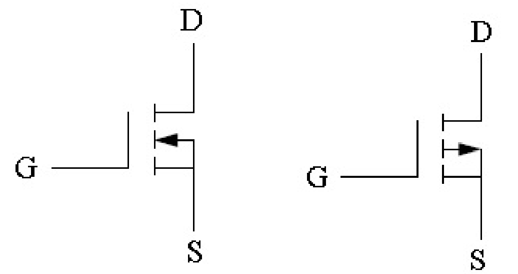
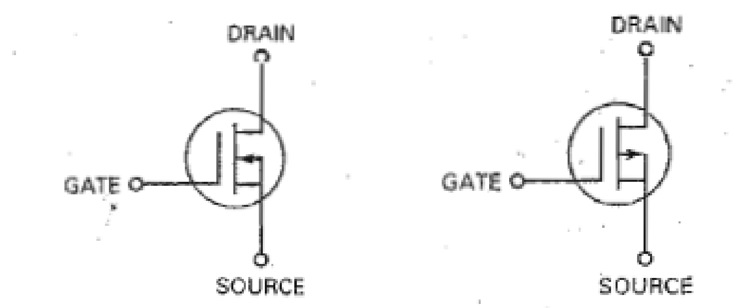
SUMMER– 18 EXAMINATION

Subject Name: Basic Electronics **Model Answer** Subject Code: 17213

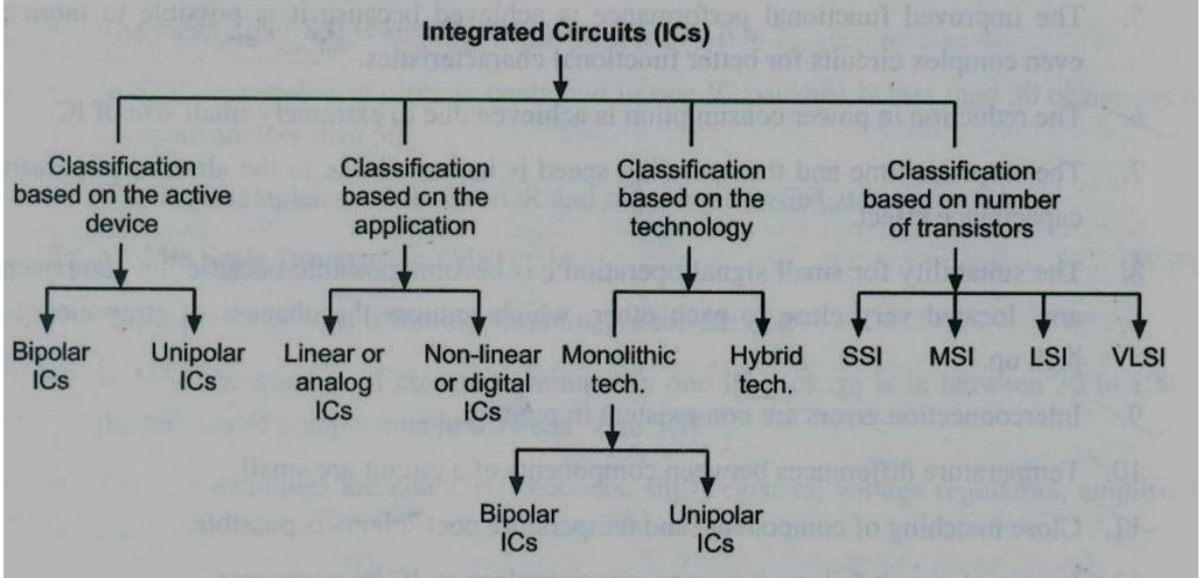
Important Instructions to examiners:

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		**Attempt any TEN:**	**20- Total Marks**
	a	**Define electronics. Give examples of active components.**	**2M**
	Ans:	**Definition**: Electronics means study of flow of electrons in electrical circuits. **(OR)** The word electronics is derived from electron mechanics which means the study of the behavior of an electron under different conditions of externally applied fields. **Examples of active components are**: Diode, BJT,FET, MOSFET ,SCR, DIAC, TRIAC, ICs etc.	**(definition: 1mark, any 2examples :1 mark)**
	b	**Draw the symbol of MOSFET.**	**2M**

	Ans:	 **N- channel E-MOSFET** **P- channel E-MOSFET**  **N- channel D-MOSFET** **P- channel D-MOSFET**	**(1/2 mark each symbol)**
	c	**Write the application of Varactor Diode**	**2M**
	Ans:	**Applications of Varactor Diode:** 1. Voltage controlled oscillators 2. RF filters 3. Tuning Circuits 4. High frequency amplifiers 5. Radio, Television and other commercial receivers. 6. Automatic frequency control devices 7. Adjustable band pass filter 8. Parametric amplifiers	**(any 2 applications :2 marks)**
	d	**State the need of multistage amplifier.**	**2M**

	Ans:	The Voltage (or Power)gain of a single stage amplifier is not sufficient for all practical applications. The voltage level of a signal can be raised by using more than one stage such that, output of each amplifier stage is coupled to the input of the next stage. The resulting system is referred to as multi-stage amplifier or cascade amplifier. Voltage gain of multistage (cascade amplifier) is given as: $A_V = A_{V1} X A_{V2} X…………X A_{Vn}$	**2 Marks**
	e	**Define static and dynamic resistance.**	**2M**
	Ans:	**Static resistance:** It is the opposition offered by the diode to the direct current. It is given as ratio of d.c voltage across the diode to the resulting d.c current flowing through it. $$Rf = \frac{Vf}{If}$$ **(ii) dynamic resistance:** It is the opposition offered by the diode to the A.C current. It is measured by the ratio of change in voltage across diode to the resulting change in current through it. $$r_{ac} = \frac{\Delta VF}{\Delta IF}$$	**(1 mark each definition)**
	f	**Give the classification of I-C.**	**2M**

	Ans:	The classification of ICs is as under :  Classification of integrated circuits (ICs)	**2 Marks**
	g	**Define filter. State its types.**	**2M**
	Ans:	**Definition:** A filter circuit is a device which removes unwanted A.C. component from rectifier output, and allows only the D.C. components to reach the load. **Types of filters:** 1. Shunt capacitor filter (Capacitor filter) 2. Series inductor filter (Choke filter) 3. Choke input filter (LC filter) 4. CLC or π filter	**(definition: 1 mark, types: 1 mark)**
	h	**State the meaning of I_{dss} and $V_{gs(off)}$.**	**2M**
	Ans:	**IDSS (Drain saturation current):** The maximum drain current corresponding to zero gate to source voltage VGS is known as drain saturation current IDSS. **Vgs (off) :** The value of gate to source voltage at which drain current becomes approximately zero in a JFET is called cut off voltage Vgs (off) or pinch off voltage (Vp).	**(1 mark each definition)**

