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 definition : 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**

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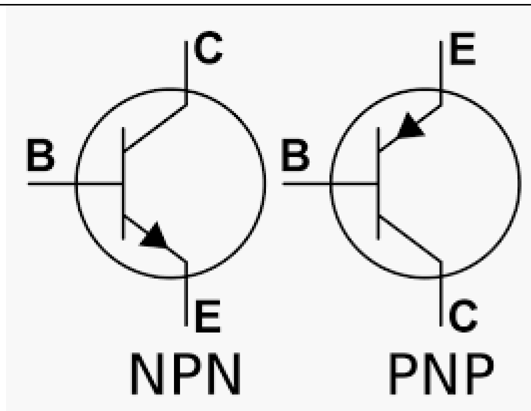
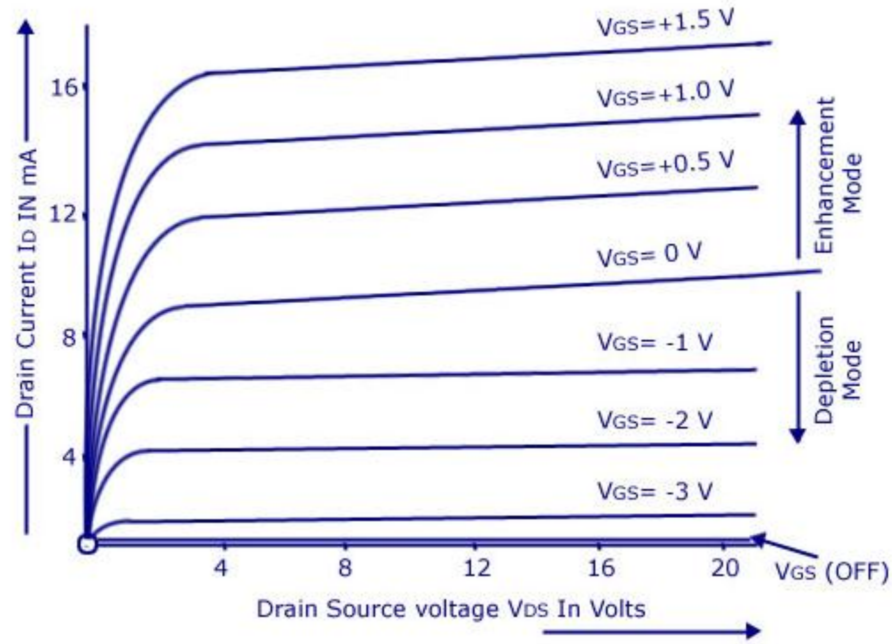
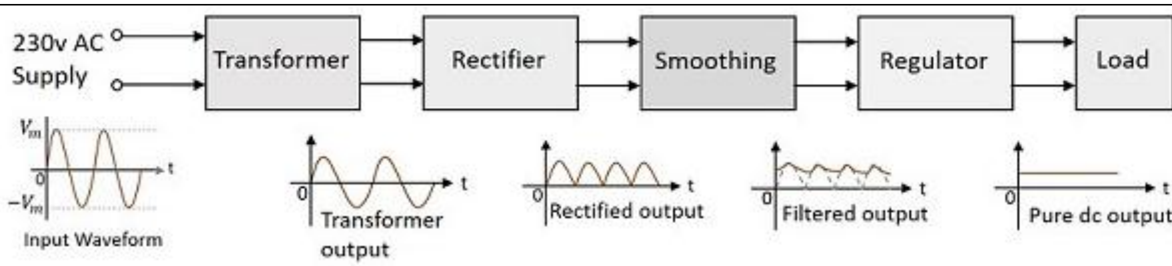
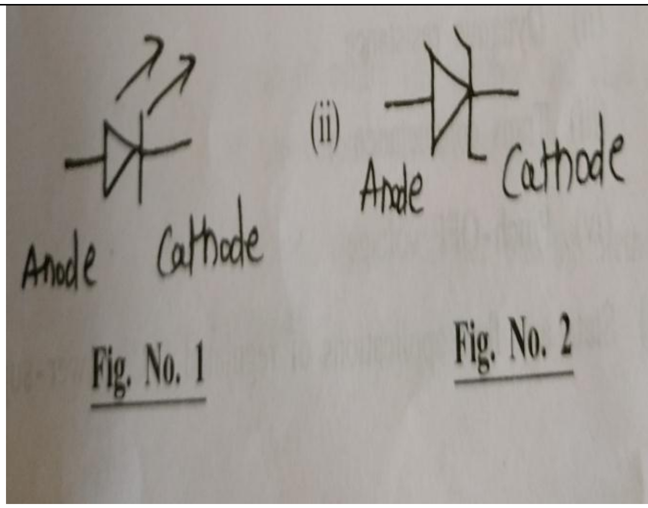
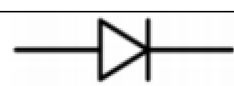
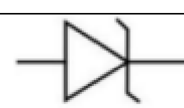
		• FETs are used in mixer circuits of FM and TV receivers as it reduces inter modulation distortion. • Used as Analog switch. • As a Voltage Variable Resistor (VVR) in operational amplifiers.	
	(c)	**Draw symbol of NPN and PNP transistor.**	**2M**
	Ans:		**Each symbol : 1M**
	(d)	**Sketch the drain characteristics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

