WINTER-19 EXAMINATION

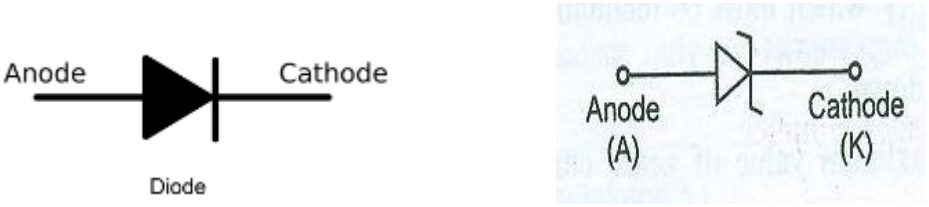
Subject Name: Basic Electronics **Subject Code:** 17321

Model Answer

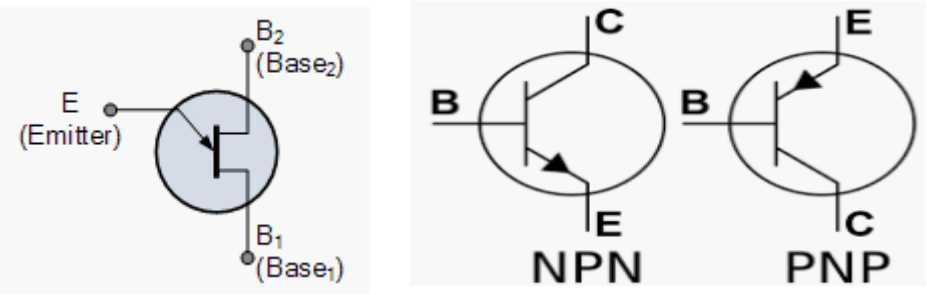
Important Instructions to examiners:

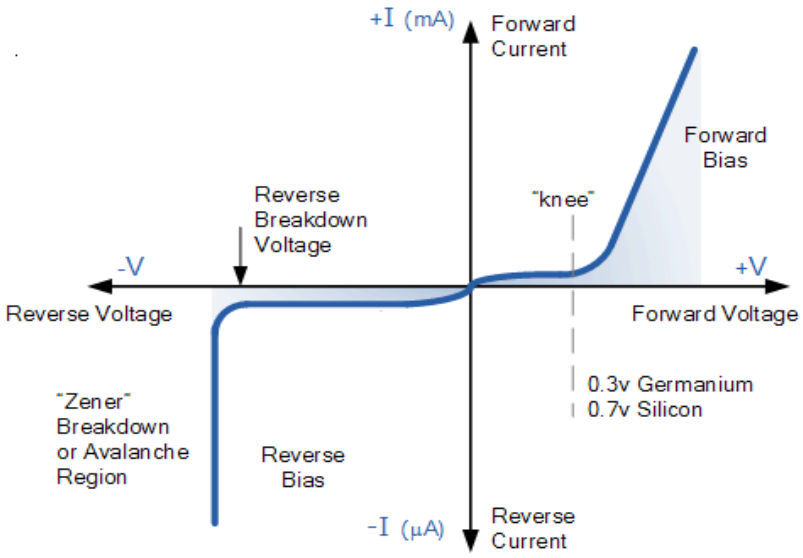
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 SIX of the following:**	**12- Total Marks**
	(a)	**State any two trivalent and pentavalent impurities each.**	**2M**
	Ans:	Trivalent impurities are: 1) Boron (B) 2) Gallium (G) 3) Indium(In) 4) Aluminium(Al). Pentavalent impurity are: 1) Phosphorus (P) 2) Arsenic (As) 3) Antimony (Sb) 4) Bismuth (Bi)	1 mark for any 2 Trivalent impurities 1 mark for any 2 Pentavalent impurities

	(b)	**Draw the symbol of (i) PN junction diode (ii) Zener diode.**	**2M**
	Ans:	**PN junction diode** **Zener diode** 	**1M each**
	(c)	**State the application of LED and photodiode.**	**2M**
	Ans:	**Application of LED are:** **1)** Indicator in AC circuit. **2)** Alphanumeric and Numeric display. **3)** For indicating power ON/OFF conditions **4)** Optical switching **5)** In burglar alarm **6)** Indicate digital logic state **Application of photodiode are:** **1.** Photo detection(both visible and invisible **2.** Demodulation **3.** Logic circuits **4.** Switching **5.** Optical communication systems **6.** Encoders	**1 mark for any two applications of each diode**
	(d)	**State the need of filter circuit and state its types.**	**2M**

	Ans:	**Need of filter circuit:** A filter circuit is required to remove the ac component present in the rectified output and allows only the dc component to reach the load. **Types of Filter:** **1)** Series Inductor (L) filter. **2)** Shunt Capacitor (C) Filter **3)** LC filter **4)** π (CLC) filter	**1Mark for need** **1Mark for Types**
	e)	**Define the following with respect to rectifier:** **(i) Ripple factor** **(ii) TUF**	**2M**
	Ans:	**i) Ripple factor:** Ripple Factor is the ratio of rms value of ac component present in the rectified output to the average value of rectified output. $\text{Ripple Factor, } \gamma = \frac{\text{RMS value of AC component present in Rectifier Output}}{\text{Average Value of Rectifier Output}}$ $= \frac{V_{rms}}{V_{dc}}$ **ii) 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. $= \frac{Pdc}{\text{Effective VA Rating of Transformer}}$ where Pdc is the dc power output **Note: Formulas are optional.**	**1mark for each definition**
	f)	**Draw symbol of UJT and transistor.**	**2M**
	Ans:	**Symbol:**	**1M each**

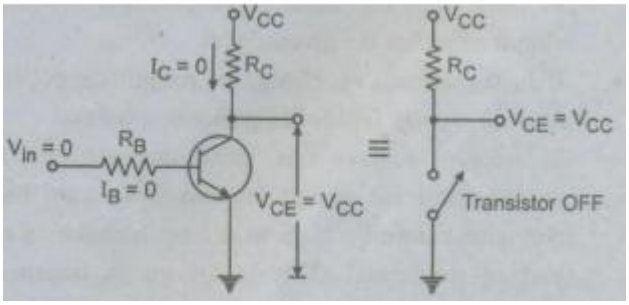
		UJT **Transistor** 	
	g)	**Define α and β for transistor.**	**2M**
	Ans:	**ALPHA (α):** It is a large signal current gain in common base configuration. It is the ratio of collector current (output current) to the emitter current (input current). $\alpha = \frac{Collector\ current}{Emitter\ current}$ $\alpha = \frac{I_C}{I_E}$ **Beta (β):** It is a current gain factor in the common emitter configuration. It is the ratio of collector current (output current) to base current (output current). $\beta = I_C / I_B$ **Formulas are optional.**	**1mark for each definition**
	h)	**Define operating point of transistor.**	**2M**
	Ans:	The point which is obtained from the values of the I_C (collector current) or V_{CE} (collector-emitter voltage) when no signal is given to the input is known as the operating point or Q-point in a transistor.	**2M**
Q. No.	Sub Q. N.	Answers	Marking Scheme
	B)	**Attempt any TWO of the following:**	**8-Total Marks**

	a)	**Draw and explain V-I characteristics of PN junction transistor.**	**4M**
	Ans:	**V-I characteristics of PN junction diode:**  **Explanation:** **Forward Bias:** • If the external voltage applied on the silicon diode is less than 0.7 volts, the silicon diode allows only a small negligible electric current. • When the external voltage applied on the silicon diode reaches 0.7 volts, the p-n junction diode starts allowing large electric current through it. • At this point, a small increase in voltage increases the electric current rapidly. • The forward voltage at which the silicon diode starts allowing large electric current is called cut-in voltage. • The cut-in voltage for silicon diode is approximately 0.7 volts. **Reverse Bias:** • Due to thermal energy in crystal minority carriers are produced. • These minority carriers are the electrons and holes pushed towards P-N junction by the negative terminal and positive terminal, respectively. • Due to the movement of minority carriers, a very little current flows, which is in nano Ampere range (for silicon). This current is called as reverse saturation current. • When the reverse voltage is increased beyond the limit and the reverse current increases drastically is called as reverse breakdown voltage.	**2M Characteristics** **1M Forward Bias** **1M Reverse Bias**

		• Diode breakdown occurs by two mechanisms: Avalanche breakdown and Zener breakdown.	
	b)	**Compare Half wave , Full wave and Bridge rectifier (Four points)**	**4M**
	Ans:	Any Four Points	**1M for any 4 points**

SI.No	Parameter	Type of the rectifier		
		Halfwave	Fullwave	Bridge
1.	Number of diodes	1	2	4
2.	V_{dc}	V_m/π	$2V_m/\pi$	$2V_m/\pi$
3.	Peak inverse voltage	V_m	$2V_m$	V_m
4.	Ripple factor	1.21	0.48	0.48
5.	Rectifier efficiency	40.6%	81.2%	81.2%
6.	Transformer Utilization factor	0.287	0.693	0.812
7.	Form factor	1.57	1.11	1.11

	c)	**Draw circuit diagram of transistor as a switch and describe its working.**	**4M**
	Ans:	**For switching applications transistor is biased to operate in the saturation or cut off region.** **a. Transistor in cut- off region (open switch):** In the cut-off region both the junctions of a transistor are reverse biased and very small reverse current flows through the transistor. The voltage drop across the transistor (V_{CE}) is high. Thus, in the cut off region the transistor is equivalent to an open switch.	**2marks for circuit diagram** **2marks for working**



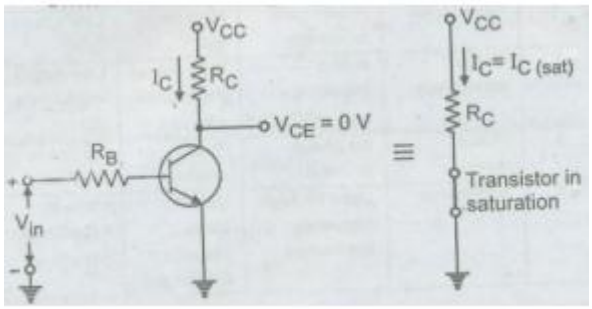
b. Transistor in the saturation region(closed switch):

When V_{in} is positive a large base current flows and transistor saturates.

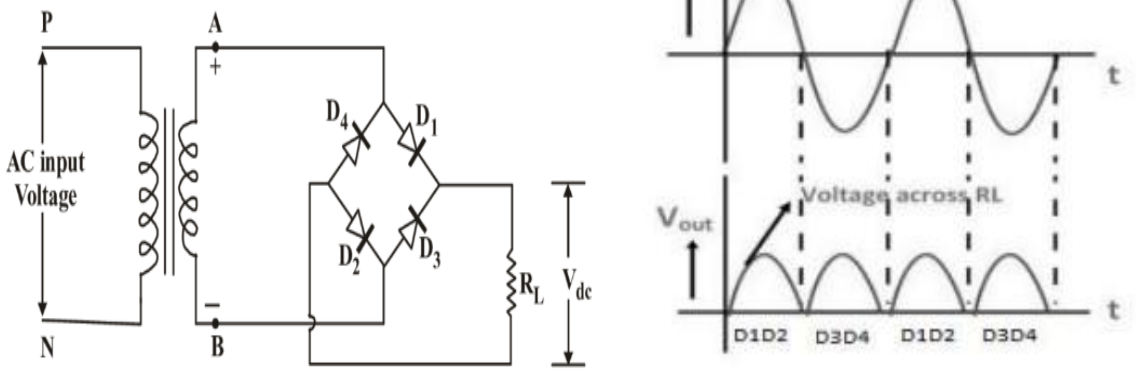
In the saturation region both the junctions of a transistor are forward biased.

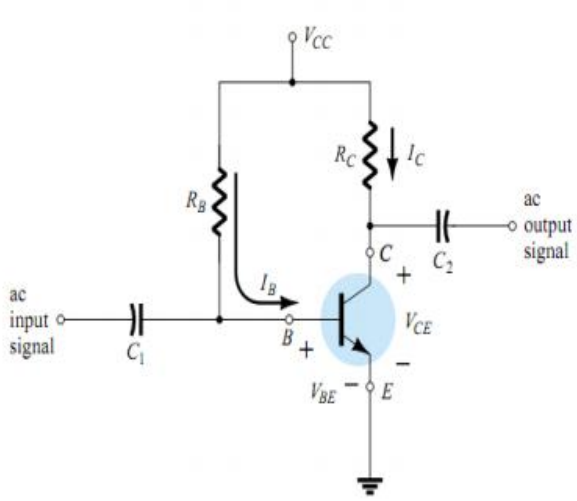
The voltage drop across the transistor (V_{CE}) is very small, of the order of 0.2 V to 1V depending on the type of transistor and collector current is very large.

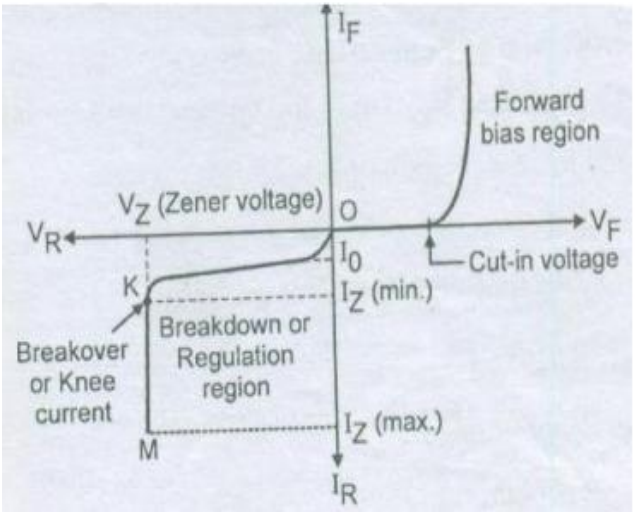
In saturation the transistor is equivalent to a closed switch.

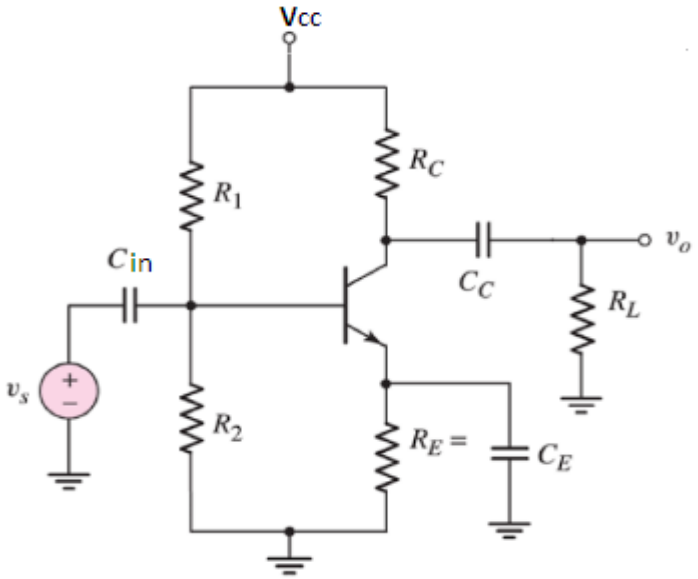


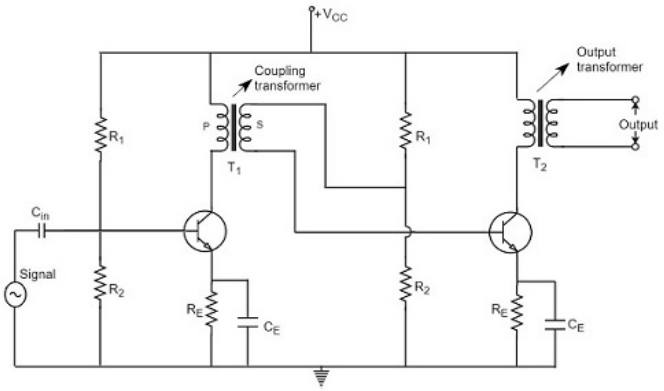
Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any FOUR of the following :**	**16- Total Marks**
	a)	**State and Explain any four specifications of diode.**	**4M**
	Ans:	**1) Cut in voltage:** The forward voltage at which the silicon **diode** starts allowing large electric current is called **cut-in voltage**. **2) Peak Inverse Voltage (PIV):** The maximum value of the reverse voltage that a PN junction or **diode** can withstand without damaging itself is known as its **Peak Inverse**	**1Mark for any four specifica**

		Voltage. 3) **Maximum Power Rating**: It is defined as the maximum power that a PN junction or diode can dissipate without damaging the device itself. 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. 5) **Effective (or) R.M.S current:** The effective (or) R.M.S. current squared of a periodic function of time is given by the area of one cycle of the curve, which represents the square of the function divided by the base. **Any relevant four specifications should be considered.**	**tion**
	b)	**Draw circuit diagram of bridge type rectifier and describe its working with input/output waveform.**	**4M**
	Ans:	**Circuit Diagram:** **Waveform:**  **Working:** **During positive half cycle:** • The end A of the secondary winding becomes positive and end B negative. • This makes diode D1 and D2 forward biased while diode D3 and D4 are reverse biased. • The conventional current direction is as follows. A – D1 – RL – D2 – B making load voltage positive. **During negative half cycle**: • The end B is positive and A is negative.	**2M – circuit diagram** **1M – Waveform** **1M – Working**

		• This makes diode D3 and D4 forward biased and diode D1 and D2 is reverse biased. • The conventional current through diode D2 and D3 when it is conducting is as follows. B – D3 – RL – D4 – A making load voltage negative.	
	c)	**State the need for biasing and explain fixed bias circuit.**	**4M**
	Ans:	**Need for biasing:** Transistor Biasing is the process of setting a transistors DC operating voltage or current conditions to the correct level so that any AC input signal can be amplified correctly by the transistor. **Explanation:**  • In this method, a resistor R_B of high resistance is connected in base, as the name implies. The required zero signal base current is provided by V_{CC} which flows through R_B. The base emitter junction is forward biased, as base is positive with respect to emitter. • The required value of zero signal base current and hence the collector current (as $I_C = \beta I_B$) can be made to flow by selecting the proper value of base resistor R_B. Hence the value of R_B is to be known.	**1Mark for need** **1Mark for explanation** **2M - Circuit Diagram**
	d)	**Draw the characteristics of zener diode in forward and reverse bias. Explain reverse bias characteristics.**	**4M**
	Ans:	**Characteristics of zener diode in forward and reverse bias:**	**2Marks for diagram**

		 • When reverse biased voltage is applied to a zener diode, it allows only a small amount of leakage current until the voltage is less than zener voltage. • When reverse biased voltage applied to the zener diode reaches zener voltage, it starts allowing large amount of electric current. • At this point, a small increase in reverse voltage will rapidly increases the electric current. Because of this sudden rise in electric current, breakdown occurs called zener breakdown. • The zener breakdown voltage of the zener diode depends on the amount of doping applied.	**2Marks for explanation**
	e)	**Draw the circuit diagram of single stage CE amplifier and state the function of each component.**	**4M**
	Ans:	**Circuit diagram of single stage CE amplifier:**	**2M**

		 **Function of each component in single stage CE amplifier:** • **Biasing circuit**: The resistances R_1, R_2 and R_E form the biasing and stabilization circuit. • **Input capacitance C_{in}:** This is used to couple the signal to the base of the transistor. If this is not used, the signal source resistance will come across R_2 and thus change the bias. The capacitor C_{in} allows only a.c. signal to flow. • **Emitter bypass capacitor C_E:** This is connected in parallel with R_E to provide a 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 shifting the output voltage. • **Coupling capacitor Cc:** This is used to couple the amplified signal to the output device. This capacitor C allows only a.c. signal to flow. • **Resistance R_L:** It represents the resistance of whatever is connected at the output. It may be load resistance or input resistance of the next stage.	**2M**
	f)	**Draw transformer coupled cascaded amplifier and explain its operation. State its application.**	
	Ans:	**Circuit diagram of transformer coupled cascaded amplifier:**	**2Marks for diagram**



Working:

- When an a.c. input signal is applied to the base transistor Q_1, it appears in the amplified form across primary winding of the transformer (T_1).
- The voltage developed across the primary winding is then transferred to the input of the next stage by the secondary winding of the transformer (T_1).
- The second stage does amplification in an exactly similar manner.

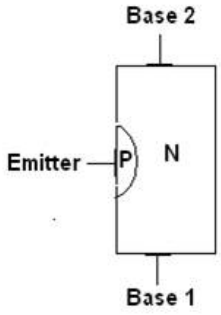
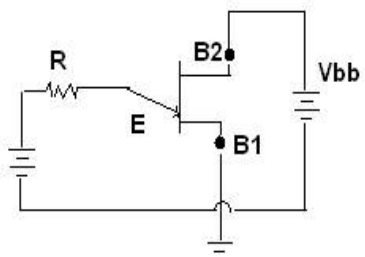
Applications: (Any two)

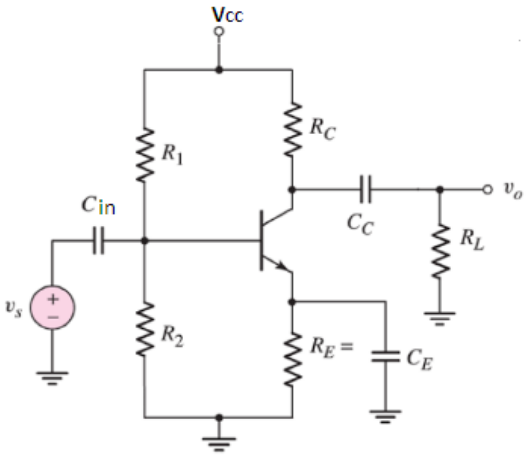
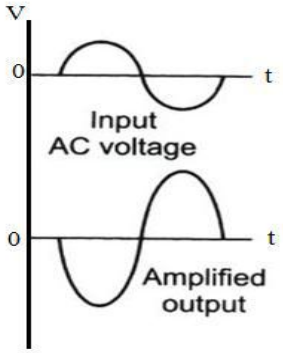
- Mostly used for impedance matching purposes.
- Used for Power amplification.
- Used in applications where maximum power transfer is needed.
- Used for amplification of radio frequency signal.

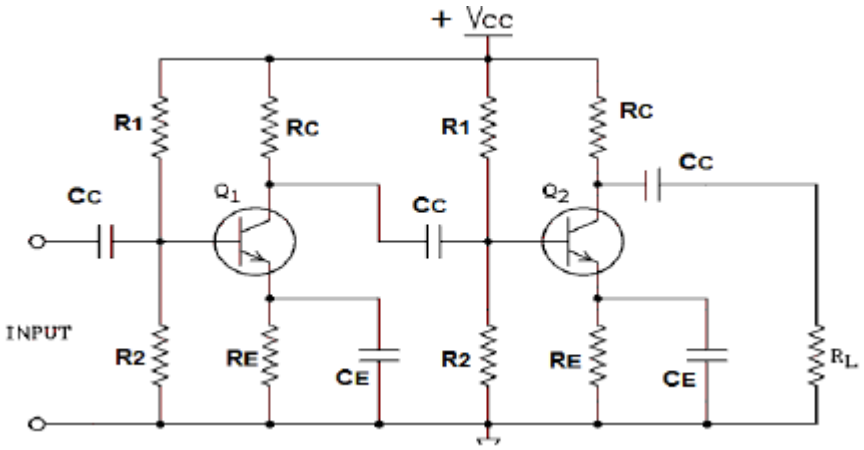
1Mark for working

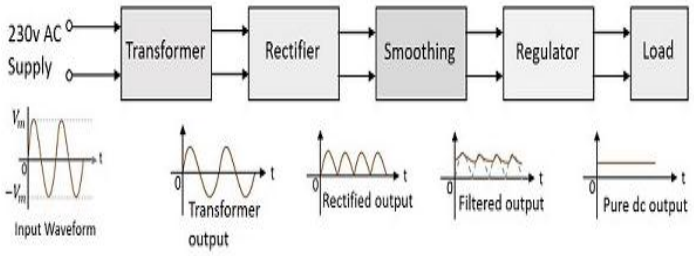
1Mark for application

Q. No.	Sub Q. N.	Answers	Marking Scheme
3		**Attempt any FOUR of the following :**	**16- Total Marks**
	(a)	**Draw construction and explain the operating principle of UJT.**	**4M**

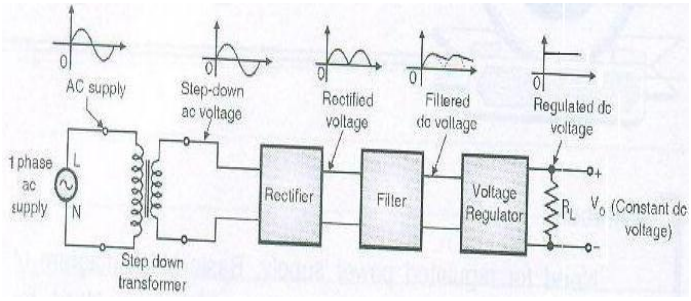
	Ans:	**Construction of a UJT:** The UJT is consist of a light doped N-Type of silicon bar, there is a heavily doped P-Type of region at one side of the N-Type of bar. The terminal which is connected to the P-Type region is called emitter terminal (E), while the other two terminals which are connected to the opposite ends of the N-Type of bar are called Base 1, Base 2 (B1, B2) as shown in the Figure below.  **Operation of a UJT:** When the voltage between the emitter and Base 1 is zero, the Uni Junction Transistor did not conduct and so the N-Type bar act as resistor. But we will see that a small leakage current flows due to reverse bias junction. Now when we increase the emitter voltage step by step, the resistance between emitter and base 1 decrease and also the reverse current decreases, when the emitter voltage is increased to the level that it forward bias the junction and the emitter current start to flow. It is so because the holes of heavily doped P-Type of region are entered in the N-Type bar and recombine with the electrons of lightly doped N-Type bar. In this way the Uni Junction Transistor starts conducting.  	**2M for construction** **2M for operation**
	(b)	**Describe the working of transistor as amplifier (CE amplifier) with graphical**	**4M**

		representation.	
	Ans:	Operation of Common Emitter Amplifier When a signal is applied across the emitter-base junction, the forward bias across this junction increases during the upper half cycle. This leads to increase the flow of electrons from the emitter to a collector through the base, hence increases the collector current. The increasing collector current makes more voltage drops across the collector load resistor RC. The negative half cycle decreases the forward bias voltage across the emitter-base junction. The decreasing collector-base voltage decreases the collector current in the whole collector resistor Rc. Thus, the amplified load resistor appears across the collector resistor. The common emitter amplifier circuit is shown below figure (a). **CE Amplifier circuit**   Fig(a) Fig(b) From the voltage waveforms for the CE circuit shown in Fig. (b) It is seen that there is an 180-degree phase shift between the input and output waveforms. *Common Emitter Amplifier Circuit Elements and their Functions:* The resistances R_1, R_2 and R_E used to form the voltage biasing and stabilisation circuit. The biasing circuit needs to establish a proper operating Q-point otherwise, a part of the negative half cycle of the signal may be cut-off in the output. **Input Capacitor (C_{in})** The capacitor C_{in} is used to couple the signal to the base terminal of the BJT. If it is not there, the signal source resistance, Rs will come across R_2 and hence, it will change the bias. C_{in} allows only the AC signal to flow but isolates the signal source from R_2	**2M for working** **2M for graphical representation**

		Emitter Bypass Capacitor (C_E) An Emitter bypass capacitor C_E is used parallel with R_E to provide a low reactance path to the amplified AC signal. If it is not used, then the amplified AC signal following through R_E will cause a voltage drop across it, thereby dropping the output voltage. **Coupling Capacitor (Cc)** The coupling capacitor Cc couples one stage of amplification to the next stage. This technique used to isolate the DC bias settings of the two coupled circuits.	
	(c)	**State the need of cascading of amplifier. Draw RC coupled cascaded amplifier.**	**4M**
	Ans:	**Need of cascading of amplifier:** Most systems a single transistor amplifier does not provide sufficient gain or bandwidth or will not have the correct input or output impedance matching .Hence cascade amplifier is used which consist more than one stages of amplification. **RC Coupled cascaded amplifier:**  	**2M for need** **2M for diagram of RC coupled cascade amplifier**
	(d)	**Draw block diagram of DC regulated power supply and explain the function of each block.**	**4M**
	Ans:	The block diagram of a Regulated Power supply unit is as shown below.	**2M for block diagram** **2M for explanat**



OR



A typical Regulated Power supply unit consists of the following.

Transformer − An input transformer for the stepping down of the 230v AC power supply.

Rectifier − A Rectifier circuit to convert the AC components present in the signal to DC components.

Smoothing − A filtering circuit to smoothen the variations present in the rectified output.

Regulator − A voltage regulator circuit in order to control the voltage to a desired output level.

Load − The load which uses the pure dc output from the regulated output.

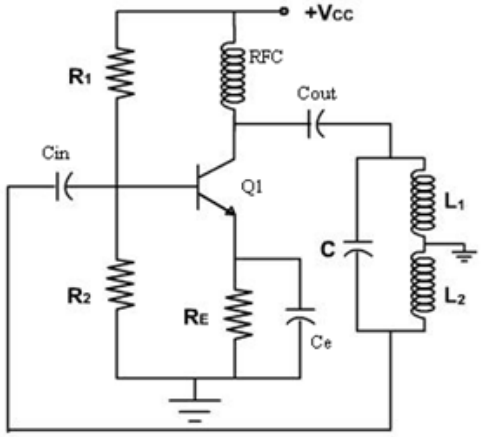
ion

(e) **Compare BJT and FET (four points)** **4M**

Ans:

BJT	FET
1.Input resistance is low	1.Input resistance is high
2.Noise is high	2.Noise is low
3.It is Bipolar	3.It is unipolar

1M each for any 4 correct comparison points

		4.size is large compare to FET	4.size is small compare to BJT
		5.Bipolar junction Transistor	5.Field effect Transistor
		6.Types:NPN,PNP	6.N channel & P channel FET
	f)	**Draw the circuit diagram of Hartley oscillator and explain its working. State the formula for frequency.**	**4M**
	Ans:	 Figure 1 Circuit Diagram of Hartley Oscillator 1. Figure 1 shows the circuit diagram for hartley's oscillator. It consist of tank circuit which is made up of two inductors connected in series and an capacitor is connected parallel to this series combination. The frequency of oscillator is determined by the value of capacitor and inductor. 2. RFC (Radio Frequency Choke) is used to prevent high frequency oscillations passing through power supply. 3. In this circuit resistor R1 and R2 provides voltage divider biasing to the transistor Q1. Cin is the input DC decoupling capacitor while Cout is the output decoupling capacitor. