, $V_{CE\ (MAX)}$ on output characteristics: Get $V_{CE\ (MAX)}$ by putting $I_{c\ =\ 0}$ $V_{CE} = V_{CC} - I_c \ R_c$ $V_{CE\ (MAX)} = V_{CC}$ since $I_c = 0$ Get $I_{C(MAX)}$ by putting $V_{CE\ =\ 0}$ $I_{C(MAX)} = \frac{V_{CC}}{R_C}$	1M 2M

		 **Operating point or Q- point**: The fixed levels of certain currents and voltages in a transistor in active region defines the operating point on the DC load line. For normal operation of the transistor, the Q- point is to be selected at the center of the load line.	1M
Q. 3		**Attempt any THREE of the following:**	**12-Total Marks**
	a)	**An AC supply of 230 V is applied to HWR through a transformer with turns ratio 10:1. Find Average DC output, Voltage current and PIV of diode, RMS value of voltage and current.**	**4M**
	Ans:	Vrms=230V, np/ns=10/1 Max primary voltage is Vp=√2* Vrms =√2* 230 =325.22Volt The max secondary voltage is Vm=ns/np*Vp= =1/10*325.22 **=32.52V** V average=Vdc=Vm/π =32.5/ 3.14 **=10.35V** PIV=Vm= 32.52V Vrms=Vm/2 =32.52/2 **=16.25V** Idc=Im/π Irms= Im/2 **Assume R_L=10KΩ - *(Note - Students may assume any value and attempt to solve, can be considered)***	Vdc = 1 Mark PIV = 1 Mark

		$Im=Vm/R_L$ $=32.52/10*1000$ **$=3.25mA$** $Idc=Im/\pi$ $=3.25*10^{-3}/\pi$ **$=1.03\ mA$** $Irms=Im/2$ $=3.25*10^{-3}/2$ **$=1.62\ mA$**	Idc = 1 Mark Irms = 1mark
b)	**State the values of following parameters with reference to full wave rectifier:** **(i) Ripple factore (ii) Efficiency** **(iii) TUF (iv) P/V**		**4M**
Ans:	(i) Ripple factor -48% (ii) Efficiency - 81.2% (iii) TUF -69.3 or 81.2 (iv) PIV- Vm		1 mark each parameter
c) **Ans:**	**Compare EMOSFET & DMOSFET.**		**4M** Any 4 points – 1mark each

Sr. No.	E MOSFET	DMOSFET
1	Insulating oxide layer is present between gate and substrate channel is absent. At the operation induced channel get created.	An insulating oxide layer is present between G & channel n or p-type channel is present.
2.	For n- channel EMOSFET V_{GS} will be only positive.	For an n-channel DMOSFET, the V_{GS} can be negative for depletion mode & positive for Enhancement mode
3	For an n-channel EMOSFET I_D increases as V_{GS} becomes more and more positive	For an n-channel DMOSFET I_D decreased as V_{GS} becomes more and more negative.
4	For an n-channel EMOSFET $I_D = 0$ for $V_{GS} \leq V_T (V_{GSTh})$	For an n-channel DMOSFET $I_D = 0$ for $\|V_{GS}\| \geq V_P$

		5	 N- Channel EMOSFET P- Channel EMOSFET	 N- Channel DMOSFET P- Channel DMOSFET		
	d)	**Determine output voltage V_0, load current I_L, zener current I_z & power dissipation in zener diode for the circuit shown below.** 				**4M**
	Ans:	i)Vo=Vz =8V ii) load current I_L $I_L = V_o/R_L$ = 8/(10*1000) =0.0008 **=0.8 mA** iii)zener current I_z Vo=Vin-Is.Rs Is=(Vin- Vo)/Rs = (10-8)/100 =2/100 **Is =0.02A**				V_0 = 1mark I_L = 1mark I_z = 1mark

Is=Iz+I_L
Iz=Is- I_L
=0.02 - 0.0008
= 0.0192A

iv)Power dissipation
=V_L* I_L
= 8* 0.0008
= 0.0064
=6.4mW

Power dissipation = 1mark

Q. 4 **Attempt any THREE of the following:** **12-Total Marks**

a) **Compare L, C, LC and π filter on the basis of usefulness in reducing ripple or suitability for heavy / light load.** **4M**

Ans:

Parameters	**L filter**	**C filter**	**LC filter**	**π filter**
Ripple	MORE	LESS	LOW	LOWEST
Suitability for heavy / light load.	HEAVY LOAD	LIGHT LOAD	HEAVY LOAD CURRENT	LOW LOAD CURRENT

ripple or suitability for heavy / light load = 1 mark each point

b) **Explain the operating principle of PNP transistor.** **4M**

Ans:

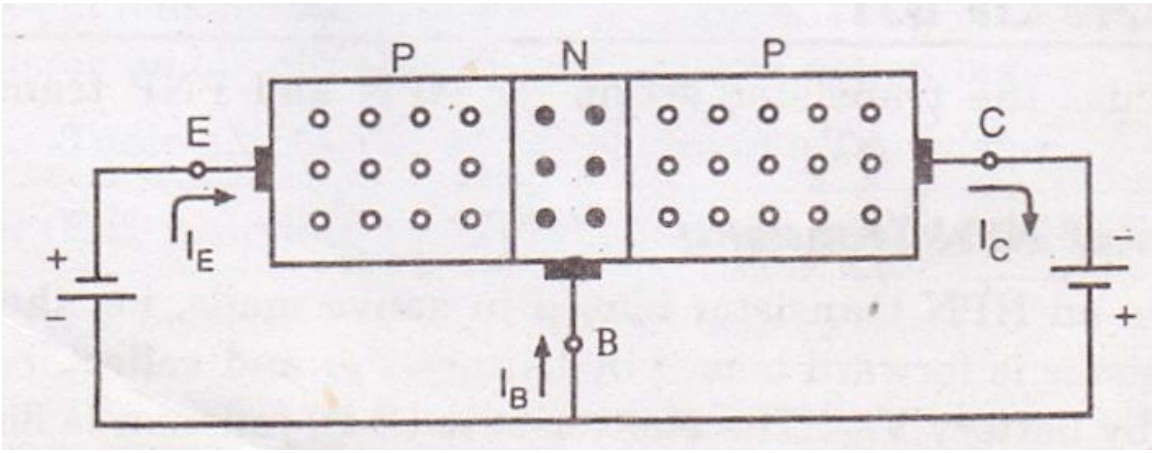
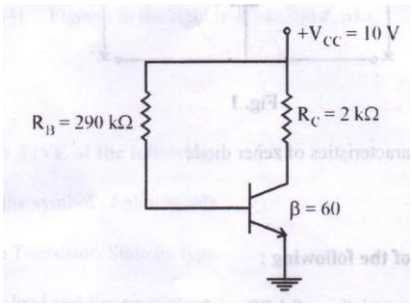
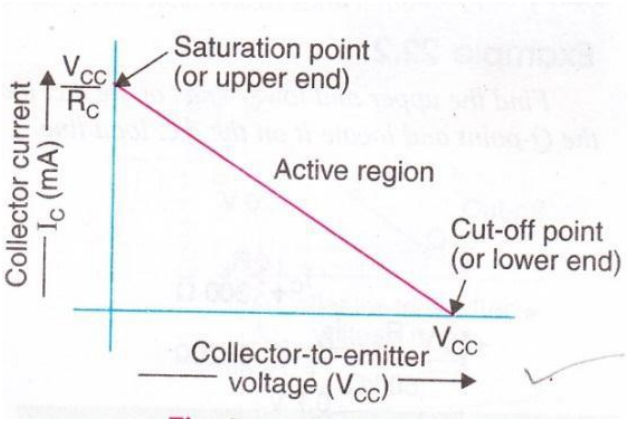


Diagram – 1 mark
Explanation = 3marks

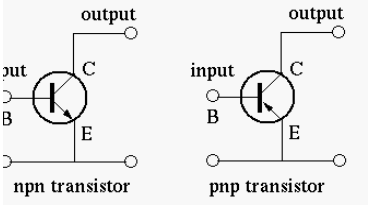
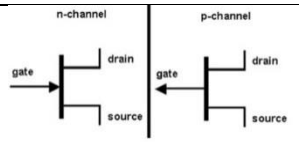
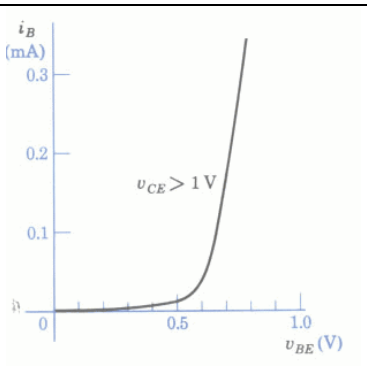
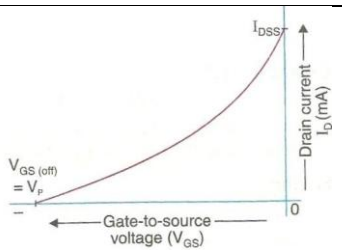
A PNP transistor biased in active mode, i.e. the emitter –base (E-B) junction as forward biased battery V_E and the collector – base (C-B) junction as reverse biased, the emitter – base (E-B), junction is forward biased only if the emitter to base (E-B) voltage (VEB) exceed the barrier potential which is 0.7 volts for silicon and 0.3 volts for germanium transistors.

The forward biased on the emitter base (E-B) junction causes majority carriers i.e. holes in the P type emitter region to flow towards the N type base region. This E-B junction, they tend to combine with the majority carriers i.e. holes in the base region.