3

	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 definition : 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:	(see table below)	**Four points : 4M**

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

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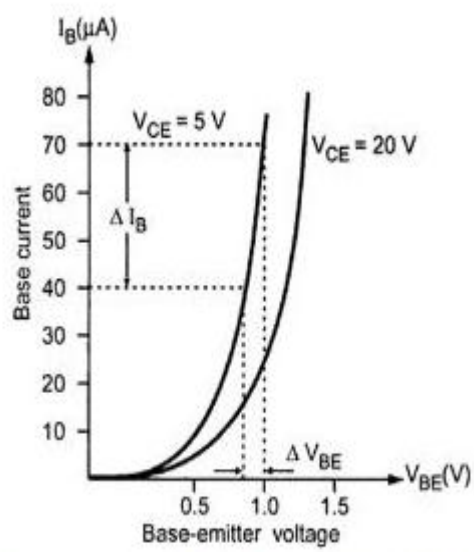
Breakdown voltage	It has no sharp reverse breakdown	It has quite sharp reverse breakdown
Applications	Used in rectification	Voltage stabilizer, motor protection and wave shaping

	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**

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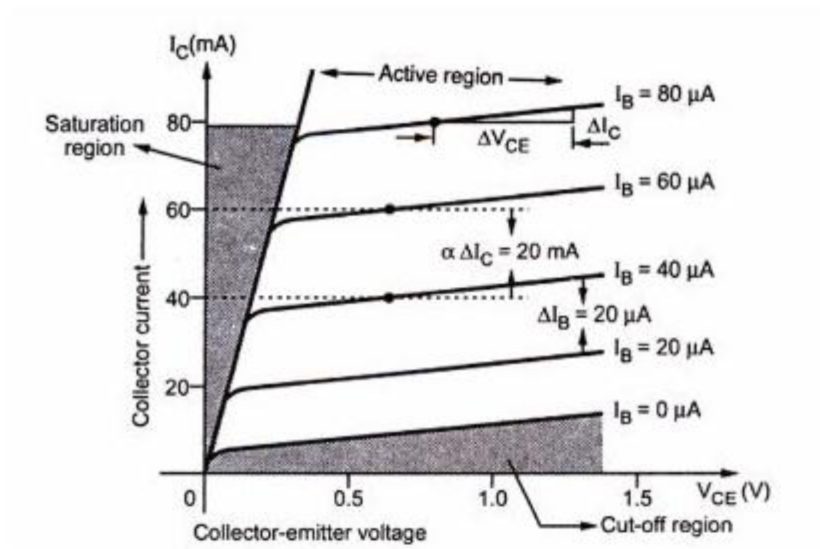
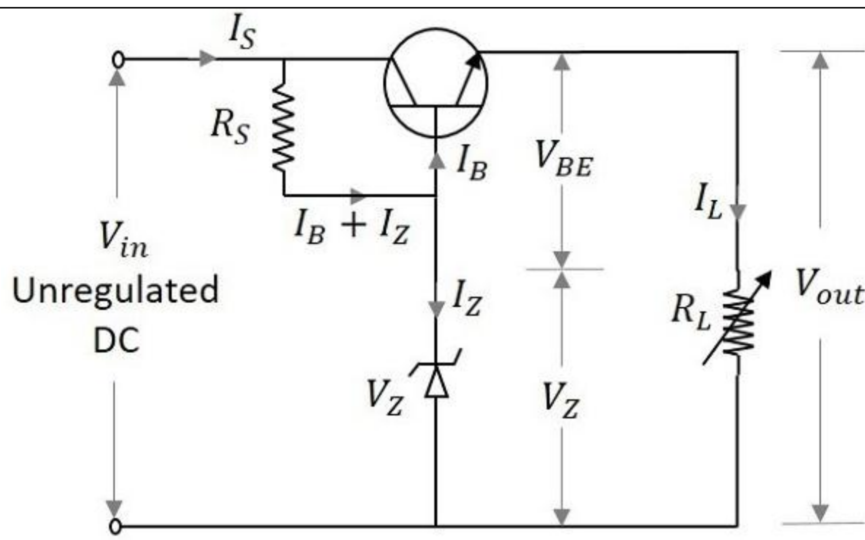