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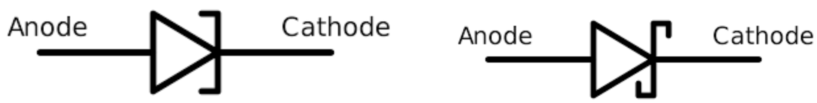
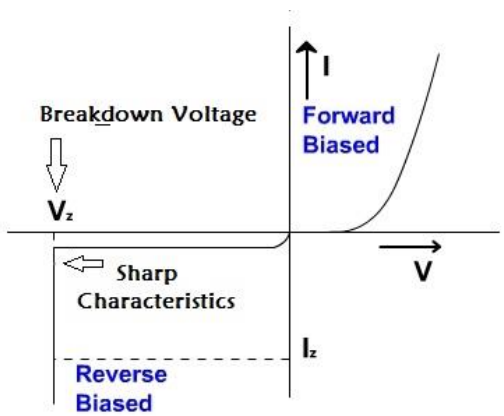
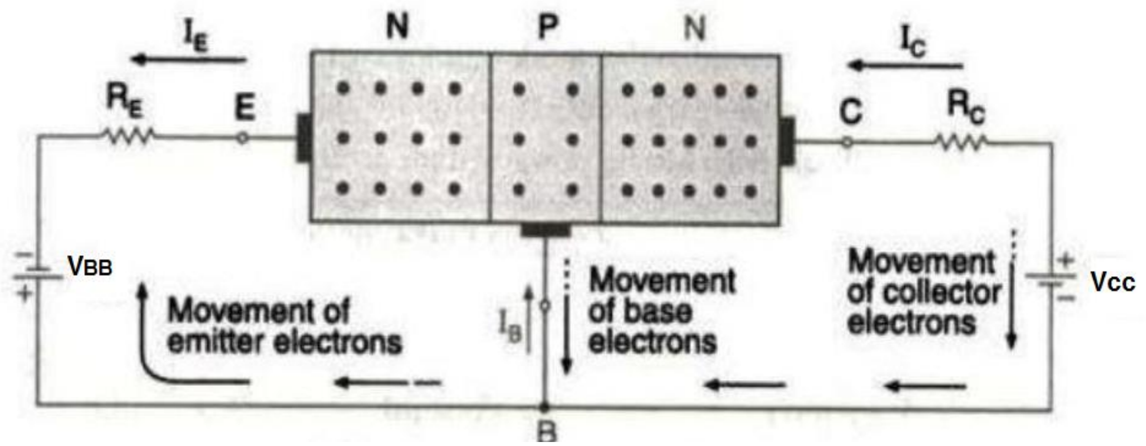
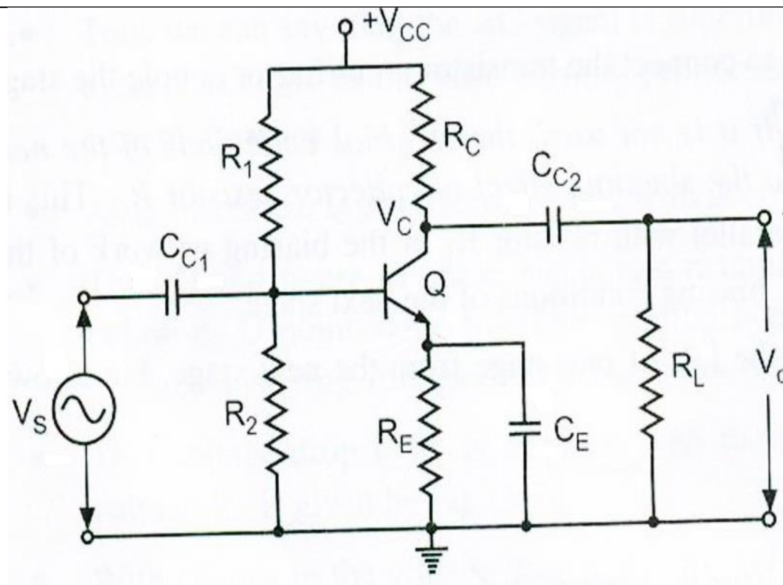
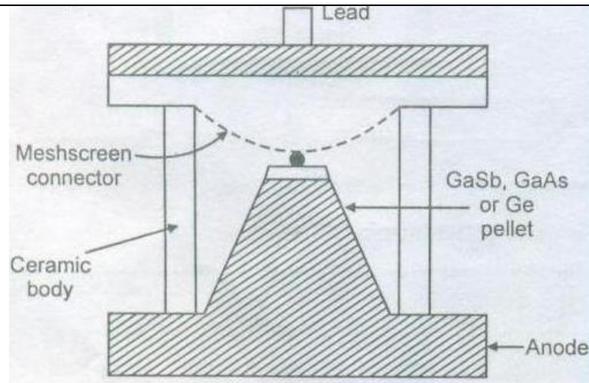
	i	**Draw the symbol of Tunnel Diode and Schottky Diode**	**2M**
	Ans:	 **TUNNEL DIODE** **SCHOTTKY DIODE**	**(1 mark each)**
	j	**Name the examples of analog and digital IC. (Write any 1 of each).**	**2M**
	Ans:	1) **Analog ICs:** LM741-, LM 324, LM358, NE555, LM78XX etc. 2) **Digital ICs:** 7400, 7402, 7408, 4001, 4011 etc. **(OR)** 1) **Analog ICs:** operational amplifiers, small signal amplifiers, power amplifiers, RF and IF amplifiers, microwave amplifiers, voltage comparators, voltage regulators, etc. 2) **Digital ICs:** Logic circuits, flipflops, Counters, registers, clock chips, memory chips, microprocessor chips, microcontroller chips, Analog to digital convertor chips, etc.	(1 mark each) Marks may be given for any examples
	k	**State the value of knee voltage for Si and Ge.**	**2M**
	Ans:	knee voltage for Silicon (Si) is 0.7 V and for Germanium (Ge) is 0.3V	(1 mark each)
	l	**Define variable capacitor. State its types.**	**2M**
	Ans:	A variable capacitor is a capacitor whose capacitance may be changed mechanically or electronically. Types of variable capacitor are: 1.Tuning capacitor 2. Trimmer 3.Gang capacitor 4. Electronic capacitor	(definition: 1 mark , types:1 mark)

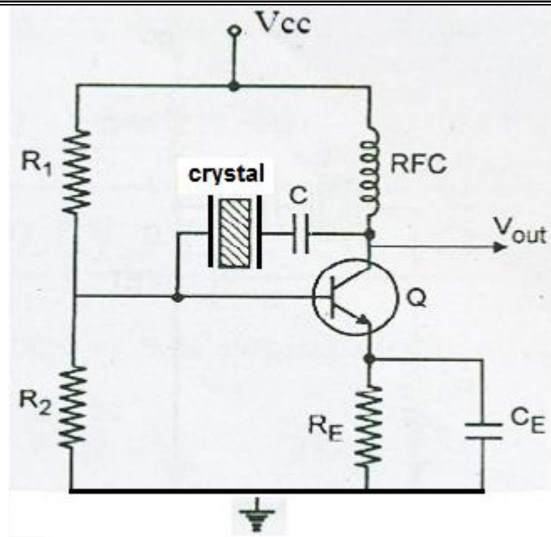
Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any FOUR:**	**16- Total Marks**
	a	**Describe the working of Zener breakdown of Zener Diode.**	**4M**
	Ans:	**Working:** When a reverse voltage is applied to a Zener diode, it causes a very intense electric field to appear across a narrow depletion region. Such an intense electric field is strong enough to generate large number of electron-hole pair by breaking covalent bonds. Because of large number of these carriers reverse current increases sharply and breakdown occurs which is known as Zener Breakdown.  **Zener breakdown characterisitics**	(V-I characteristics :2 marks , explaination 2 marks)
	b	**State the application of electronics (any 8).**	**4M**
	Ans:	**Application of electronics**: 1. Wired communication or Line communication. 2. Wireless communication 3. Defense 4. Industrial Applications 5. Medical sciences 6. Instrumentation and control 7.Consumer electronics	Any 8 applications (1/2 mark each)

		8.security systems 9.computer-aided design of electronic circuits 10. Entertainment 11. Printers 12. Automation 13. ATM machines 14. Robotics	
	c	**State the working of NPN transistor.**	**4M**
	Ans:	**NPN transistor**:  **Working of NPN transistor:** 1. Emitter -base junction of transistor is forward biased by supply VBB and collector base junction in reverse biased by Vcc 2. The forward biased on E-B junction causes the free electrons in the N-type emitter to flow towards the base region. This constitutes the emitter current I_E. 3. The electrons after reaching the base region tend to combine with the holes. This constitutes the base current I_B. However most of the free electrons do not combine as base region is lightly doped, and the base width is extremely small. 4. Thus most of the free electrons will diffuse to the collector region and will constitutes	(diagram: 2 marks, explainatio n:2 marks)

<table>
<tr><td></td><td></td><td>the collector current I_C.
5. It is clear that emitter current is the sum of collector current and base current i.e.
$$I_E = I_B + I_C$$
6. Since base current is very small
$$I_E \approx I_C$$</td><td></td></tr>
<tr><td></td><td>d</td><td>Draw the circuit diagram of single stage amplifier? State the function of each component.</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>

Biasing Circuit: The resistance R_1, R_2 and R_E forms the biasing and stabilization circuit.
Input Capacitor C_{C1}: It is used to couple the input AC signal to the base of the transistor. The capacitor C_{C1} allows only a.c. signal to flow but isolates signal source from R_2
Emitter bypass capacitor C_E: An emitter bypass capacitor C_E is used in parallel with R_E to provide low reactance path to the amplified a.c. signal. If it is not used, then amplified a.c. signal flowing through R_E will cause a voltage drop across it, thereby reducing the output voltage.
Coupling capacitor C_{C2}: The capacitor C_{C2}couples output signal of amplifier to the next stage or load.</td><td>(diagram: 2 marks, explainatio n:2 marks)</td></tr>
</table>

e	**State the working of Tunnel diode.**		**4M**
	Ans:	 **Working of Tunnel diode:** The operation of tunnel diode is based on special characteristics known as negative resistance. The width of the depletion region is inversely proportional to the square root of impurity concentration. So with increase in the impurity concentration, the depletion region width will reduce. The thickness of depletion region of this diode is so small. That indicates there is large probability of an electron can penetrate through this barrier. This behavior is called is tunneling & hence the name of the high impurity density PN junction is called as tunnel diode.	(diagram: 2 marks, explainatio n:2 marks)
f	**Describe the working of crystal oscillator**		**4M**
	Ans:		(diagram: 2 marks, explainatio n:2 marks)