		Most collector current is also injected current because this current is produced due to the holes injected from the emitter region. There is another small component of collector current due to thermally generated carriers. This current component is called reverse saturation current (I_{CO}) and is quite small. In this way, almost entire emitter current flows in the collector circuit, it is clear that the emitter current is the sum of the base current and collector current i.e. $I_E = I_B + I_C$	
	c)	**Find the Q point values for the following circuit, Assume V_{BE} = 0.7 V & β = 60.** 	**4M**
	Ans:	 By KVL V_{CE}= Vcc - Ic.Rc For point on X axis—Ic=0 **V_{CE}= Vcc=10V** For point on Y AXIS -- VCE=0 **I_C=V_{CC}/R_C** **= 10/2000** **= 0.005** **=5mA**	Ic = 2marks V_{CE} = 2marks
	d)	**Compare BJT & JFET with reference to following point:** **i) Symbol** **ii) Transfer characteristics** **iii) I/P impendence** **iv) Application**	**4M**

Ans:

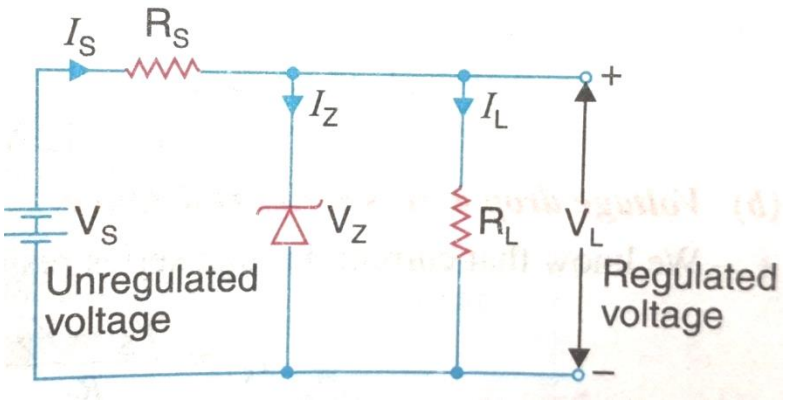
1 mark each

Parameters	BJT	FET
Symbol		
Transfer characteristics	 **OR** Linear in BJT	 **OR** Non-linear in FET
I/P impedance	Low	High
Application	Amplifier and Switch	Amplifier and Switch

e) **Describe the working of Zener diode as a voltage regulator with reverse characteristics of zener diode** **4M**

Ans:

2 marks diagram 2 marks explanation



Circuit Description

As the zener diode is connected in parallel or shunt with the load hence it is also known as SHUNT REGULATOR.

A resistance (Rs) is connected in series with the zener diode to limit current in the circuit. For proper operation, the input voltage(Vs) must be greater than the zener voltage(Vz).

$$Is = \frac{Vs - Vz}{Rs}$$

$$V_L = V_Z + I_Z . R_Z$$

Where,

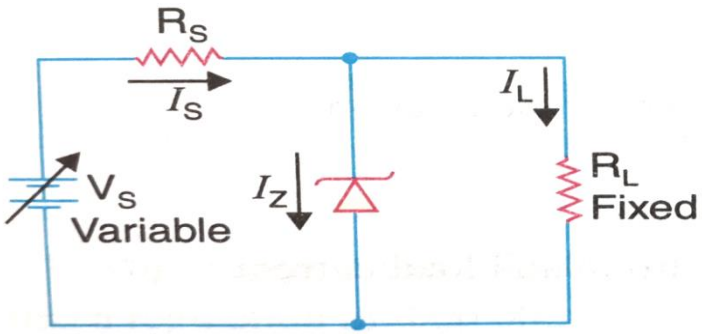
Rz= zener resistance

$$I_L = \frac{V_L}{R_L}$$

$I_s = I_z + I_L$

WORKING OF ZENER DIODE SHUNT REGULATOR

A] <u>REGULATION BY VARYING INPUT VOLTAGE</u>



This diagram is optional

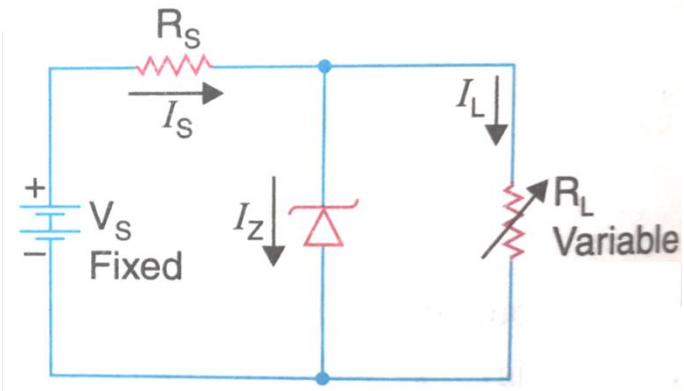
Here the load Resistance is kept fixed and input voltage is varied within the limits

CONDITION 1. WHEN INPUT VOLTAGE IS INCREASED

When input voltage is increased the input current (Is) also increases. Thus current through zener diode gets increased without affecting the load current(IL).The increase in input voltage also increases the voltage drop across the resistance Rs thereby keeping the VL constant.

CONDITION 2. WHEN INPUT VOLTAGE IS DECREASED
When input voltage is decreased, the input current gets reduced, as a result of this Iz also decreases. The voltage drop across Rs will be reduced and thus the load voltage (V_L) and load current(I_L) remains constant.

B] <u>REGULATION BY VARYING LOAD RESISTANCE</u>



This diagram is optional

In this method the input voltage is kept constant whereas load resistance R_L is varied.

CONDITION 1. WHEN LOAD RESISTANCE IS INCREASED

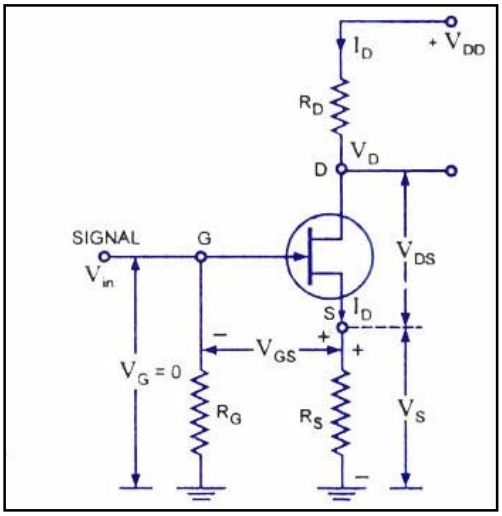
When load resistance is increased, the load current reduces, due to which the zener

current I_Z increases. Thus the value of input current and voltage drop across series resistance is kept constant. Hence the load voltage remains constant.

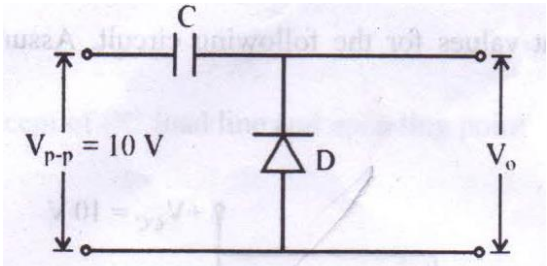
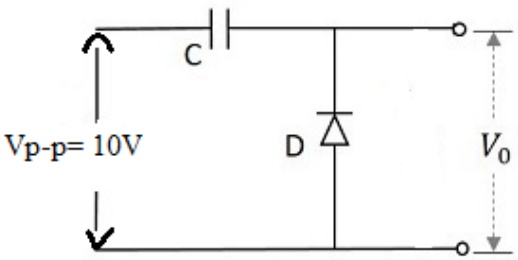
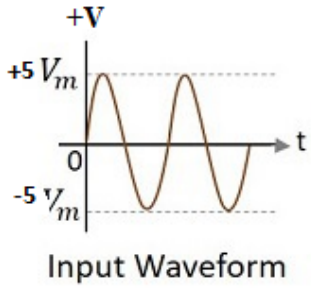
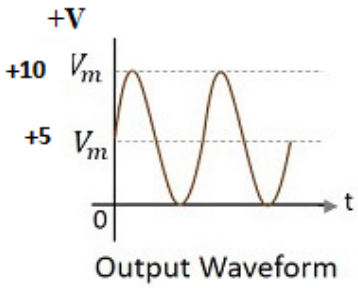
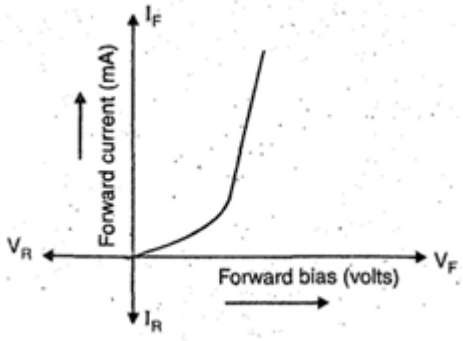
CONDITION 2. WHEN LOAD RESISTANCE IS REDUCED

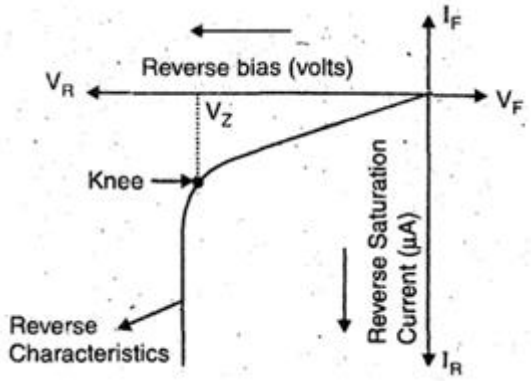
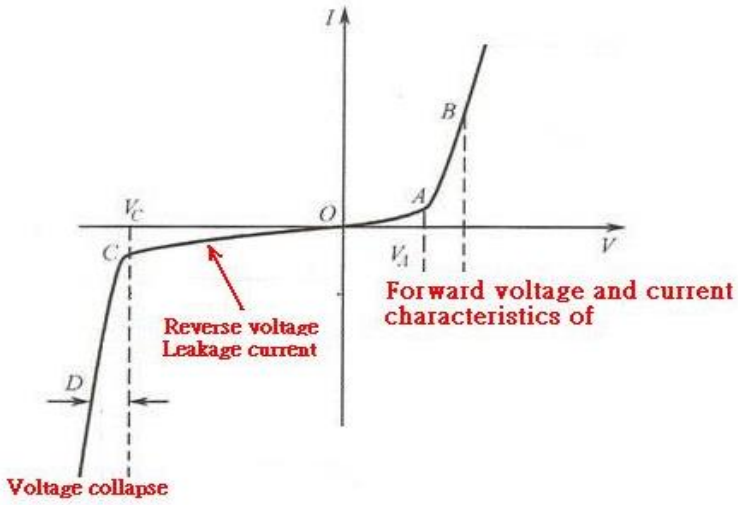
When load resistance is decreased, the load current increases. This leads to decrease in I_Z. Because of this the input current and the voltage drop across series resistance remains constant. Hence the load voltage is also kept constant.