Output characteristics of the transistor in CE configuration

c) **Sketch circuit diagram of transistorized series voltage regulator and explain its working.** **4M**

Ans:



Circuit diagram : 2M

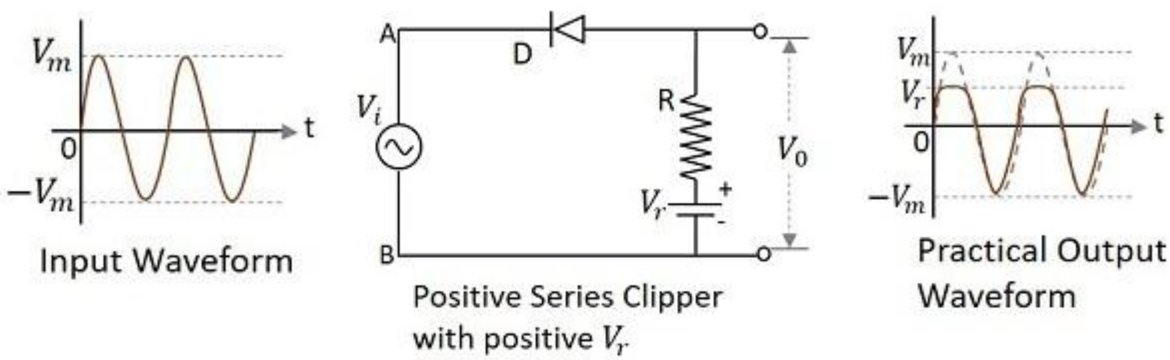
Explanation: 2M

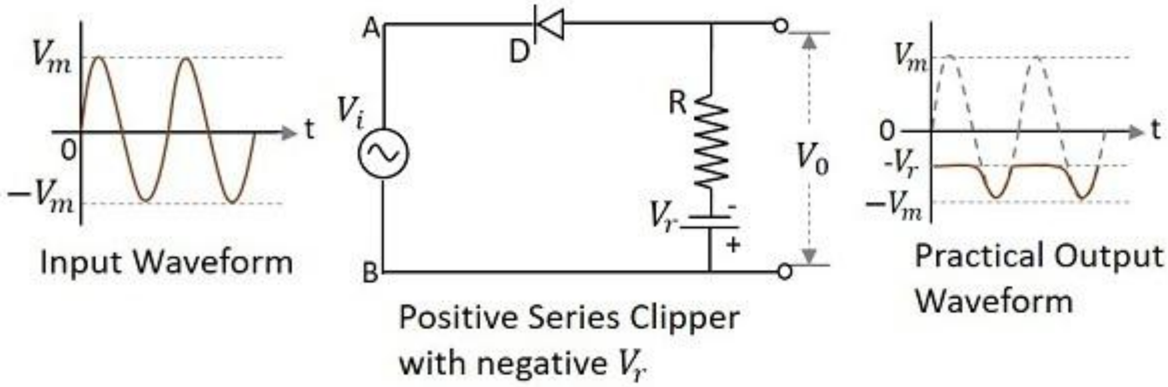
- This regulator has a transistor in series to the Zener regulator and both in parallel to the load. The transistor works as a variable resistor, regulating its collector emitter voltage in order to maintain the output voltage constant.
- With the input operating conditions, the current through the base 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

		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 definition: 1M**

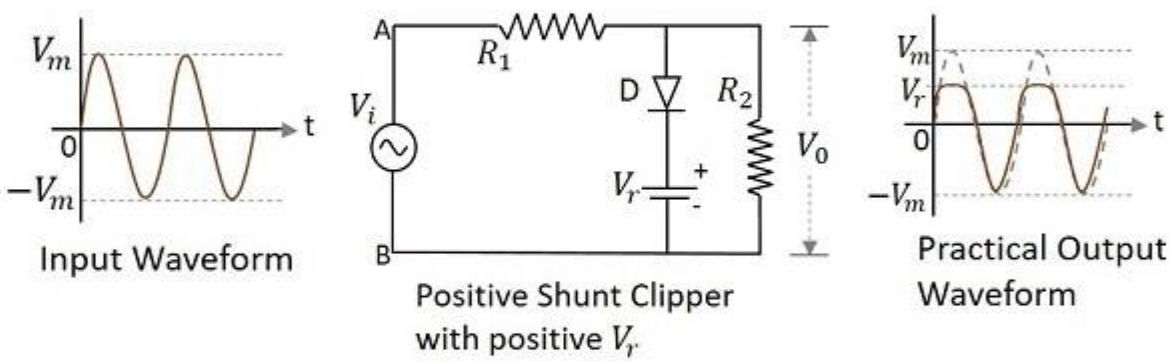
		average of primary and secondary VA rating of transformer.	
	b)	**Sketch circuit diagram of positive biased clipper using diode and explain its working.**	**4M**
	Ans:	**Positive Series Clipper with positive** Vr. The following figure represents the circuit diagram for positive series clipper when the 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.

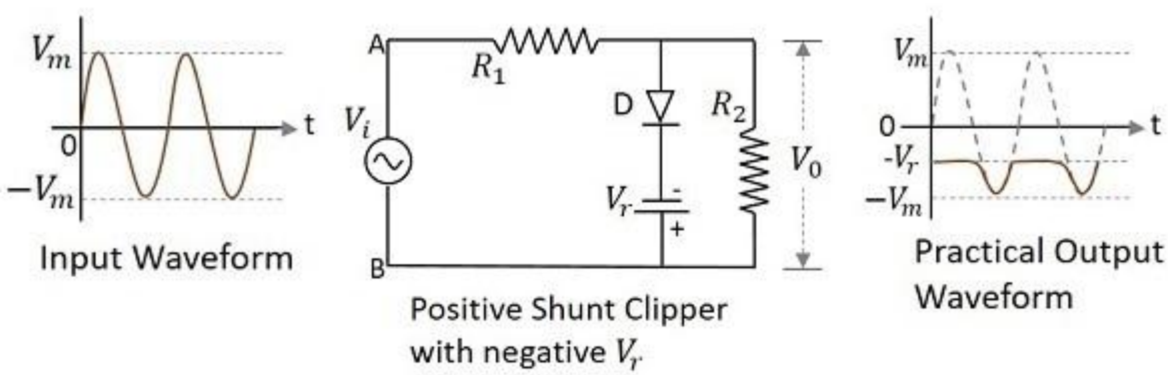
OR

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



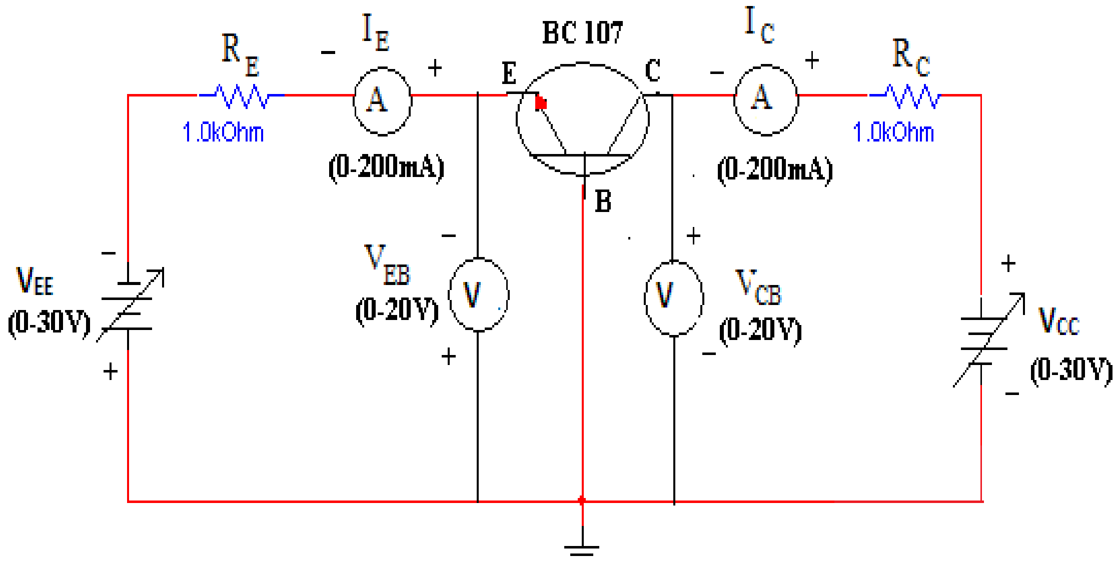
During the positive cycle of the input the diode gets forward biased and nothing but the reference voltage appears at the output. During its negative cycle, the diode gets reverse biased and behaves as an open switch. The whole of the input appears at the output. Hence the output waveform appears as 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 definition: 1M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
		$R_d = (\Delta V_{DS})/(\Delta I_D)$ 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:	(see table below)	**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:	$\beta = \alpha/1-\alpha$ $= (0.9)/(1-0.9)$ $=9$				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

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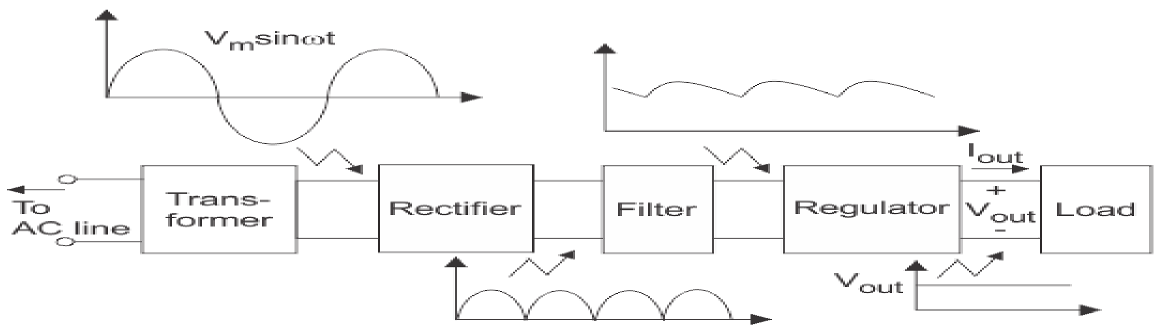
	Ans:	Block diagram of regulated DC power supply:-  Components of typical linear power supply Explanation 1)Transformer 2) Rectifier 3) Filter 4) Voltage regulator. 1. Transformer:- Transformer can be step up or step dow. Depending on requirement. The AC main voltage is applied to a transformer. It will 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**

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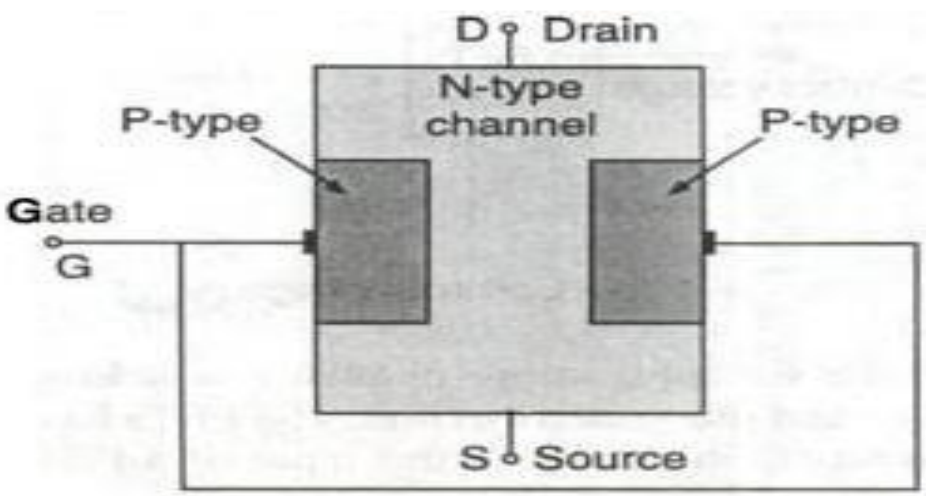
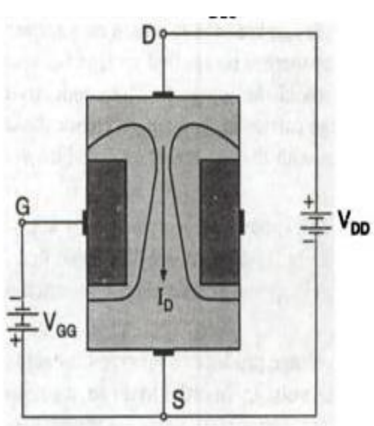
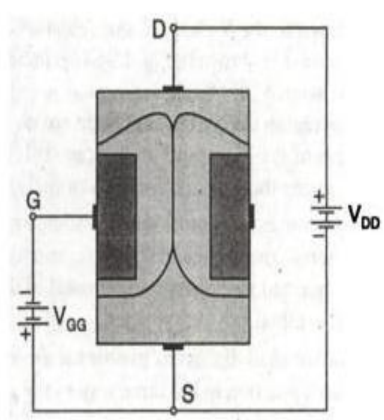
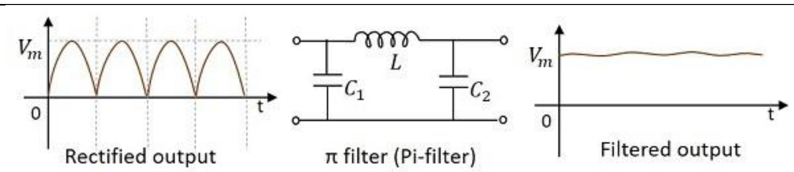
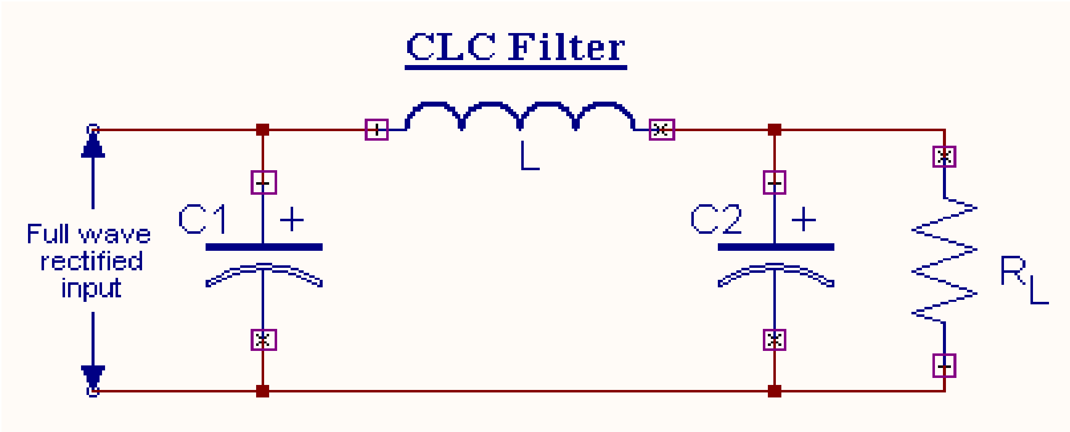
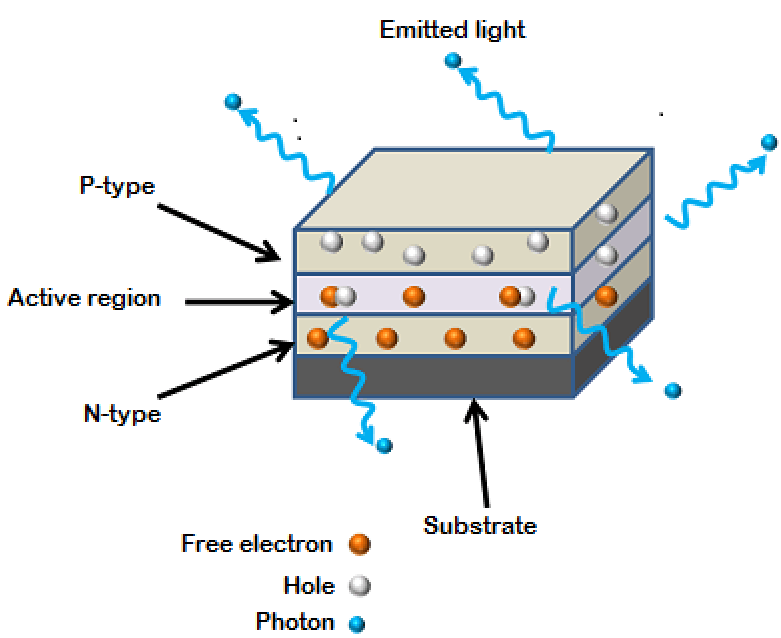
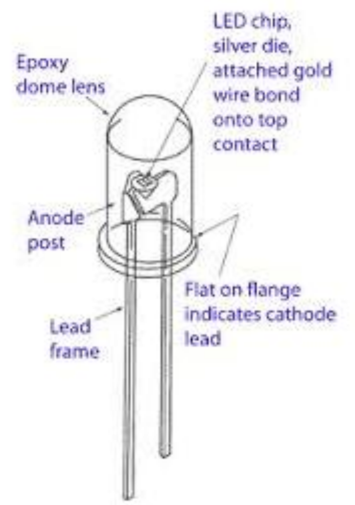
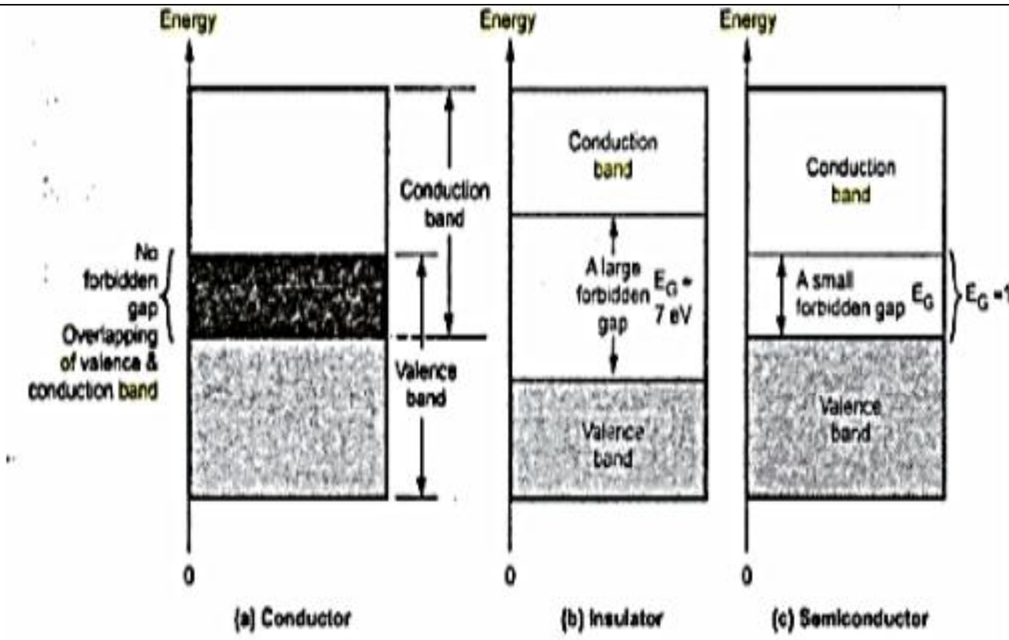
Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any TWO of the following:**	**12- Total Marks**
	a)	**Sketch construction of N-channel JFET and explain its operating principle.**	**6M**
	Ans:	**Construction of N-channel JFET:**  **Working of N channel FET:**  a)when V_{GS} is zero,I_D flows because 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 constructional diagram** **3M for applications**

		 **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

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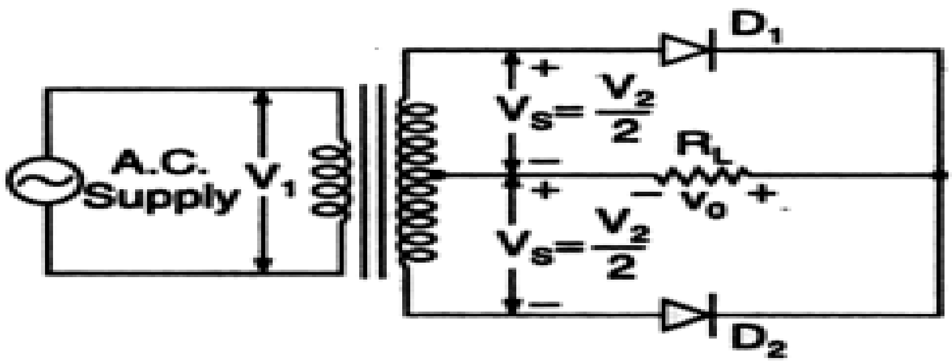
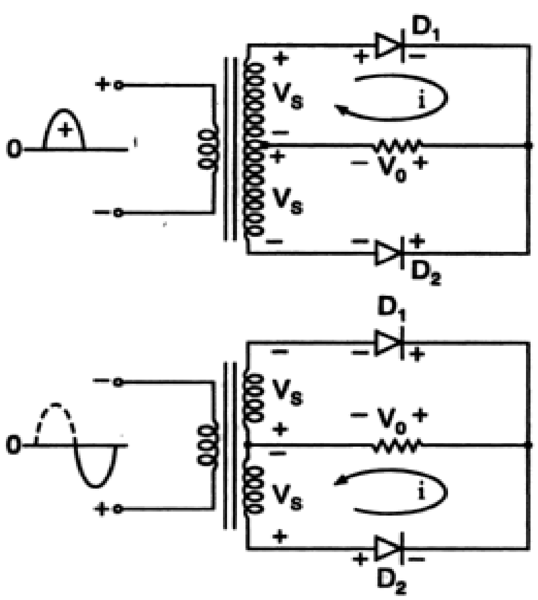
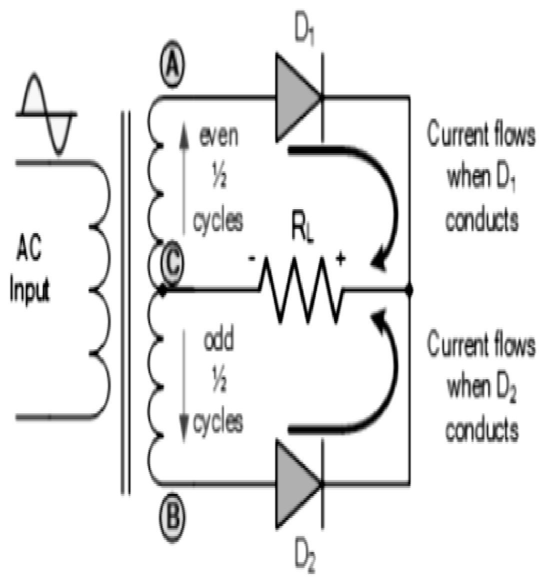
	b)	**Sketch the circuit diagram of centre tap rectifier and explain its working with input and output waveforms.**	**6M**
	Ans:	 **Circuit operation of Centre tapped Full wave rectifier**  	**2M Circuit diagram** **2M explanation** **2M for input and output waveforms**

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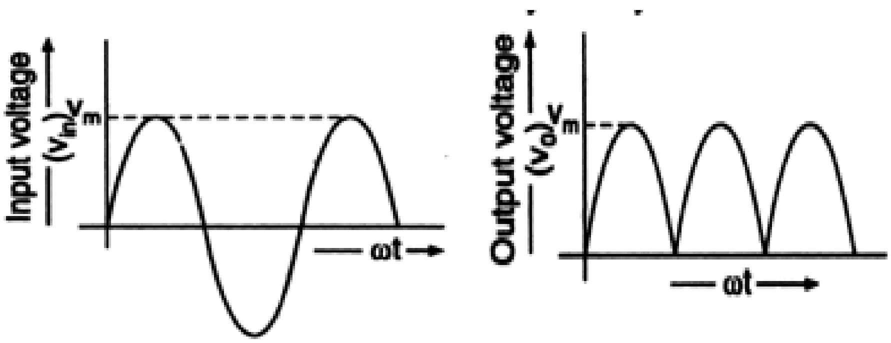
Input and Output Waveforms



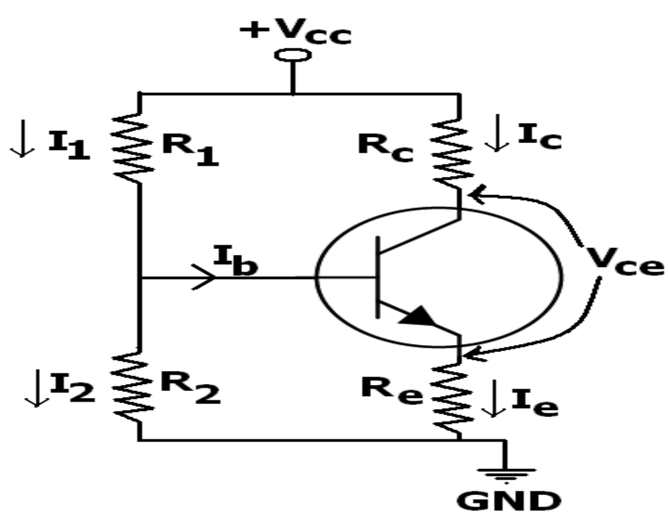
Two diodes are used.

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	