Working of crystal oscillator:

Above fig shows the circuit of crystal oscillator using transistor. In this circuit, the crystal is connected as a series element in the feedback path from collector to the base. The resistors R1, R2 and RE provide voltage divider stabilized d.c. bias circuit. The capacitor CE provides a.c bypass of emitter resistor and RFC coil provides for d.c bias. The coupling capacitor C has negligible impedance at the circuit operating frequency. The circuit frequency of oscillation is set by the series resonant frequency of the crystal and its value is given by the relation

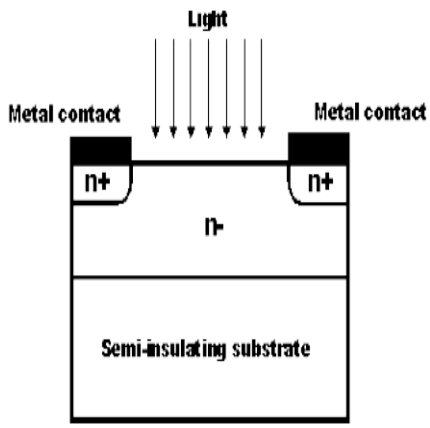
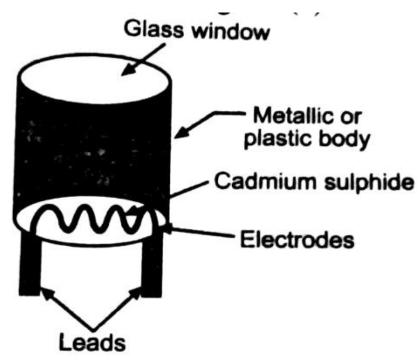
$$f_o = \frac{1}{2\pi\sqrt{LC}}$$

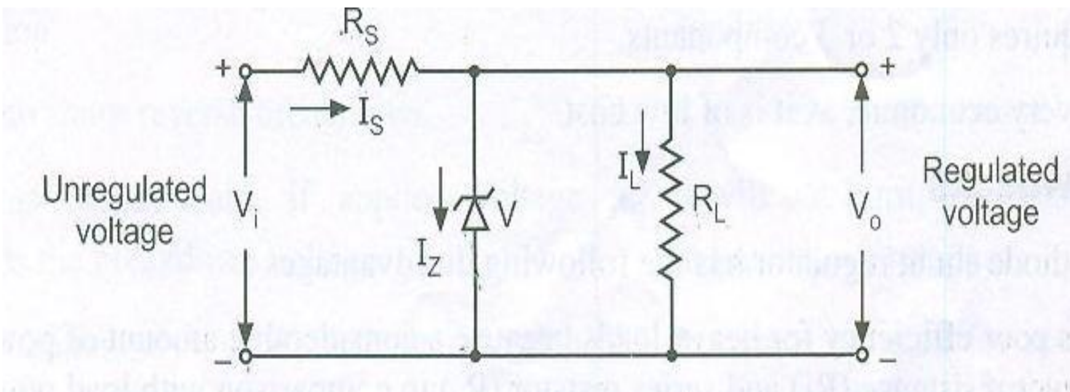
Where f_o = Frequency of oscillations

C= Couplling Capacitance

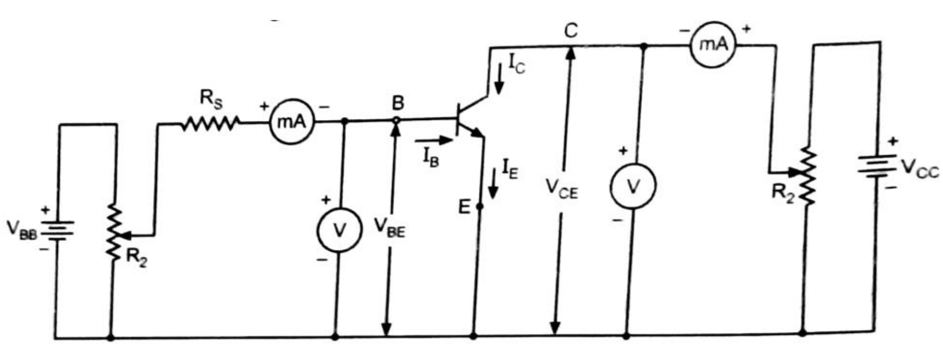
L= Inductance of a Crystal depending upon thickness and physical geometry

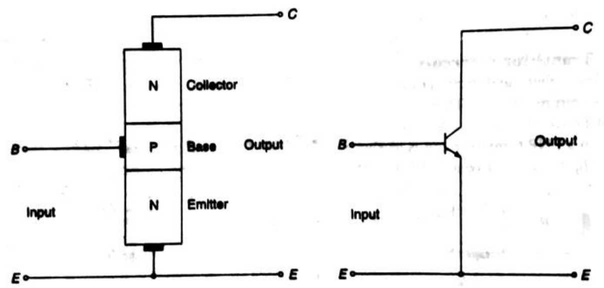
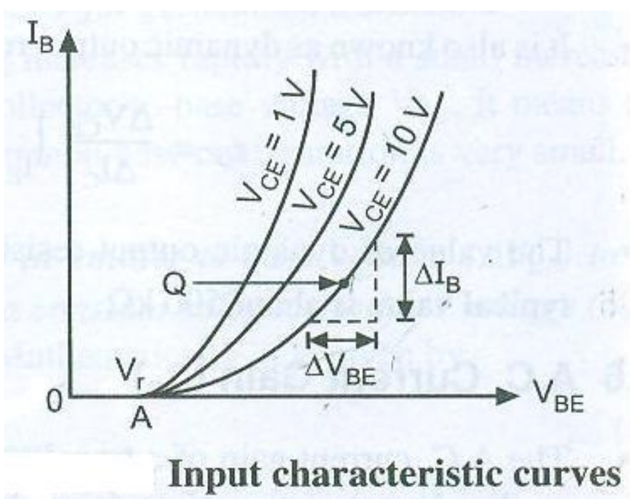
Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any FOUR:**	**16- Total Marks**
	a	**Draw and explain the construction of LDR. Explain its working principle.**	**4M**

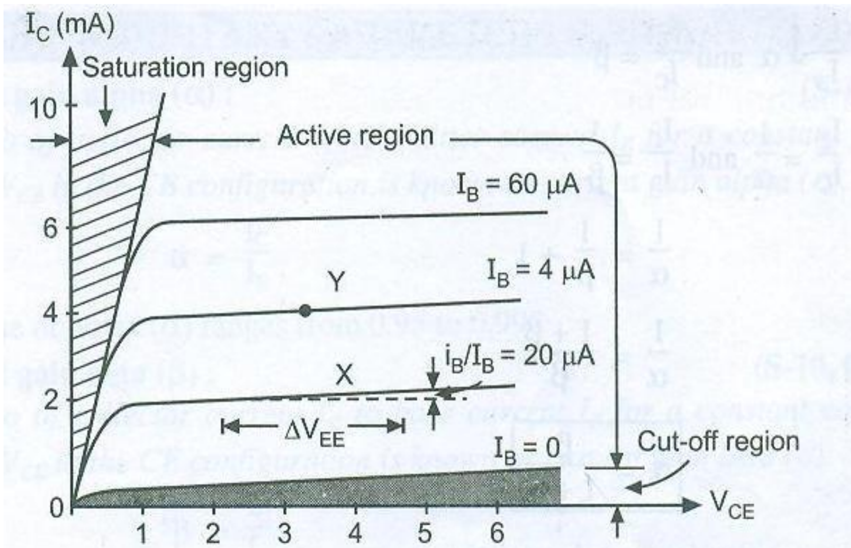
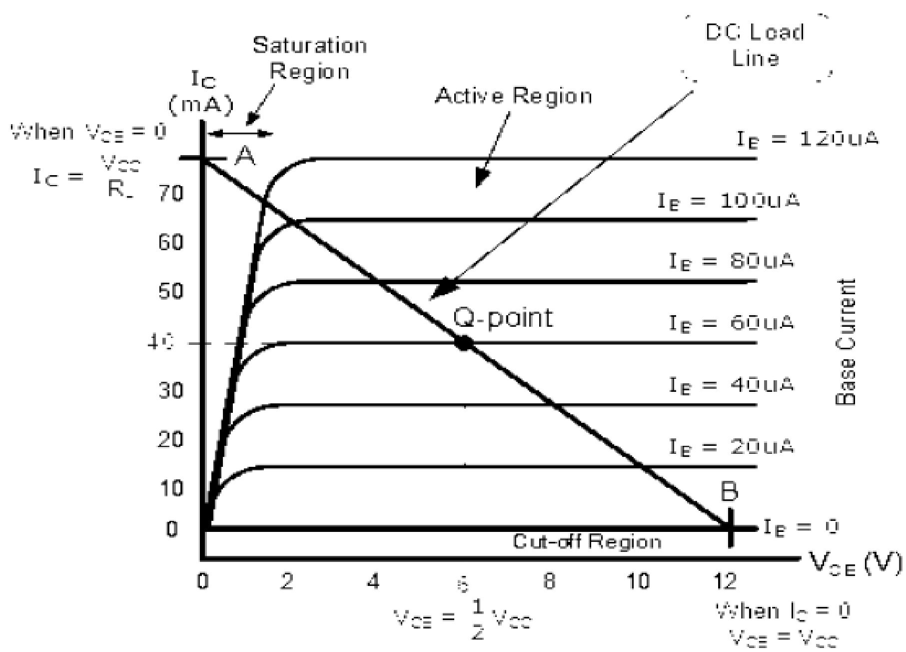
	Ans:	**Construction:** **Diagram :**  **(OR)** 	1 Marks for any Constructional diagram
		Explanation : • The structure of a light dependent resistor consists of a light sensitive material which is deposited on an insulating substrate such as ceramic. • The material is deposited in zig-zag pattern in order to obtain the desired resistance & power rating. • This zig-zag area separates the metal deposited areas into two regions. Then the ohmic contacts are made on the either sides of the area. • Materials normally used are cadmium sulphide, cadmium selenide, lead sulphide, indium antimonide and cadmium sulphonide	1 Mark for explanation
		Working Principle: • An LDR works on the principle of photo conductivity, which is an optical phenomenon in which the material's resistivity reduces when the light is absorbed by the material. • When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. • These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band.	2 Marks for Working principle

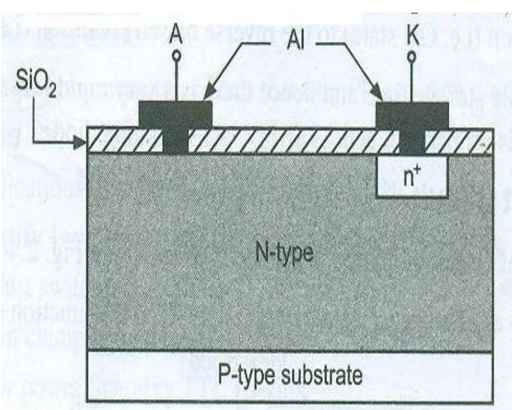
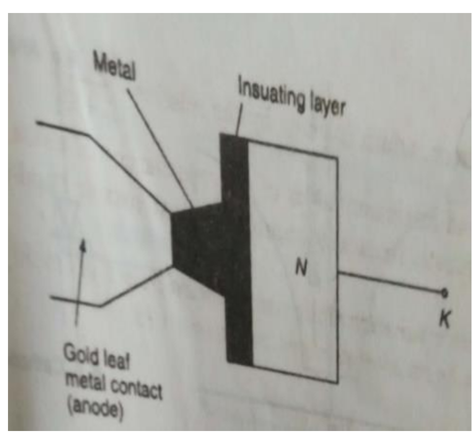
		• Hence when light having enough energy is incident on the device more & more electrons are excited to the conduction band which results in large number of charge carriers. • The result of this process is more and more current starts flowing and hence it is said that the resistance of the device has decreased.	
	b	**Explain Zener diode as voltage regulator.**	**4M**
	Ans:	 Zener regulator **Operating Principle** For proper operation, the input voltage V_i must be greater than the Zener voltage Vz. 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, i.e. Vz = Vo across the load inspite of input AC voltage fluctuations or load current variations. The input current is given by, $$I_S = \frac{V_i - V_Z}{R_S} = \frac{V_i - V_O}{R_S}$$ We know that the input current $I_S$is the sum of Zener current Iz and load current I_L. Therefore, I_S = Iz+ I_L	2 Marks for circuit diagram 2 Marks for explanatio n

		or $Iz = Is - I_L$ 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, $$Vo = V_i - Is .Rs$$ As the input current is constant, the output voltage remains constant (i.e. unaltered or unchanged). 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.	
	c	**Explain the FET parameters.**	**4M**
	Ans:	1) **Dynamic drain resistance(r_d)** : It is defined as the ratio small change in drain to source voltage (ΔV_{DS}) to the resulting change in drain current(ΔI_D) for constant gate to source voltage(V_{GS}) It is also called A.C drain resistance. $$r_d = \frac{\Delta V_{DS}}{\Delta I_D} \text{ for } V_{GS} = \text{Constant}$$ 2) **Transconductance**(g_m): Transconductance is defined as the ratio of change in Drain current (ΔI_D) to change in Gate to Source Voltage (ΔV_{GS}) at a constant V_{DS}. $$g_m = \frac{\Delta I_D}{\Delta V_{GS}} \text{ keeping } V_{DS} \text{ constant.}$$	1 Mark for Any four parameters

		3) **Amplification Factor(μ)** : Amplification Factor is defined as the ratio of change in Drain to Source Voltage (ΔV_{DS}) tochange in Gate to Source Voltage (ΔV_{GS}) at a constant I_D . $$\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}} \quad I_D = \text{constant}$$ 4) **Input resistance (R_i)**:- It is the ratio of reverse gate to source(V_{GS}) to a resulting reverse gate current when the drain to source voltage is zero. $$R_i = \frac{V_{GS}}{I_{GSS}}$$ 5) **Static or ohmic resistance(R_D):** It is the ratio of drain-to-source voltage V_{DS} to the resulting drain current(I_D) for a constant gate-to-source voltage V_{GS} $$R_D = \frac{V_{DS}}{I_D} at V_{GS} = constant$$ 6) **I_{DSS}(Drain saturation current):** The maximum amount of drain current at zero gate-to source voltage V_{GS} is known as drain saturation current.	
	d	**Draw the block diagram of CE configuration with input and output characteristics.**	**4M**
	Ans:	**Circuit diagram of CE configuration:**  	2 Marks for any diagram

		(OR)  **Input characteristics:**  **Output characteristics:**	1 Mark for input characteristic 1 Mark for output characteristic

		 **Output characteristic curves for CE configuration**	
	e	**Draw DC load line on output characteristics of BJT and show different operating point on DC load line.**	**4M**
	Ans:	 **Note: Marks may be given for waveforms even if numerical values are not specified.**	2 Marks for characteristic 1 M ark for correct marking of points on X and Y axis $V_{CE}=V_{CC}$ $I_C= V_{CC}/R_C$ 1 Mark for operating regions.

	f	**State Barkhausen criteria for oscillator and describe its use.**	**4M**
	Ans:	**Barkhausen's Criterion for Oscillations :** 1. Loop gain (β.Av) $\geq$ 1 2. Phase shift between the input and output signal must be equal to 360^0or 0^0. **Use:** Oscillators are circuits which produce periodic waveforms of desired frequencies which are necessary for functioning of various electronics circuits. When Barkhausen's Criterion is satisfied then these circuits will work as oscillators and produce sustained oscillations.	2 Marks for criteria 2 Marks for use
Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any FOUR:**	**16- Total Marks**
	a	**Draw constructional diagram of Schottky diode and explain it.**	**4M**
	Ans:	Construction of a Schottky diode **(OR)** 	2 Marks for any relevant diagram

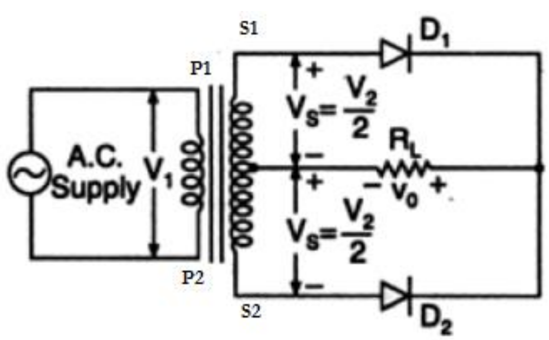
Explanation:

- The metal region of a Schottky diode is heavily occupied with the conduction band electrons and the N-type region is lightly doped.
- There are no minority carriers as in other types of diodes, but there are only majority carriers as electrons. It operates only with majority carriers.
- When it is forward biased, higher energy electrons in the N-region are injected into the metal region where they give up their excess energy very rapidly.
- Since there are no minority carriers as in a conventional diode, there is no charge storage and hence there is no reverse recovery diode when it is switched from the forward biased condition (i.e. ON state) to the reverse biased condition (i.e. OFF state).
- As junction capacitance is very less it has much faster switching time, it acts as a very fast switching diode.