Q.5		Attempt any TWO of the following :	12-Total Marks
	a)	**With neat circuit diagram and mathematical expressions, explain the self-biasing used in F.E.T.**	6M
	Ans:	**1. SELF BIASING** • In this circuit there is only one drain supply and no gate supply. • The gate terminal is connected through resistor R_G to the ground. • The source terminal is connected through resistor R_S to the ground. {NOTE: In JFET input PN junction between gate & source is always reverse bias, due to this input resistance of JFET is very high. Due to this input gate current I_G = zero. Hence if resistor R_G is connected in series with gate terminal, voltage drop across R_G is zero as $V_{RG} = I_G R_G = 0$}	Circuit Digram:3M Explanation: 1M Mathematical expression:2 M



- $V_G = I_G R_G = 0$
- $V_{GS} = V_G - V_S$
  $= -V_S$
  APPLY KVL TO INPUT LOOP
  $V_{GS} + I_D R_S = 0$
  $\therefore V_{GS} = -I_D R_S$
- $I_D = I_{DSS}\{1-\frac{V_{GS}}{V_P}\}^2$ Shockley's equation
- APPLY KVL TO OUTPUT LOOP
  $V_{DD} - I_D R_D - V_{DSQ} - I_D R_S = 0$
  $V_{DSQ} = V_{DD} - I_D R_D - I_D R_S$

		$= V_{DD} - I_D [R_D + R_S]$	
	b)	**Identify the following circuit shown in Fig. No. 1 and draw input and output waveforms.**  **Fig. 1**	**6M**
	Ans	 **Assume Ideal Diode** Ckt is Positive Diode Clamper  Input Waveform  Output Waveform	Circuit Identification :2M Input, output waveform:4 M
	c)	**Explain V-I characteristics of zener diode.**	**6M**
	Ans:	**Forward characteristics of Zener diode:**  This characteristic is similar to that of an ordinary silicon P-N junction diode. This indicates forward current is very small for voltages below knee voltage (VK =	Forward characteristics of Zener diode: 2M Reverse characteristics of Zener diode: (2M Draw and 2M Description)

		0.7V) and large for voltages above knee voltage. **Reverse characteristics of Zener diode:**  • Fig above shows the reverse portion of V-I characteristics of the zener diode. • As the reverse voltage (V_R) is increased the reverse current (I_Z) remains negligibly small up to the 'Knee' of the curve. • At this point the effect of breakdown process begins. • From the bottom of the knee, the breakdown voltage or Zener voltage (V_Z) remains essentially constant. • This ability of a diode is called regulating ability and is an important feature of Zener diode. • Following two points are important from the characteristics of a Zener diode. • There is a minimum value of Zener current called "break over current" designated as I_{ZK} or I_Z(min) which much be maintained in order to keep the diode in regulation region. There is a maximum value of Zener current designated as I_{ZM} or I_Z(max) above which the diode may be damaged.	
Q.6		**Attempt any TWO:**	**12-Total Marks**
	a)	**Draw the characteristics of LED and write advantages, disadvantages and application of it. (each two points)**	**6M**
	Ans:	**V-I characteristics of LED:**  	V-I characteristics of LED:3M

ADVANTAGES: (Any Two Points)

- **Efficiency:** LEDs emit more lumens per watt than incandescent light bulbs.
- **Color:** LEDs can emit light of an intended color. This is more efficient and can lower initial costs.
- **Size:** LEDs can be very small (smaller than 2 mm^2) and are easily attached to printed circuit boards.
- **On/Off time:** LEDs light up very quickly. LEDs used in communications devices can have even faster response times.
- **Dimming:** LEDs can very easily be dimmed either by pulse-width modulation or lowering the forward current.
- **Cool light:** In contrast to most light sources, LEDs radiate very little heat.
- **Slow failure:** LEDs mostly fail by dimming over time, rather than the abrupt failure of incandescent bulbs.
- **Lifetime:** LEDs can have a relatively long useful life. product.
- **Shock resistance:** LEDs, being solid-state components, are difficult to damage with external shock, unlike fluorescent and incandescent bulbs, which are fragile.
- **Focus:** The solid package of the LED can be designed to focus its light.

Advantages: 1M (2Points)

Disadvantages (Any Two Points)**:**

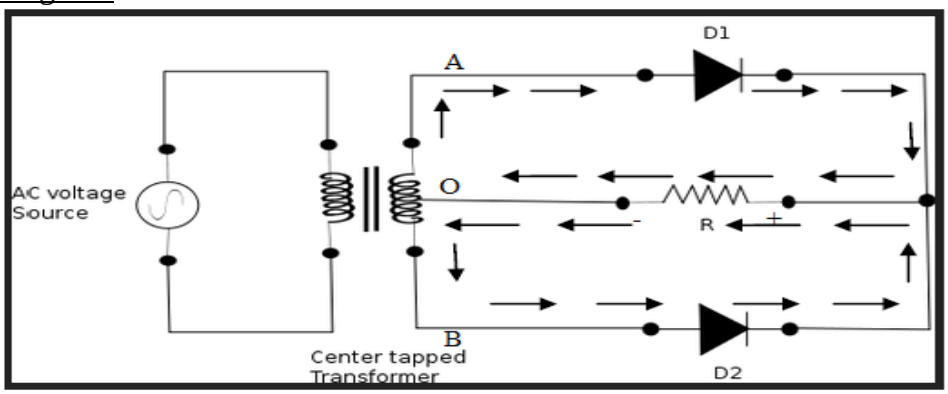
- **High initial price:** LEDs are currently more expensive (price per lumen) on an initial capital cost basis, than most conventional lighting technologies.
- **Temperature dependence:** LED performance largely depends on the ambient temperature of the operating environment – or "thermal management" properties.
- **Voltage sensitivity:** LEDs must be supplied with the voltage above the threshold and a current below the rating. Current and lifetime change greatly with a small change in applied voltage.
- **Light quality:** Most cool-white LEDs have spectra that differ significantly from a black body radiator like the sun or an incandescent light.
- **Area light source:** Single LEDs do not approximate a point source of light giving a spherical light distribution.
- **Efficiency droop:** The efficiency of LEDs decreases as the electric current increases. Heating also increases with higher currents which compromise the lifetime of the LED.
- **Impact on insects:** LEDs are much more attractive to insects.
- **Use in winter conditions:** Since they do not give off much heat in comparison to traditional electrical lights, LED lights used for traffic control can have snow obscuring them, leading to accidents.

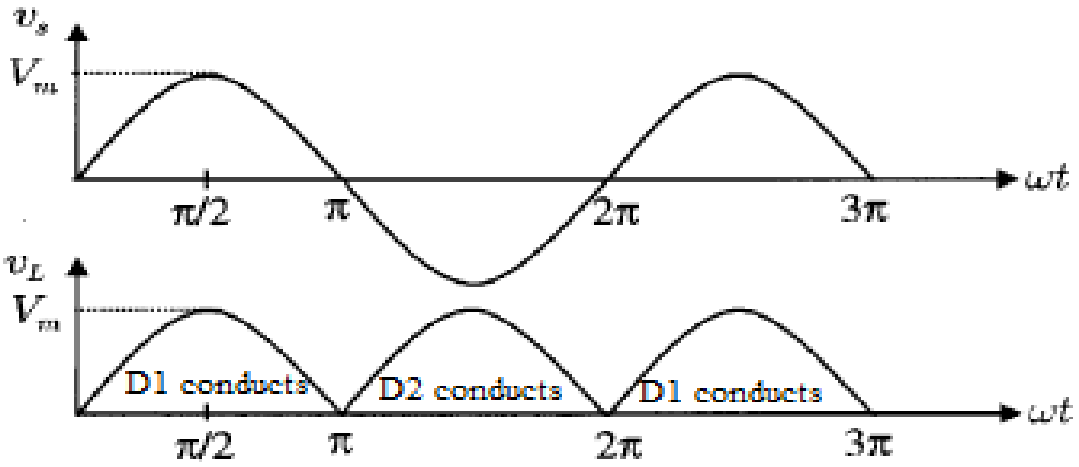
Disadvantages: 1M (2Points)

Applications of LED (Any Two Points):

- As a power indicator.
- In seven segment display.
- In the opto-couplers.
- In the infrared remote controls.

Application: 1M (2Points)

	b)	**Draw circuit and describe working of full wave rectifier using center tapped transformer with waveforms.**	**6M**
	Ans:	**<u>Full wave Rectifier with Center tapped transformer(FWR):</u>** • In full wave rectification, the rectifier conducts in both the cycles as two diodes are connected. <u>Circuit diagram:</u>  • The circuit employs two diodes D1 and D2 as shown. A center tapped secondary winding AB is used with two diodes connected. So that each uses one half – cycles of input AC voltage. • Diode D1 utilized the AC voltage appearing across the upper half (OA), while diode D2 uses the lower half winding (OB). • The voltage V_s between the center-tap and either ends of secondary winding is half of the secondary voltage V_2 i.e $V_s = \frac{V_2}{2}$ • If the output voltage should be equal to the input voltage, a step up transformer with turns ratio $\frac{N_2}{N_1} = 2$ must be used. Thus the total secondary voltage V_2 is twice the primary voltage. i.e, $V_s = V_1 = \frac{V_2}{2}$ <u>Operation:</u> 1. <u>In positive half cycle (0-Π).</u> • The end A of the secondary winding becomes positive and end B negative. • This makes diode D1 forward biased and diode D2 reverse biased. Therefore D1 conducts while D2 does not. • The conventional current flow direction in the upper half winding as shown in the fig above. A – D1 – RL – O 2. <u>In negative half cycle (Π-2Π):</u> • End A of secondary winding becomes negative and end B positive. Therefore diode D2 conducts while diode D1 does not. • The conventional current flow is from as shown by the arrows in the above fig. B – D2 – RL – O • From fig. current in the load RL is in the same direction for both half-cycles of input AC voltage. Therefore DC is obtained across the load RL.	Circuit Diagram:2 M Description: 2M

			Waveforms: 2M
c)		**i) In CE configuration if β = 99 leakage current I_{CEO} = 50 µA. If base current is 0.5 mA. Determine I_C and I_E.** **ii) Derive relation between α & β.**	**6M**
Ans:		**i)** Given: β= 99 I_{CEO} = 50 µA, I_B = 0.5 mA, = 500 µA To Find: I_C & I_E Solution: $I_C = \beta * I_B + I_{CEO}$ Therefore, I_C = 99 x 500 µA + 50 µA I_C = 49550µA Therefore, IC = 49.55 mA $I_E = I_C + I_B$ I_E = 49.55 mA + 0.5 mA I_E = 50.05mA I_E = 50.05 mA **ii) Relation between α & β:** We know that; $I_E = I_B + I_C$……..(i) Dividing equation (i) by I_C. $I_E / Ic = I_B / I_C + I_C / I_C$ Therefore $1/\alpha = 1/\beta + 1$ (Since $\alpha = I_C / I_E$, $\beta = I_C/I_B$	**To find I_C and I_E = 1/5marks each** **Derive relation between α & β = 3marks**

		Therefore $1/\alpha = \frac{1+\beta}{\beta}$ Therefore $\alpha = \frac{\beta}{1+\beta}$ $\alpha(1+\beta) = \beta$ $\alpha + \alpha\beta = \beta$ Therefore $\alpha = \beta - \alpha\beta$ Therefore $\alpha = \beta (1 - \alpha)$ Therefore $\beta = \frac{\alpha}{1-\alpha}$	

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WINTER-19 EXAMINATION

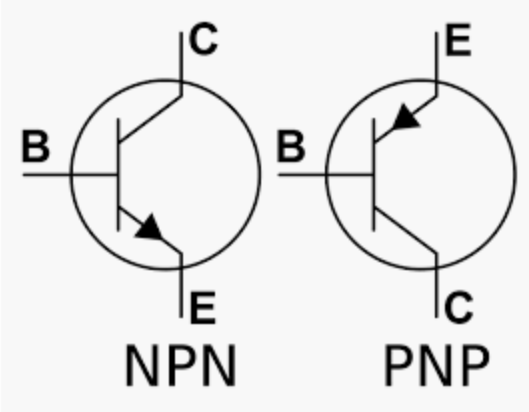
Subject Name: Basic Electronics **Subject Code:** 22216

Model Answer

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.

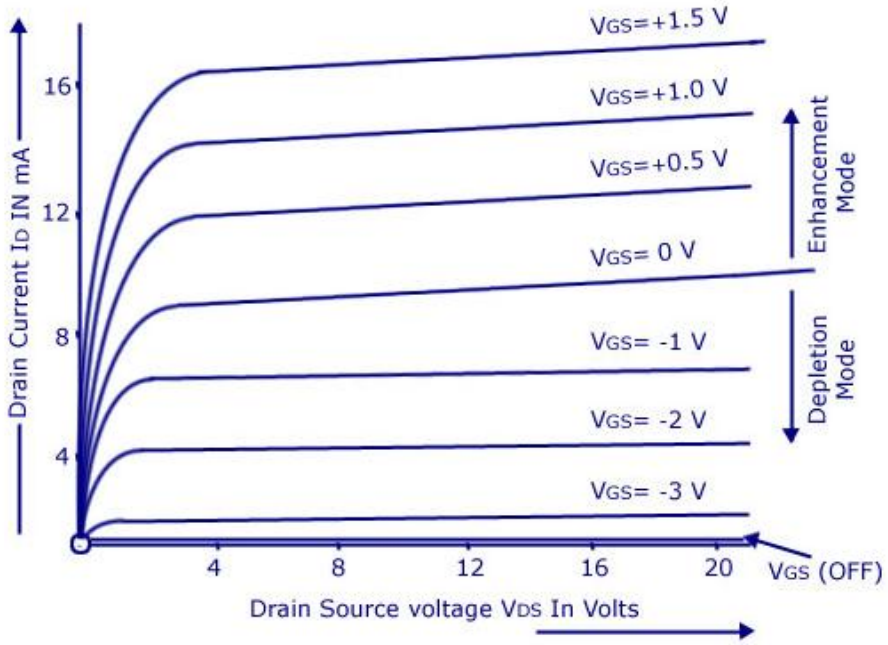
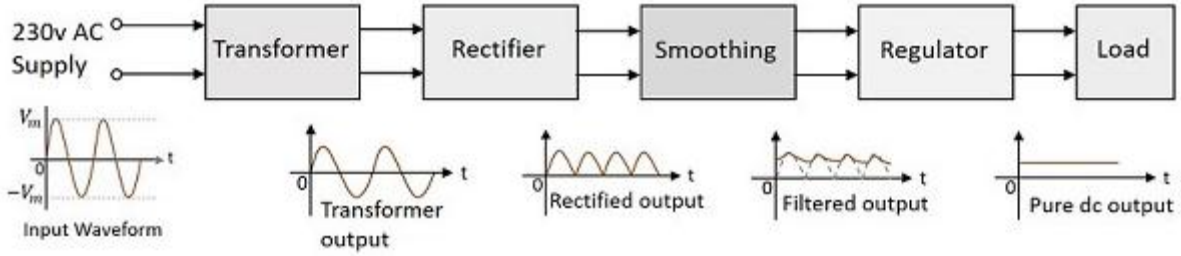
Q. No.	Sub Q. N.	Answers	Marking Scheme
1	**(A)**	**Attempt any FIVE of the following:**	**10- Total Marks**
	(a)	**Define : Intrinsic semiconductor and Extrinsic semiconductor.**	**2M**
	Ans:	**Intrinsic** – Semiconductor in pure form is called as intrinsic semiconductor. **Extrinsic** – Semiconductor with added impurity is called as extrinsic semiconductor.	**Each definitio n : 1M**
	(b)	**State any two applications of FET.**	**2M**
	Ans:	Applications of FET : • As input amplifiers in oscilloscopes, electronic voltmeters and other measuring and testing equipment because high input impedance reduces loading effect to the minimum. • As Constant current source. • They are used to build RF amplifiers in FM tuners and other communication circuits. Because of low noise.	**Any two : 2M**

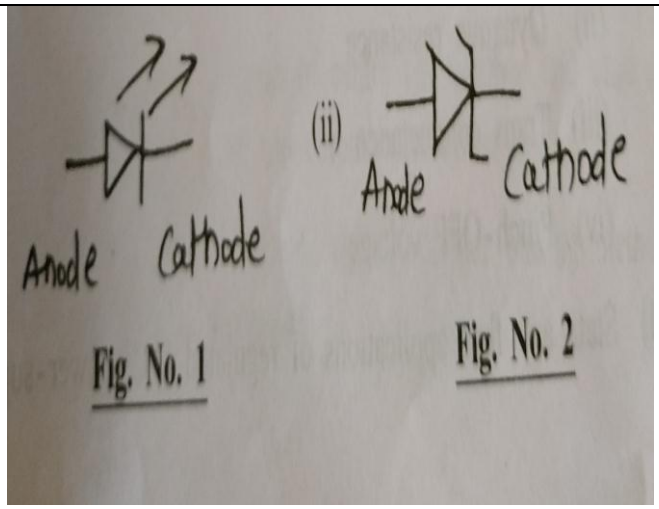
		• FETs are used in mixer circuits of FM and TV receivers as it reduces inter modulation distortion. • Used as Analog switch. • As a Voltage Variable Resistor (VVR) in operational amplifiers.	
	(c)	**Draw symbol of NPN and PNP transistor.**	**2M**
	Ans:		**Each symbol : 1M**
	(d)	**Sketch the drain characteristics of N-channel MOSFET.**	**2M**

WINTER-19 EXAMINATION

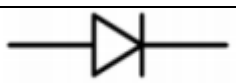
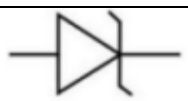
Subject Name: Basic Electronics **Subject Code:** 22216

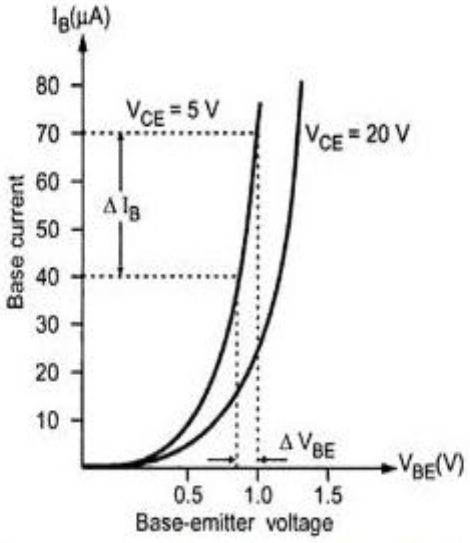
Model Answer

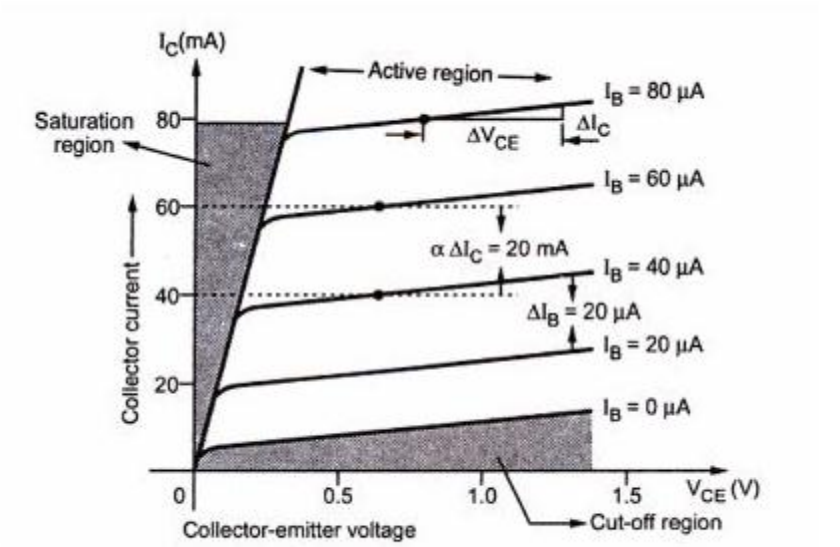
	Ans:		**2M**
	e)	**Define : Load regulation and Line regulation.**	**2M**
	Ans:	**Load regulation** is the ability of the power supply to maintain its specified output voltage over changes in the load. **Line regulation** is the ability of the power supply to maintain its specified output voltage over changes in the input line voltage.	**Each definitio n : 1M**
	f)	**Draw basic block diagram of DC regulated power supply.**	**2M**
	Ans:		**2M**
	g)	**Identify the components of following symbol.**	**2M**

			
	Ans:	Fig no. 1 : LED Fig no. 2 : Zener Diode	**Each symbol : 1M**

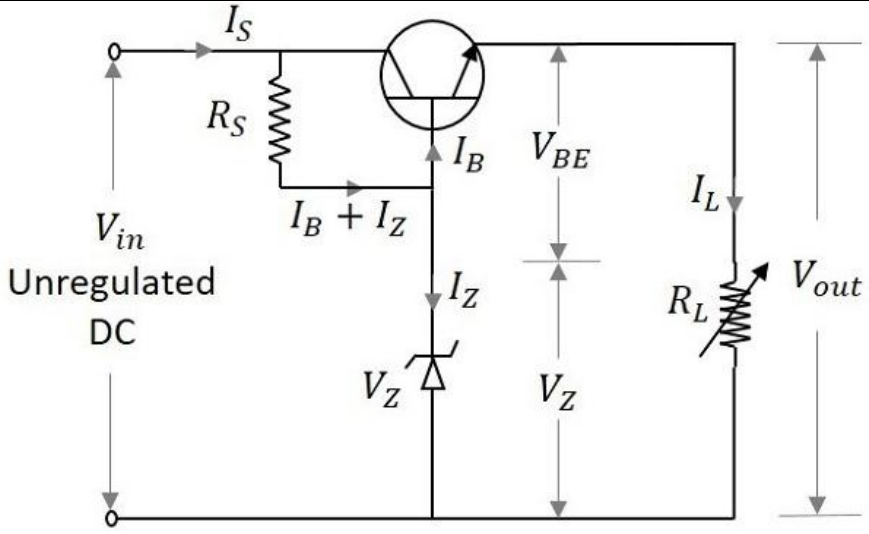
Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any THREE of the following:**	**12- Total Marks**
	a)	**Compare P-N junction diode and zener diode on following parameters:** **(i) Symbol** **(ii) Doping level** **(iii) Breakdown Voltage** **(iv) Applications.**	**4M**
	Ans:		**Four points : 4M**

Parameter	**PN junction diode**	**Zener diode**
Symbol		
Doping level	Low	High

		Breakdown voltage	It has no sharp reverse breakdown	It has quite sharp reverse breakdown
		Applications	Used in rectification	Voltage stabilizer, motor protection and wave shaping
	b)	**Sketch input and output characteristics of CE configuration. Label various regions on characteristics.**		**4M**
	Ans:	 Input characteristics of the transistor in CE configuration		**Each characteristic : 2M**



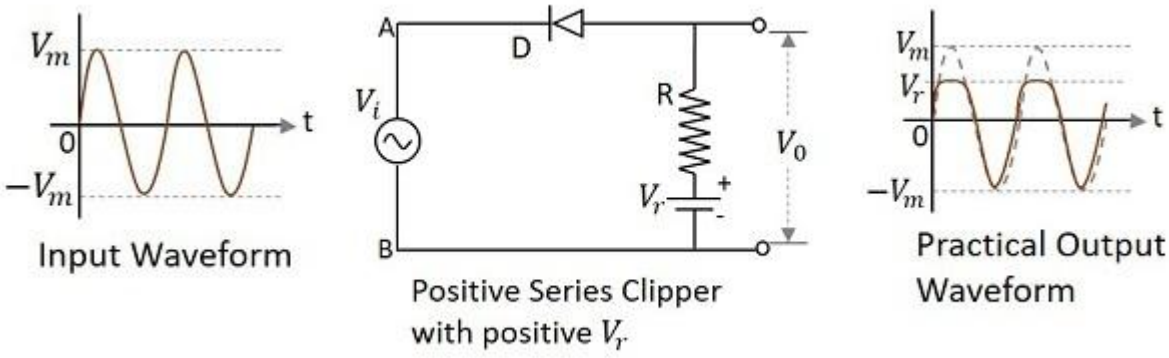
Output characteristics of the transistor in CE configuration

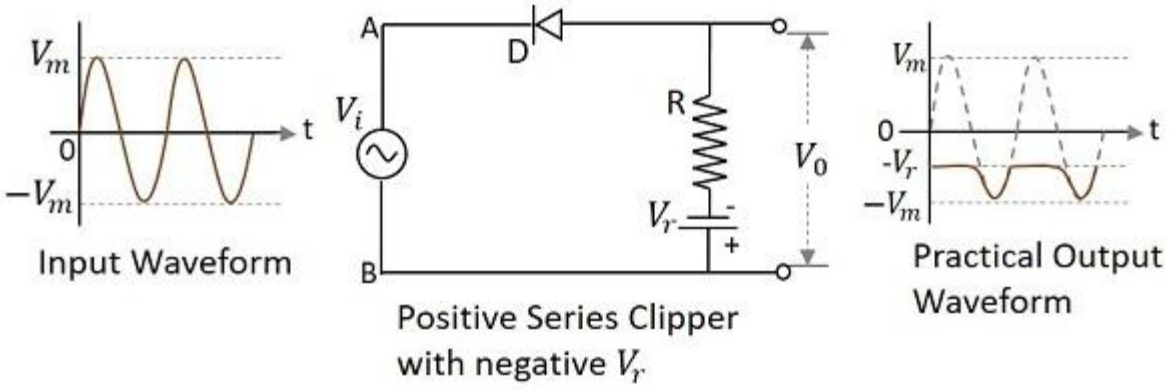
	c)	**Sketch circuit diagram of transistorized series voltage regulator and explain its working.**	**4M**
	Ans:	 • This regulator has a transistor in series to the Zener regulator and both in parallel to the load. The transistor works as a variable resistor, regulating its collector emitter voltage in order to maintain the output voltage constant. • With the input operating conditions, the current through the base of the transistor changes. This affects the voltage across the base emitter junction of the transistor V_{BE}. The output voltage is maintained by the Zener voltage V_Z which is	**Circuit diagram : 2M** **Explanation: 2M**

		constant. As both of them are maintained equal, any change in the input supply is indicated by the change in emitter base voltage V_{BE}. • Hence the output voltage Vo can be understood as $V_O=V_Z - V_{BE}$ • By applying KVL, $Vo = Vin – V_{CE}$ Also, $V_{CE} = V_{CC} – Ic.Rc$ • If the input voltage Vin is increased, the output voltage Vo also increases. • But this in turn makes the voltage across the emitter base junction V_{BE} to decrease. If V_{BE} decreases the base current and collector current decreases which in turn increases collector to emitter voltage V_{CE}. Thus reducing the output voltage V_O. • This decrease of output voltage compensates the initial increase in output voltage. Thus it acts as a regulator.	
	d)	**Derive the relationship between α and β of a transistor.**	**4M**
	Ans:	Relation between α & β: We know that; $I_E = I_B + I_C$.....(i) Dividing equation (i) by I_C . $I_E / Ic = (I_B / I_C) + (I_C / I_C)$ Therefore, $\frac{1}{\alpha} = \frac{1}{\beta} + 1$ (Since $\alpha = I_C / I_E$, $\beta = I_C/I_B$ Therefore $\frac{1}{\alpha} = \frac{1+\beta}{\beta}$ Therefore $\alpha = \frac{\beta}{1+\beta}$	**Relation : 4M**

		$\alpha(1+\beta) = \beta$ $\alpha + \alpha\beta = \beta$ Therefore $\alpha = \beta - \alpha\beta$ Therefore $\alpha = \beta (1 - \alpha)$ Therefore $\beta = \frac{\alpha}{1-\alpha}$ Optional	

Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any THREE of the following :**	**12- Total Marks**
	a)	**Define following parameter of rectifier:** **(i) Ripple factor** **(ii) Efficiency** **(iii) Peak Inverse Voltage** **(iv) Transformer utilization factor**	**4M**
	Ans:	(i) **Ripple Factor** - Ripple factor (γ) may be defined as the ratio of the root mean square (rms) value of the ripple voltage to the absolute value of the DC component of the output voltage. (ii) **Efficiency**- Rectifier efficiency is defined as the ratio of DC power to the applied input AC power. Rectifier efficiency, η = DC output power/input AC power (iii) **Peak inverse voltage**: For rectifier applications, peak inverse voltage (PIV) or peak reverse voltage (PRV) is the maximum `reverse voltage that a diode can withstand without destroying the junction (iv) **Transformer Utilization Factor** (TUF) : Transformer Utilization Factor (TUF) is defined as the ratio of DC power output of a rectifier to the effective Transformer VA rating used in the same rectifier. Effective VA Rating of transformer is the	**Each definitio n: 1M**

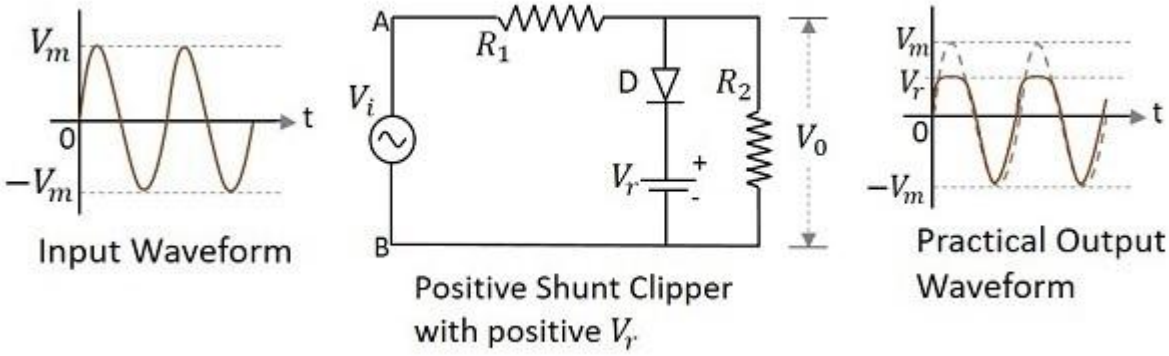
		average of primary and secondary VA rating of transformer.	
	b)	**Sketch circuit diagram of positive biased clipper using diode and explain its working.**	**4M**
	Ans:	**Positive Series Clipper with positive** Vr. The following figure represents the circuit diagram for positive series clipper when the reference voltage applied is positive.  During the positive cycle of the input the diode gets reverse biased and the reference voltage appears at the output. During its negative cycle, the diode gets forward biased and conducts like a closed switch. Hence the output waveform appears as shown in the above figure. **OR** Positive Series Clipper with negative **Vr** A Clipper circuit in which the diode is connected in series to the input signal and biased with negative reference voltage Vr and that attenuates the positive portions of the waveform, is termed as **Positive Series Clipper with negative** Vr. The following figure represents the circuit diagram for positive series clipper, when the reference voltage applied is negative.	**Circuit diagram : 2M** **Explanation : 2M**



During the positive cycle of the input the diode gets reverse biased and the reference voltage appears at the output. As the reference voltage is negative, the same voltage with constant amplitude is shown. During its negative cycle, the diode gets forward biased and conducts like a closed switch. Hence the input signal that is greater than the reference voltage, appears at the output.

OR

Positive Shunt Clipper with positive Vr. The following figure represents the circuit diagram for positive shunt clipper when the reference voltage applied is positive.



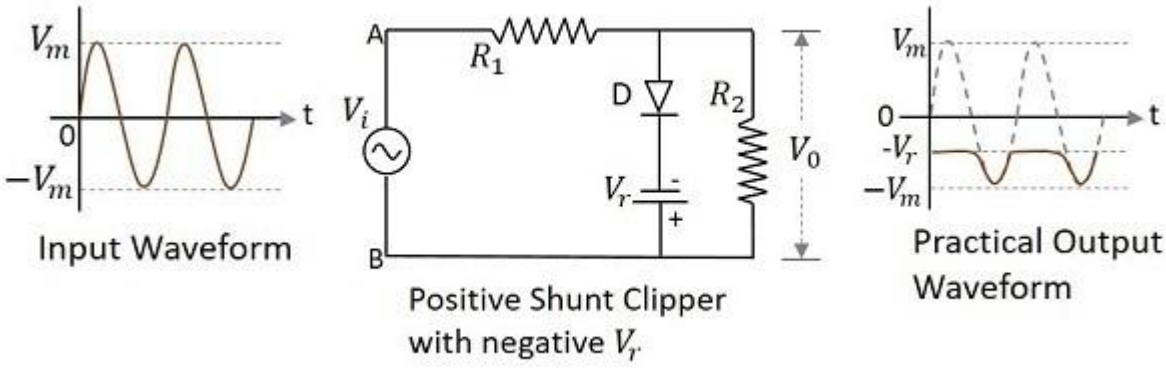
During the positive cycle of the input the diode gets forward biased and nothing but the reference voltage appears at the output. During its negative cycle, the diode gets reverse biased and behaves as an open switch. The whole of the input appears at the output. Hence the output waveform appears as shown in the above figure.

OR

Positive Shunt Clipper with negative **Vr**

A Clipper circuit in which the diode is connected in shunt to the input signal and biased with negative reference voltage Vr and that attenuates the positive portions of the waveform, is termed as **Positive Shunt Clipper with negative** Vr.

The following figure represents the circuit diagram for positive shunt clipper, when the reference voltage applied is negative.



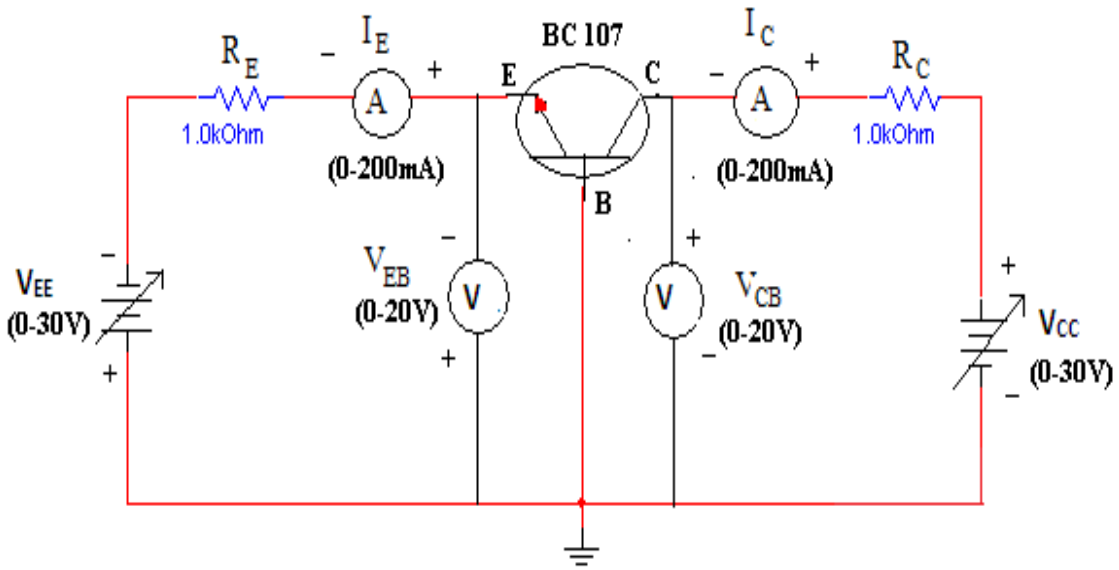
During the positive cycle of the input, the diode gets forward biased and the reference voltage appears at the output. As the reference voltage is negative, the same voltage with constant amplitude is shown. During its negative cycle, the diode gets reverse biased and behaves as an open switch. Hence the input signal that is greater than the reference voltage, appears at the output.

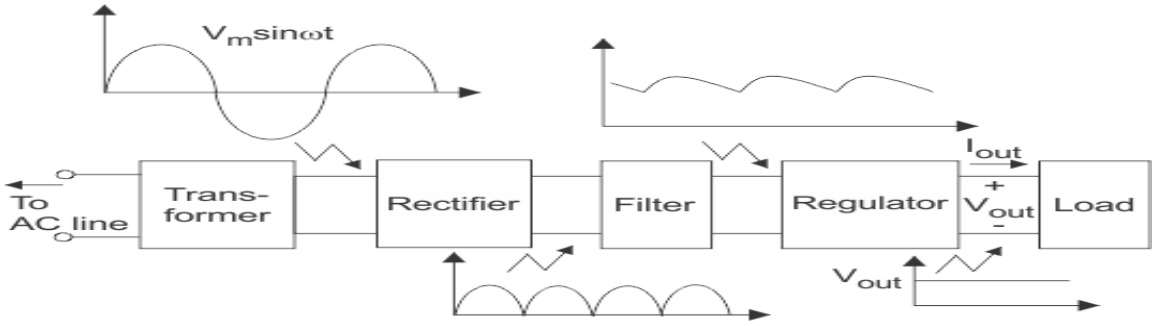
c)	**Define with respect to FET:-** **(i) Static drain resistance** **(ii) Dynamic resistance** **(iii) Trans conductance** **(iv) Pinch-off voltage**	**4M**
Ans:	(i) Static drain resistance- It is the ratio of drain source voltage (ΔV_{DS}) to the drain current (I_D) at constant gate-source voltage. It can be expressed as, $R_d = (V_{DS})/(I_D)$ at Constant V_{GS} (ii) Dynamic resistance– It is the ratio of change in the drain source voltage (ΔV_{DS}) to the change in drain current (ΔI_D) at constant gate-source voltage. It can be expressed as,	**Each definitio n: 1M**

		$R_d = (\Delta V_{DS})/(\Delta I_D)$ at Constant V_{GS} (iii) Transconductance (gm) – It is the ratio of change in drain current (ΔI_D) to the change in gate source voltage (ΔV_{GS}) at constant drain-source voltage. It can be expressed as, $g_{fs} = (\Delta I_D)/(\Delta V_{GS})$ at constant V_{DS} **(iv)** Pinch –off voltage-The gate to source voltage at which the entire channel will be depleted of charge carrier and the value of drain current reaches its constant saturation value is called **pinch off voltage.**	
	d)	**State any four applications of regulated DC power supply.**	**4M**
	Ans:	• Amplifiers • Mobile Phone power adaptors • Regulated power supplies in appliances • Various oscillators	**1 mark each**

Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any THREE of the following :**	**12- Total Marks**
	(a)	**Compare half wave rectifier and full wave bridge rectifier with following parameters.** **(i) No. of diodes used** **(ii) Efficiency** **(iii) Peak inverse voltage** **(iv) Ripple frequency**	**4M**
	Ans:		**Four points : 4M**

PARAMETERS	HWR	FWCR	FWBR
No. of diodes used	1	2	4
Efficiency	40.6%	81.2%	81.2%
Peak inverse voltage	Vm	2Vm	Vm

		Ripple frequency	50	100	100
	(b)	**Sketch the experimental setup for CB transistor configuration.**			**4M**
	Ans:				**Diagram : 4M**
	(c)	**If α of a transistor is 0.9, Calculate β.**			**4M**
	Ans:	β = α/1-α = (0.9)/(1-0.9) =9			**4M**
	(d)	**State advantages of MOSFET over JFET.**			**4M**
	Ans:	➡It can be operated in either enhancement mode or depletion mode. ➡MOSFET have much higher input impedance compare to JFET. ➡They have high drain resistance due to lower resistance of channel. ➡It is easy to manufacture. ➡They support high speed of operation compare to JFETs.			**Any four points : 4M**
	(e)	**Sketch block diagram of an unregulated power supply and explain function of each block.**			**4M**

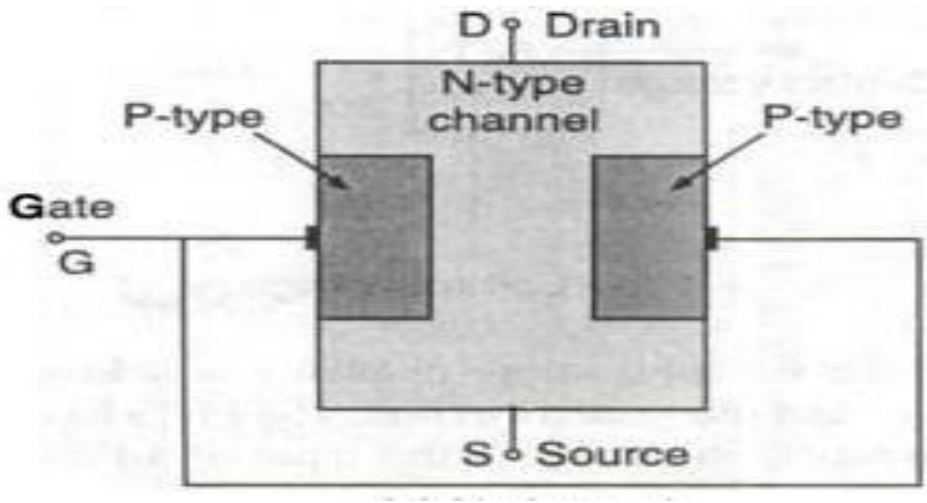
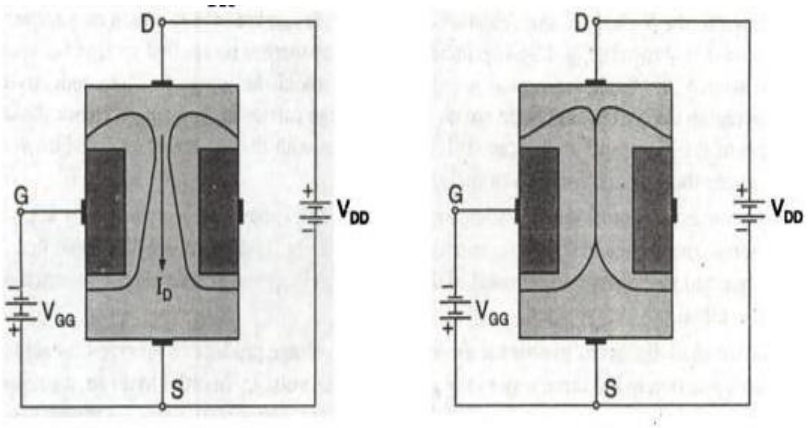
	Ans:	Block diagram of regulated DC power supply:-  Components of typical linear power supply Explanation 1)Transformer 2) Rectifier 3) Filter 4) Voltage regulator. 1. Transformer:- Transformer can be step up or step dow. Depending on requirement. The AC main voltage is applied to a transformer. It will increase or decrease the amplitude of ac voltage to the desired level and applies it to a rectifier. 2. Rectifier: The rectifier is usually a centre tapped or bridge type full wave rectifier. It converts the ac voltage into a pulsating dc voltage. 3. Filter: The pulsating dc (or rectified ac) voltage contains large ripple. This voltage is applied to the filter circuit and it removes the ripple. The function of a filter is to remove the ripples to provide pure DC voltage at its output. The DC output voltage thus obtained will change with the changes in load current,input voltage, etc. So it is unregulated DC voltage. 4. Voltage Regulator:- The unregulated DC voltage is applied to a voltage regulator. Output of the regulator circuit will be constant voltage under all operating circumstances.	**Diagram : 1M** **Function : 3M**

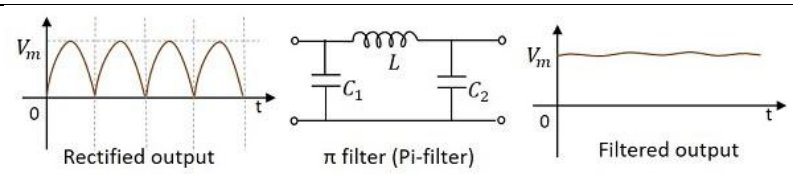
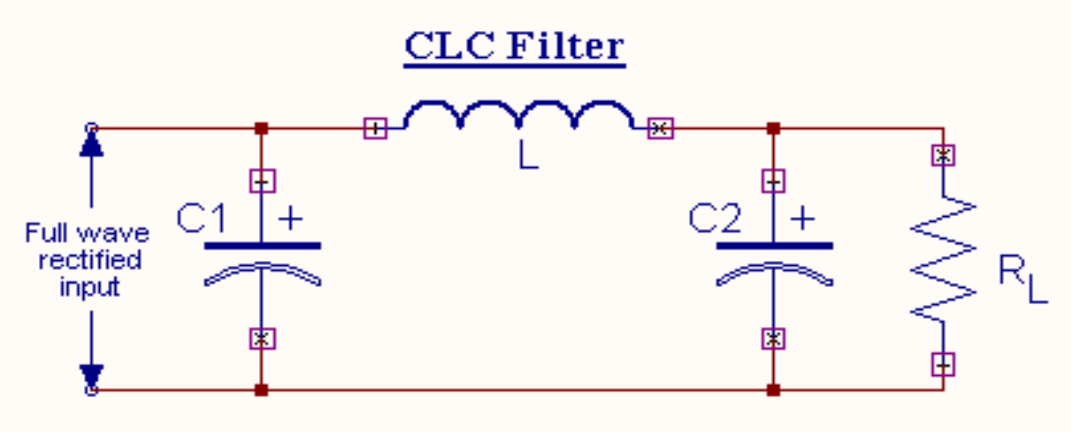
WINTER-19 EXAMINATION

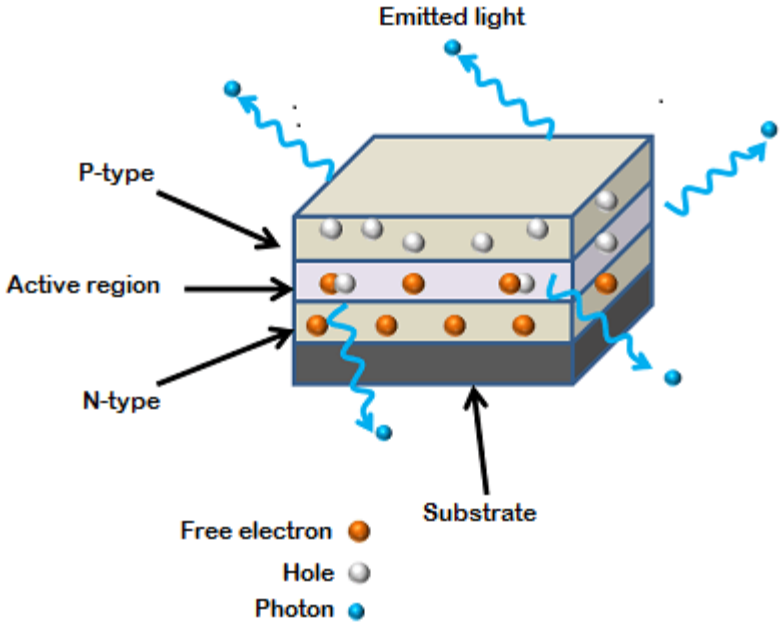
Subject Name: Basic Electronics **Subject Code:** 22216

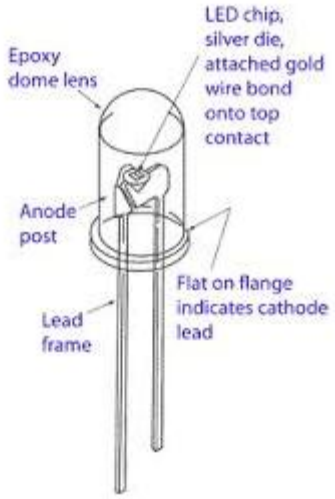
Model Answer

15

Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any TWO of the following:**	**12- Total Marks**
	a)	**Sketch construction of N-channel JFET and explain its operating principle.**	**6M**
	Ans:	**Construction of N-channel JFET:**  **Working of N channel FET:**  a)when V_{GS} is zero,I_D flows because of V_{DS} b)Now when V_{GS} increases towards negative, depletion layer also increases on both sides.	**3M Construction** **3M for operation principle with diagram**

		c)so V_{GS} control drain current I_D d)so it is called as field effect Transistor	
	b)	**Draw circuit diagram for π filter and explain its working with waveforms.**	**6M**
	Ans:	 **Working of a Pi filter:** In this circuit, we have a capacitor in parallel, then an inductor in series, followed by another capacitor in parallel. **Capacitor C_1** – This filter capacitor offers high reactance to dc and low reactance to ac signal. After grounding the ac components present in the signal, the signal passes to the inductor for further filtration. **Inductor L** – This inductor offers low reactance to dc components and offers high reactance to the ac components which remains to pass through the capacitor C_1. **Capacitor C_2** – Now the signal is further smoothened using this capacitor C2. It allows any ac component present in the signal to pass through it, which the inductor has failed to block. **OR**  C_1 will bypass ac & blocks dc.	**2M Circuit Diagram** **2M Explanation** **2M Waveform**

		This output is given to inductor,it will block ac and pass only dc. This output is given to C_2 it will again bypass remaining ac and block dc ,so at output we get ripple free dc.	
	c)	**Sketch constructional diagram of LED and state its three applications.**	**6M**
	Ans:	 OR	**3M for construc tional diagram** **3M for applicati ons**



Constructional diagram of LED

Applications of LED:

.Infra-red LEDs are used in burglar alarm systems.

· For solid state video displays which are rapidly replacing CRT.

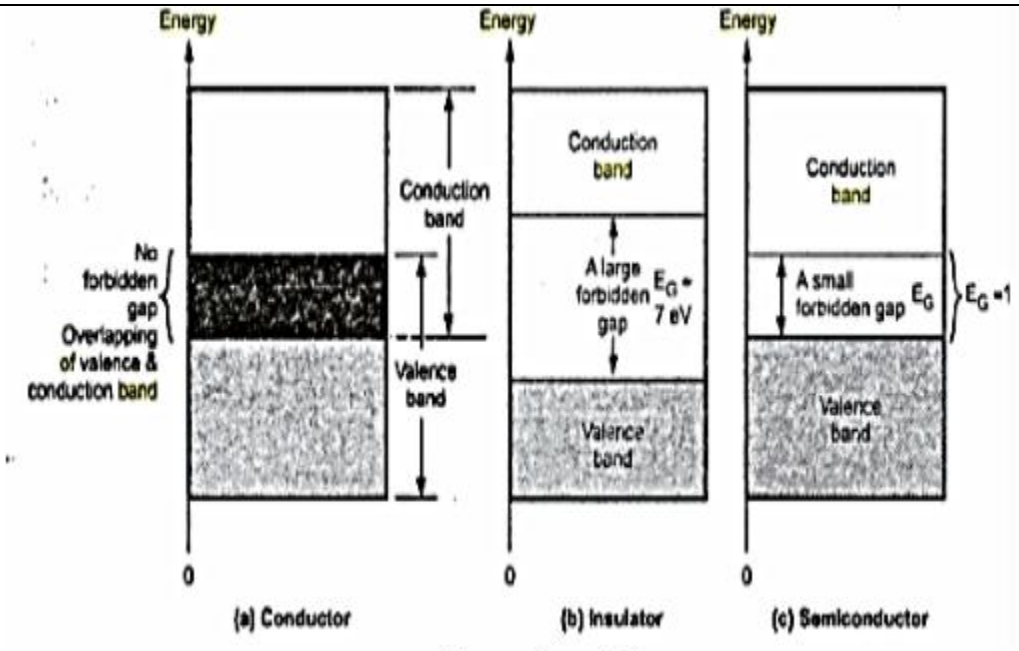
· An image sensing circuit for picture phones.

· In array of different types for displaying alpha-numeric characters.

· Displays.

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any TWO of the following :**	**12- Total Marks**
	a)	**Describe classification of solids on the basis of energy band diagram.**	**6M**
	Ans:	**Classification on the basis of energy theory:** Based on the ability of various materials to conduct current, the materials are classified as	**2M for classification**

		conductors, insulators and the semiconductors. **Conductors** • A material having large number of free electrons can conduct very easily. For example, copper has 8.5x1028 free electrons per cubic meter which is a very large number. Hence copper is called good conductor. • Intact, in the metals like copper, aluminum there is no forbidden gap between valence band and conduction band. • The two bands overlap. Hence even at room temperature, a large number of electrons are available for conduction. • So without any additional energy, such metals contain a large number of free electrons and hence called good conductors. An energy band diagram for a conductor is shown in the Figure (a). **Insulators** • An insulator has an energy band diagram as shown in the Figure (b). • In case of such insulating material, there exists a large forbidden gap in between the conduction band and the valence band. • Practically it is impossible for an electron to jump from the valence band to the conduction band. • Hence such materials cannot conduct and called insulators. • The forbidden gap is very wide, approximately of about 7 eV is present in insulators. For a diamond, which is an insulator, the forbidden gap is about 6 eV. • Such materials may conduct only at very high temperatures or if they are subjected to high voltage. Such conduction is rare and is called breakdown of an insulator. The other insulating materials are glass, wood, mica, paper etc.	**2M for diagram** **2M for explanation**



Energy band diagram

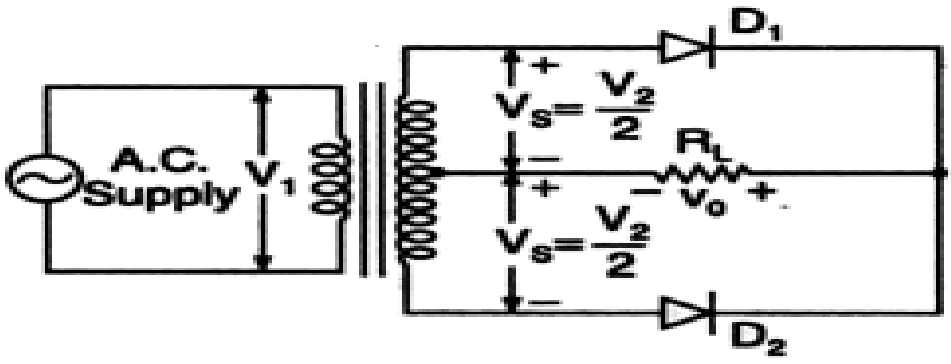
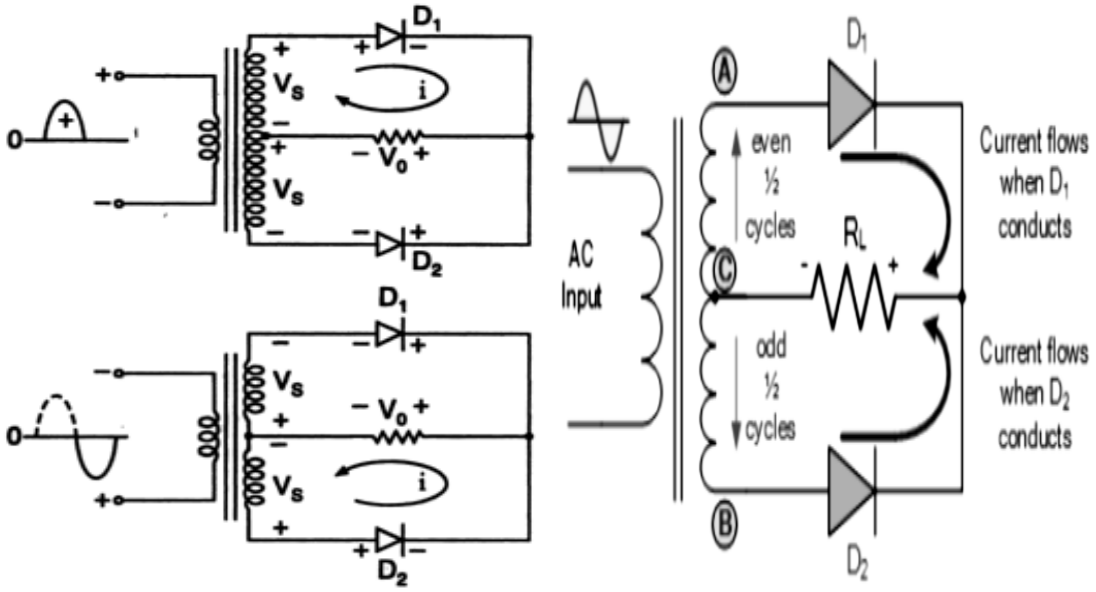
Semiconductors

- Semiconductors are neither insulators nor conductors. The forbidden gap in such materials is very narrow as shown in Figure (c). Such materials are called semiconductors.
- The forbidden gap is about 1 eV. For such materials, the energy provided by the heat at room temperature is sufficient to lift the electrons from the valence band to the conduction band.
- Therefore at room temperature, semiconductors are capable of conduction. But at 0 IC or absolute zero (-273 °C), all the electrons of semiconductor materials find themselves locked in the valence band.
- Hence at 0 IC, the semiconductor materials behave as perfect insulators. In case of semiconductors, forbidden gap energy depends on the temperature. For silicon and germanium, this energy is given by,

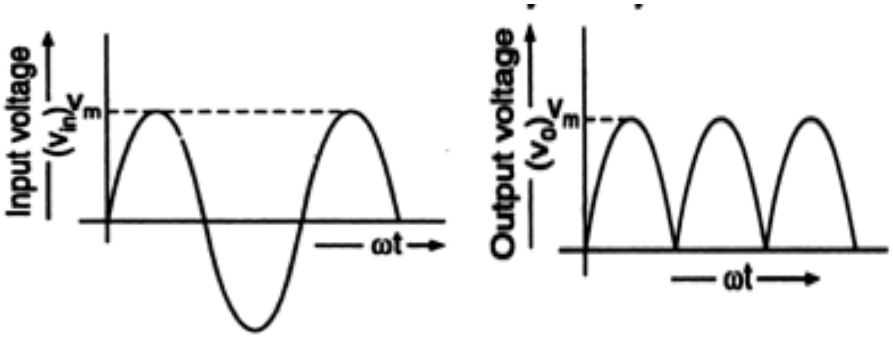
$$E_G = 1.21 - 3.6 \times 10^{-4} \times T \qquad eV(\text{for Silicon})$$

$$E_G = 0.785 - 2.23 \times 10^{-4} \times T \qquad eV(\text{for Germanium})$$

where T = Absolute temperature in K

	b)	**Sketch the circuit diagram of centre tap rectifier and explain its working with input and output waveforms.**	**6M**
	Ans:	 **Circuit operation of Centre tapped Full wave rectifier** 	**2M Circuit diagram** **2M explanation** **2M for input and output waveforms**

Input and Output Waveforms



Two diodes are used.

Here center tapped transformer is also used.

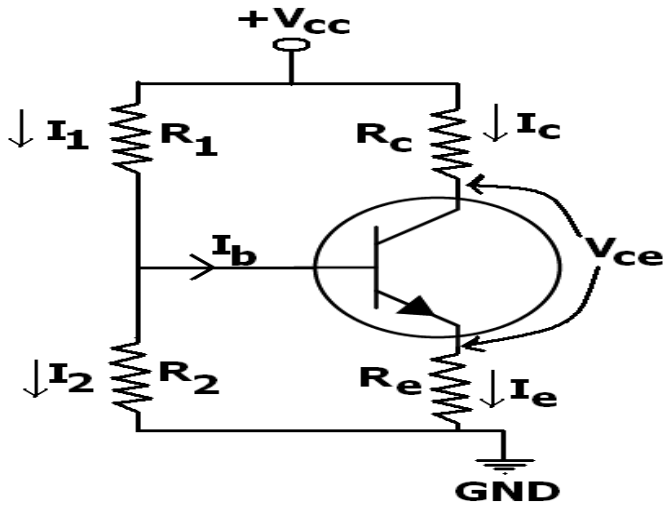
a)In positive half cycle D_1 becomes forward biased it conducts and we get output same as input.D_2 is reverse biased it will remain off.

b)In negative half cycleD_2 becomes forward biased it conducts and we get output across R_L at that time D_1 is reverse biased and it will not conduct.

Current direction through RL is same in both case and so we get full cycle output.

c) Explain with circuit diagram, voltage divider biasing method and state its two advantages. **6M**

Ans:



2M Circuit diagram

2M Explanation

2M for advantages

		a)Here R_1 and R_2 forms voltage divider biasing arrangement. b)voltage drop across R_2 ,forward biases the base emitter junction. c)so base current flows and hence collector current flows in zero signal condition. d)R_E provides stabilization and R_C controls collector current. It is most widely used method. **Advantages of voltage divider bias** The circuit operation is independent of the transistor current gain β. · The resistors help to give complete control over the voltage and current. · The emitter resistor, Re, allows for stability of the gain of the transistor, despite fluctuations in the β values. · Operating point stabilized against shift in temperature. · Operating point is almost independent of β variation	