2 Marks for explanation

b	**Explain center type F.W.R. with input output waveform.**	**4M**

Ans:



1 Mark for circuit diagram

Working of Centre-Tap Full Wave Rectifier:

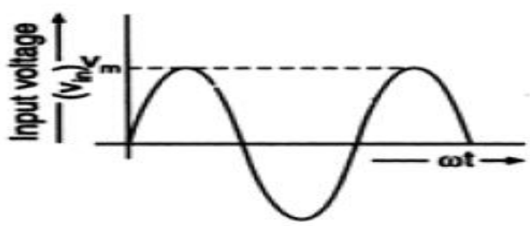
As shown in the figure, an ac input is applied to the primary coils of the transformer. This input makes the secondary ends positive and negative alternately. For the positive half of the ac signal, the secondary point S_1 is positive and S_2 will be negative. At this instant diode D_1

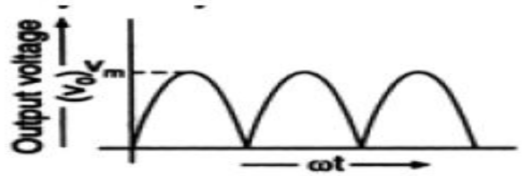
2 Mark for explanation and

will be forward biased and diode D_2 will be reverse biased. D_1 will conduct and D_2 will not conduct during the positive half cycle. Thus the current flow will be in the direction S_1-D_1-R_L-GND. Thus, the positive half cycle appears across the load resistance R_L.

During the negative half cycle, the secondary ends S_1 becomes negative and S_2 becomes positive. D_2 will be forward biased and D_1 will be reverse biased. The diode D_2 will conduct and D_1 will not conduct during the negative half cycle. The current flow will be in the direction S_2-D_2-R_L-GND.

Thus the direction of the current flow is the same through load resistance R_L in both half cycles.





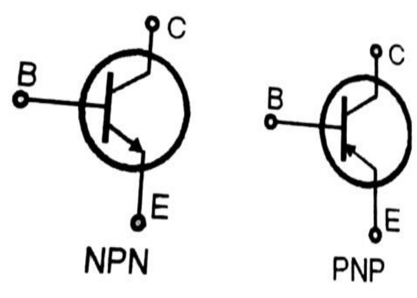
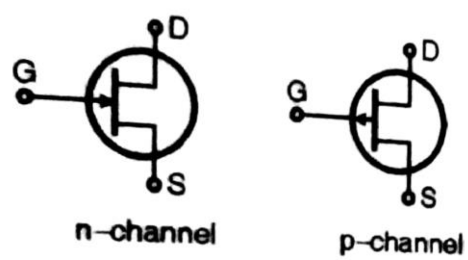
1 Mark for waveforms

c Compare BJT and FET, (any 4 points). **4M**

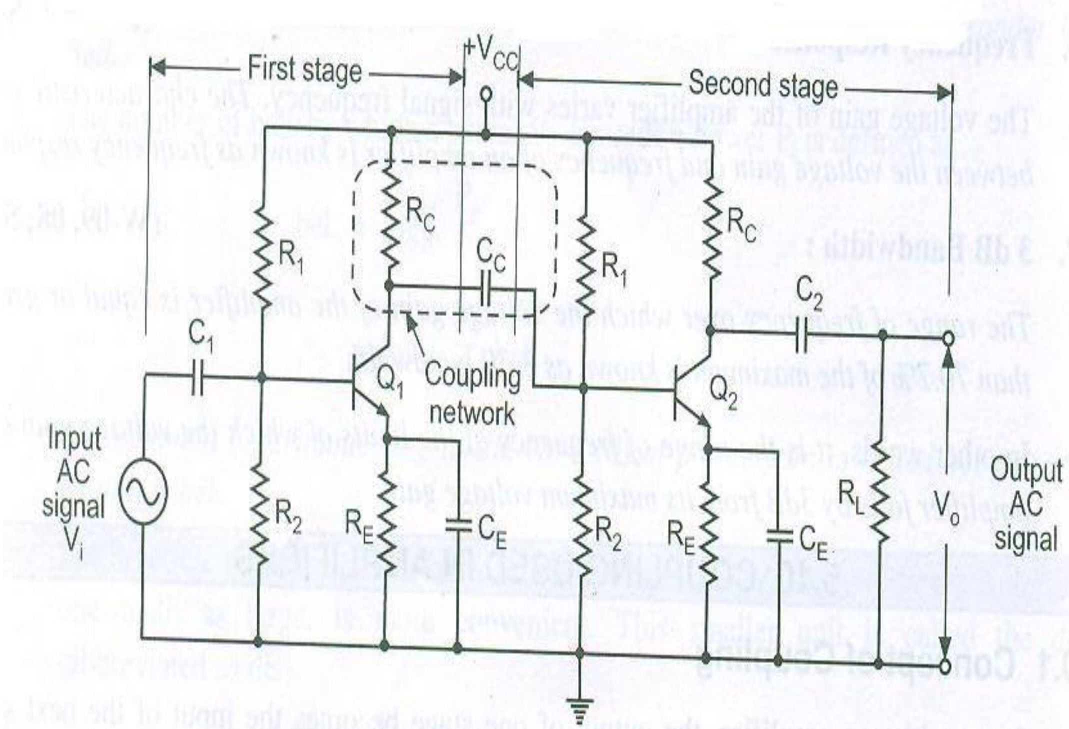
Ans:

Sr.No	Bipolar Junction Transistor(BJT)	Field Effect Transistor(FET)
1	It is bipolar device i.e. current in the device is carried either by both electrons & holes	It is unipolar device i.e. current in the device is carried either by electrons or holes
2	It is a current controlled device i.e. the base current controls the amount of collector current.	It is a voltage controlled device i.e. voltage at the gate (or drain) terminal controls amount of current flowing through the device.
3	Its input resistance is very low compared to FET.	Its input resistance is very high

4 Marks for any correct4 points.

4	It has a positive temperature co-efficient at high current levels. It means that current increases as temperature increases.	It has a negative temperature co-efficient at high current levels. It means that current decreases as temperature increases.
5	It is comparatively more noisy.	It is less noisy.
6	It has relatively higher gain bandwidth product as compared to FET	It has relatively lower gain bandwidth product as compared to BJT.
7	It is comparatively difficult to fabricate on IC & occupies more space on chip compared to FET.	It is simpler to fabricate as IC & occupies less space on chip compared to BJT.
8	Transfer characteristics is linear	Transfer characteristics is non- linear
9	Thermal runaway can damage the BJT	Thermal runaway does not take place
10	Symbol: 	Symbol: 

d	**Draw block diagram of R-C coupled amplifier.**	**4M**
Ans:		4 Marks for correct diagram

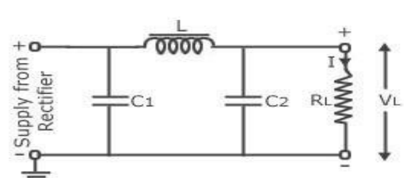


Two-stage RC coupled CE amplifier

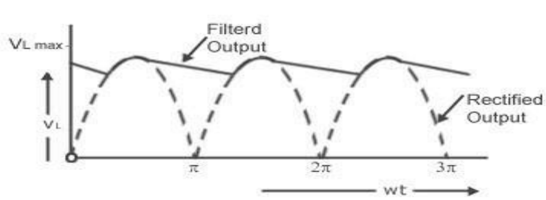
Note: Circuit diagram of R-C coupled amplifier should be considered as block diagram.

e	**Explain the working of πfilter with its waveform generation.**	**4M**

(Note any other diagram showing rectifier with filter may also be considered)



Circuit Digram



Rectified and Filtered Output Voltage Waveform
Full-wave Rectifier With capacitor Input Filter

1 Mark for diagram

1 MARK for waveform

		Explanation : CLC filter or π filter is used whenever a low output current and a high dc output voltage is required. It consists of two capacitors C_1 and C_2 and an inductor L connected in the form of Greek letter π. The pulsating output from the rectifier is applied at the input terminals of the π filter. **Working**: Capacitor C_1 filter: It offers a low reactance to ac component of rectifier output. This capacitor C_1bypasses most of the ac component to the ground, while dc component moves towards L. Inductor L : It offers a high reactance to the ac component of the rectifier output but zero resistance to the dc component. Thus, it allows the dc component to pass through it, and blocks the ac component, which could have been bypassed by the capacitor C_1. Capacitor C_2 : This works similar to C_1. It bypasses the ac component of rectifier output, which could not be blocked by Inductor L. Thus only dc component is available at the output.	2 Marks for explanation
	f	**Define the following :** **1)Bandwidth** **2)Power gain** **3)Current gain** **4)Voltage gain.**	**4M**
	Ans:	**1) Bandwidth:** The range of frequency over which the voltage gain of an amplifier remains constant is known as bandwidth of an amplifier. It is denoted as BW= F_H - F_L of an amplifier. **2) Power Gain:**	1 Mark for each definition

		The ratio of output power to input power of a BJT amplifier is known as power gain. It is denoted by a letter A_P . A_P = Output power/ Input power= P_o/ P_i **3) Current Gain:** The ratio of output current to input current of a BJT amplifier is known as current gain. It is denoted by a letter A_i A_i = Output current/ Input current= I_o/ I_i **4) Voltage Gain:** The ratio of output voltage to input voltage of a BJT amplifier is known as voltage gain. It is denoted by a letter A_v. A_v = Output voltage / Input voltage = V_o/ V_i	
. No.	Sub Q. N.	Answers	Marking Scheme
5		**Attempt any FOUR:**	**16- Total Marks**
	a	Define the following : 1)Knee voltage 2)Peak inverse voltage 3)Reverse saturation current 4)Maximum forward current	4M
	Ans:	1) **Knee voltage:** The applied forward voltage, at which the PN junction starts conducting is called knee voltage.The knee voltage for a silicon diode is 0.6 V (or 0.7 V) and that for a germanium diode is 0.2V (or 0.3 V) . 2) **Peak inverse voltage(PIV):** The maximum voltage at which non conducting PN junction diode must withstand without its damage during the negative half cycle of AC input signal is called peak inverse voltage.	1Mark each definition

3) **Reverse Saturation current:** It is the small current which flows through diode because of minority carriers when diode is reverse biased. The minority carriers are hole-electron pair as a result of thermal energy. Thus the current remain constant even though increase in reverse bias voltage if temperature is fixed. Thus the current is called as saturation current.
4) **Maximum forward current:** The Maximum value of the forward current that a PN junction or diode can carry without damaging the device is called its Maximum Forward Current.

b **Compare H.W.R. and bridge type F.W.R. (Four points).** **4M**

Ans:

Parameter	Half wave rectifier	full wave Bridge rectifier
No of diodes	1	4
Conduction	Half cycle	Full cycle
PIV	Vm	Vm
TUF	0.287	0.812
Ripple factor	1.21	0.482
Efficiency	0.406	0.812
Ripple frequency	50 Hz	100 Hz
Transformer core saturation	Possible	Not possible

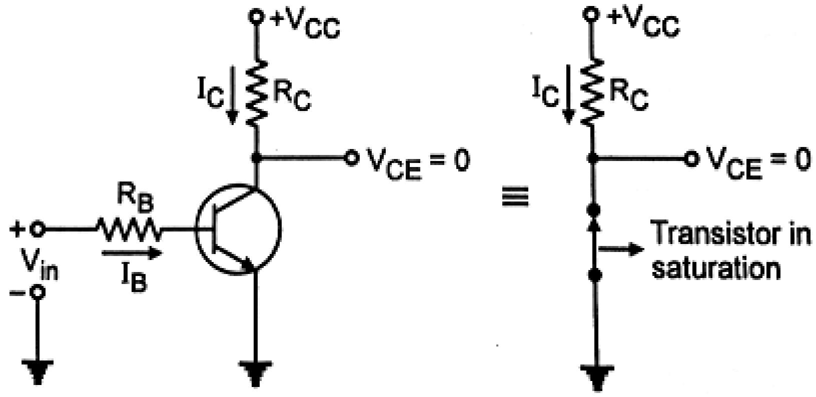
4Marksfor any four points

c **Explain transistor as a switch.** **4M**

Ans:

1. **Transistor in Saturation region**:

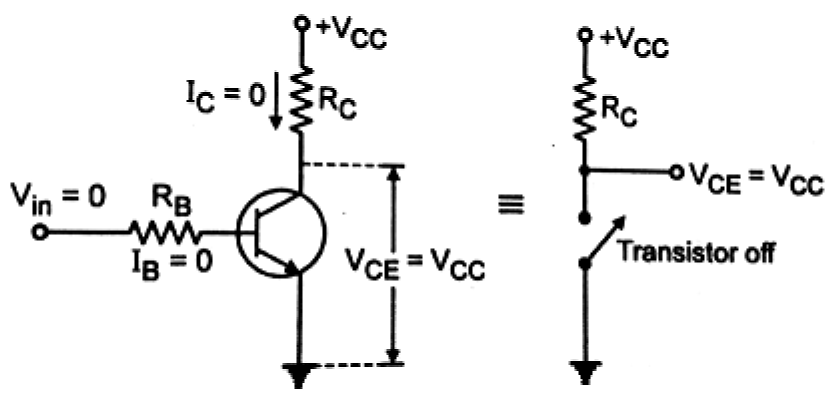
2Marks for Saturation region



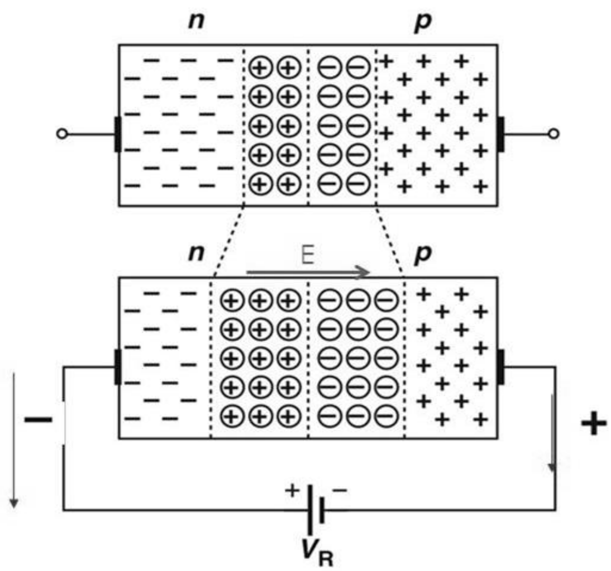
- The saturation state occurs when both junctions(EB junction and CB junction) are in forward bias.
- When input voltage V_{in}=V, both EB and CB junction are in Forward biased and transistor is saturated.
- Output voltage $V_o = V_{CE\,(sat)}$ (0.2V for Si)and collector current $I_C = I_{CMAX}$ ($I_C = V_{CC}/R_C$)
- Thus transistor acts as closed switch.

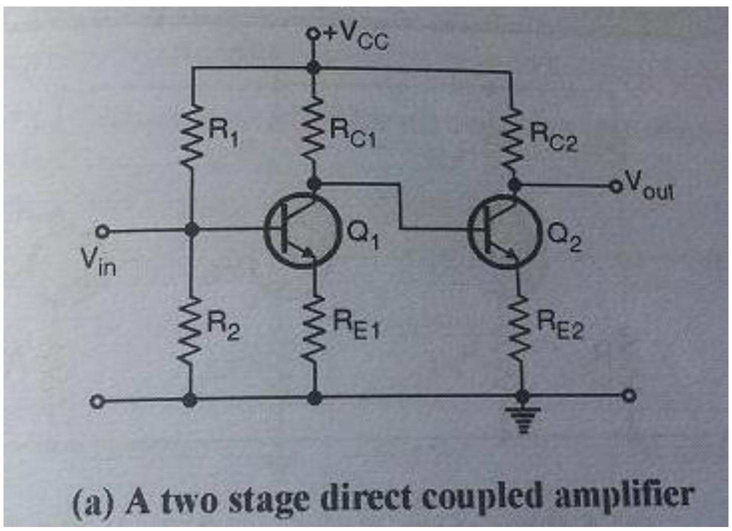
2. **Transistor in cut off region:**

2Marks for cut off region

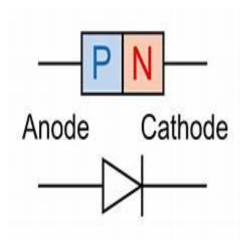
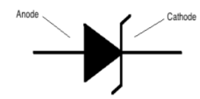


- The cut-off state occurs when both junctions(EB junction and CB junction) are in reverse bias.
- When input voltage V_{in}=0, both EB and CB junction are in reverse bias and transistor is cut off.
- Output voltage $V_o = V_{CE} = V_{CC}$ and collector current $I_C = 0$

		• Thus transistor acts as open switch	
	d	**Explain Reverse Bias of P-N junction.**	**4M**
	Ans:	 • Majority carrier current: 1. When PN junction is reverse biased the holes in the P- region are attracted towards the negative terminal of the battery, and the free electrons in the N-region are attracted to the positive terminal of the battery 2. Thus the majority carriers are drawn away from the PN junction. 3. Thus depletion region is widens. And barrier potential increases. 4. This makes the majority carriers diffusion across PN junction very difficult, this reduces the majority carrier current. • Minority carrier current: 1. In reverse biased PN diode Minority carrier is swept across the junction(ie. Holes from N region and electrons from P region) 2. Very small amount of current flows through diode due to minority carriers. (nA in Si.	2 Marks for diagram 2 Marks for Explanatio n

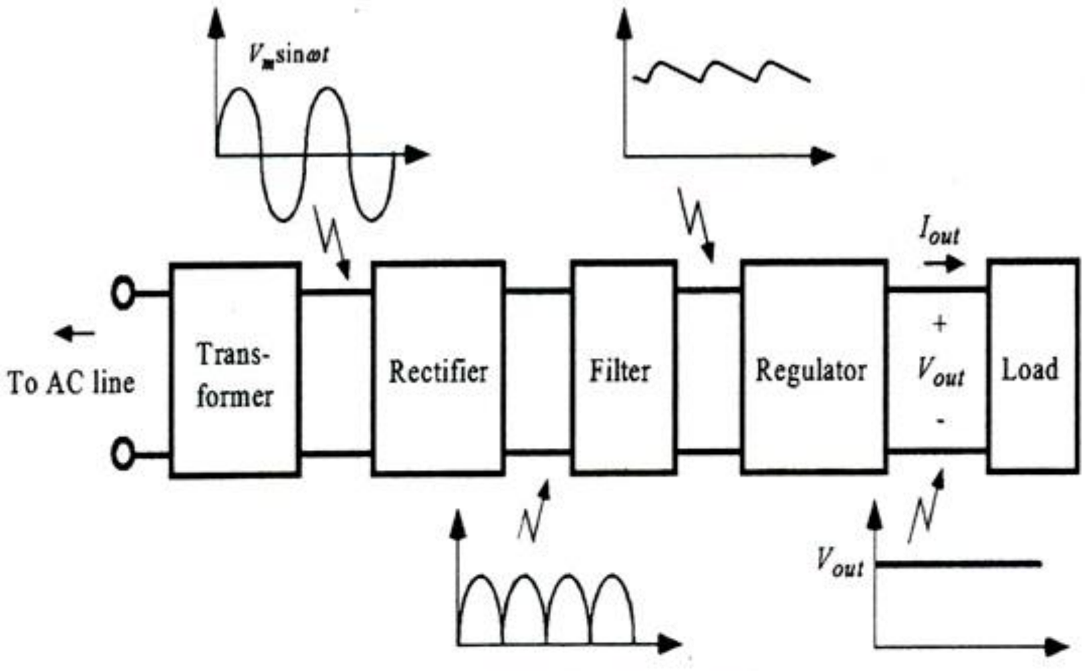
		diode and µA in Ge. Diode) 3. The rate of generation of minority carriers depend upon temperature. 4. If temperature is fixed, this current remain constant though the reverse voltage is increased, thus the current is called as reverse saturation current.	
	e	**State the working of direct coupled amplifier with the help of its circuit diagram.**	**4M**
	Ans:	**Circuit diagram :**  Direct coupled amplifier Description: • There is no capacitor used for coupling one stage to the other. • Q_1 and Q_2 are the transistors, Vcc is the dc supply, R_1, R_2, R_{c1}, Rc_2, R_{E1}, R_{E2} are the biasing elements. • Output of Q_1 (ie voltage at collector of Q_1)is connected to base of Q_2. • The input AC signal is applied to base of Q_1, o/p at collector of Q_1 is connected directly to base of Q_2. Final o/p is obtained at collector of Q_2. Hence it is called direct coupled amplifier.	2 Marks for circuit diagram 2 Marks for Explanation

		• Due to the absence of coupling capacitors, the gain does not reduce on the lower frequency side. • The amplifier can amplify even the dc signals. • It suffers from the drift problem due to direct coupling.	
	f	**Name the materials which are used for LED making. State LED's applications.**	**4M**
	Ans:	**Material used for making LED :** 1. Gallium Arsenide (GaAs) emits infrared light 2. Gallium Phosphide (GaP) emits red or green light 3. Gallium Arsenide Phosphide (GaAsP) emits red or yellow light. 4. Gallium Nitride(GaN) emits blue light **Applications of LED :** 1. LED is used as a bulb in the homes and industries. 2. The light emitting diodes are used in the motorcycles and cars. 3. These are used in the mobile phones to display the message. 4. At the traffic light signals led's are used. 5. In Opto couplers 6. In infrared remote control 7. In optical communication system 8. To indicate power On/Off conditions 9. In 7 segment display (Other suitable applications should also be considered)	2Marks for material 2Marks for any 2 applications
Q. No.	Sub Q. N.	Answers	Marking Scheme
6		**Attempt any FOUR:**	**16- Total Marks**
	a	**Compare PN Junction and Zener Diode. (4 points)**	**4M**
	Ans:		1 mark for

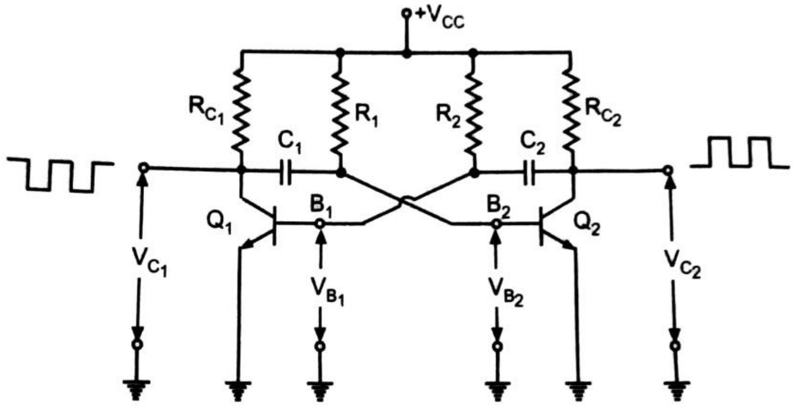
Parameter	PN junction diode	Zener diode
Symbol		
Conduction	Only in one direction	Conducts in both the directions
Operated	Only in forward direction	Only in reverse direction
Doping	Doping intensity is low	Doping intensity is high to achieve sharp breakdown
Application	Electronic switch, rectifiers, clippers, clampers	Voltage regulator

each comparision (any 4 points)

b	**Describe Regulated power supply with block diagram.**	**4M**

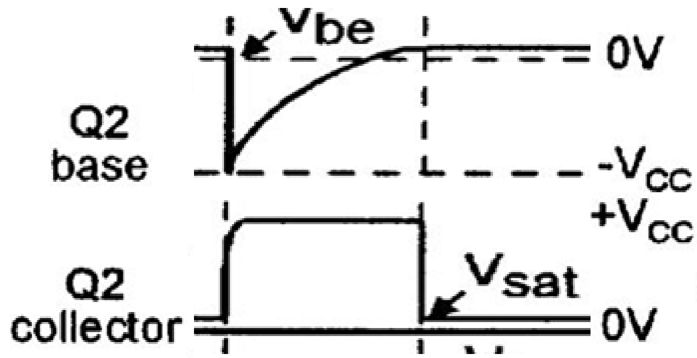
	Ans:	 Components of a typical linear power supply	2Marks Block diagram
		Step down Transformer: • A step down transformer steps down the ac voltage to required voltage level. The output of transformer is given as an input to the rectifier circuit. • Rectifier converts ac to corresponding pulsating dc voltage. Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the ac supply. • The output dc voltage is pulsating dc voltage having very high ripple content, hence filter is used, it removes the unwanted ac component from the rectifier o/p. Different types of filters are used such as capacitor filter, LC filter, π type filter. • The voltage regulator maintains the o/p voltage constant irrespective of changes in load and i/p fluctuations. • The constant and pure dc is obtained across the load.	2Marks description

	c	**State the relation between α and β. Define Q point.**	**4M**
	Ans:	Relationship : • We know, $I_E = I_B + I_C$ • Dividing the above equation on both sides by I_C, $I_E/I_C = I_B/I_C + 1$ • Since $I_C/I_E = \alpha$ and $I_B/I_C = \beta$ So, $I_E/I_C = 1/\alpha$ and $I_C/I_B = 1/\beta$ Therefore, $1/\alpha = 1/\beta + 1$ Or $1/\alpha = 1+\beta/\beta$ **Therefore,** $\boldsymbol{\alpha = \beta/(1+\beta)}$ • **The above expression may be written as** $\alpha\ (1+\beta) = \beta$ $\alpha + \alpha\beta = \beta$ $\alpha = \beta - \alpha\beta = \beta(1-\alpha)$ **Therefore,** $\boldsymbol{\beta = \alpha/(1-\alpha)}$ **Q point:** The operating point of a device, also known as bias point, quiescent point, or *Q-point*, is the point on the output characteristics that shows the DC collector–emitter voltage (V_{CE}) and the collector current (I_C) with no input signal applied.	2 Marks for derivation of α and β 2 Marks for Q-point
	d	**Explain Astable multivibrator with its circuit diagram.**	**4M**
	Ans:	**Circuit diagram Astable multivibrator** :	2Marks for circuit diagram



Explanation :

- When Vcc is connected, one transistor will conduct more than other, and we can assume say Q_1 is in saturation And Q_2 is in cutoff mode. The V_{c1} is at 0V and V_{c2} = +Vcc.
- Hence C_1 charges exponentially with R_1C_1 time constant towards Vcc through R_1. Hence V_{B2} also increases exponentially towards Vcc.

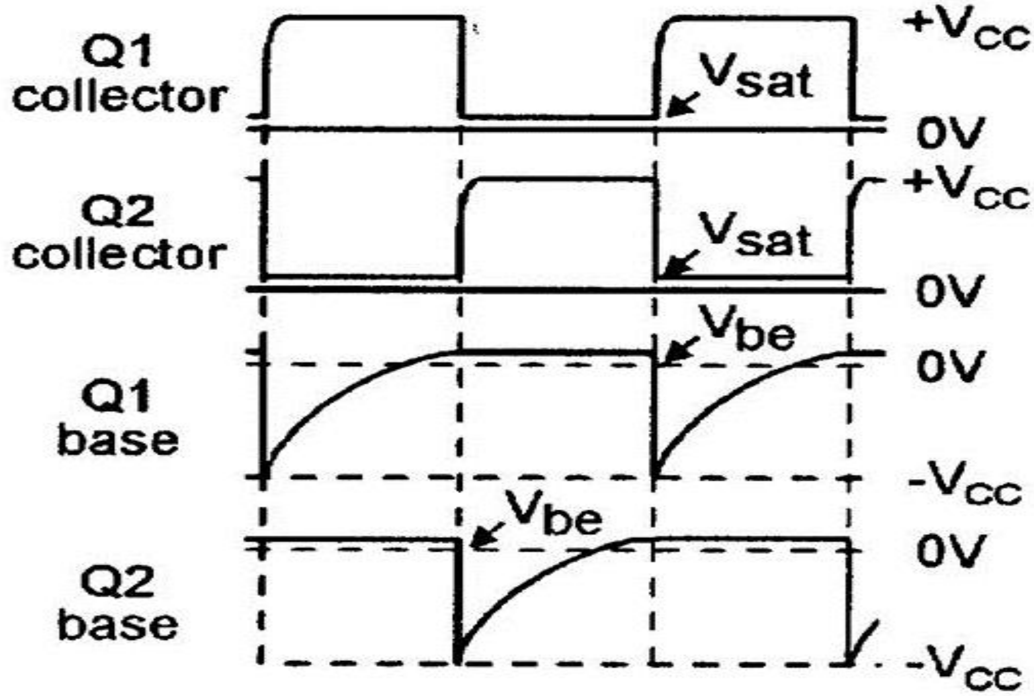


2Marks forExplanation

- When V_{B2} crosses the cut-in voltage, Q_2 starts conducting and V_{C2} fall to $V_{cE(sat)}$.
- Also V_{B1} falls , thereby driving Q_1, to OFF state.
- Thus V_{C1}= V_{CC}, V_{B2}=$V_{BE(sat)}$, and V_{C2}=V_{CE}
- (sat)
- V_{B1} now increases exponentially with R_2C_2 towards V_{CC}. Therefore Q_1 is driven into saturation and Q_2 to cutoff.
- This regenerative process continues when Q_2 is ON, falling voltage V_{C2}permits

<table>
<tr><td></td><td></td><td>
the discharging of the capacitor C_2 which drives Q_1 into cutoff.

- The rising voltage of V_{C1} feeds back to the base of Q_2 tending to turn it ON.
- T=Ton + Toff



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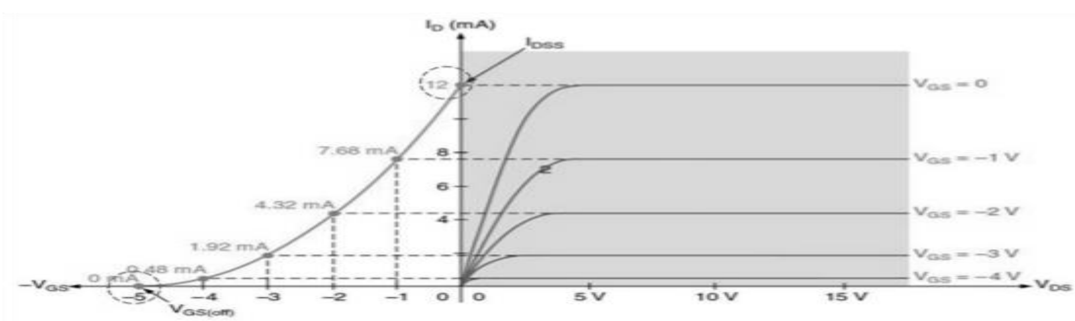
<tr><td></td><td>e</td><td>Draw the transfer characteristics of JFET and explain its significance.</td><td>4M</td></tr>
<tr><td></td><td>Ans:</td><td>
For an n-channel JFET, $V_{GS(off)}$ is negative.The relation between V_{GS} and I_D is known as Transfer characteristics



Characteristics of JFET
</td><td>2Marks for Transfer Characteristic</td></tr>
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		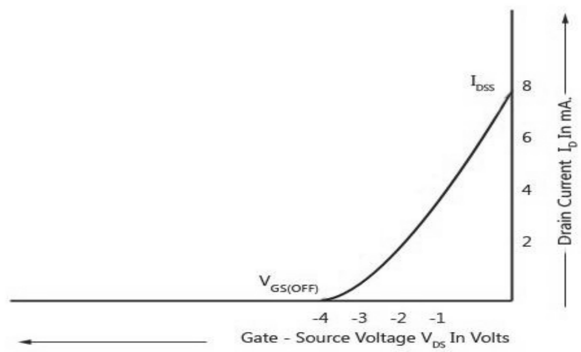 Fig: Transfer characteristics The curve is plotted between gate-source voltage, V_{GS} and drain current, I_D. It is observed that *(i)* Drain current decreases with the increase in negative gate-source bias *(ii)* Drain current, $I_D = I_{DSS}$ when $V_{GS} = 0$ *(iii)* Drain current, $I_D = 0$ when $V_{GS} = V_D$ The transfer characteristic equation $I_D = I_{DSS}\left[1 - \frac{V_{GS}}{V_{GS(off)}}\right]^2$	2Marks for Significance
	f	**An A.C. supply of 230 V is applied for F.W.R. through a transformer of turn's ratio 2:1. Calculate** **i)Direct current output voltage** **ii)PIV of diode.**	**4M**
	Ans:	**(Consider F.W.R is Bridge rectifier)** 1. **D.C. output voltage**: r.m.s. value of secondary voltage $V_2$is given by ,	3Marks

		$V_2/V_1=N_2/N_1$ $V_2=V_1*N_2/N_1$ $V_2=230*1/2$ $\boxed{V_2=115V}$ Maximum secondary voltage V_m is given by, $V_m=\sqrt{2}v_2$ $V_m=\sqrt{2}*115$ $\boxed{V_m=162.63V}$ D.C. output voltage V_{dc} is given by, $V_{dc} = 0.636* V_m$ (OR) $2* V_m/\pi$ Thus the DC output voltage is given by $\boxed{V_{dc} = 103.43V}$ 2.**PIV** =For F.W.Bridge Rectifier is , PIV = V_m $\boxed{PIV= V_m=162.63}$	for DC output voltage 1Mark for PIV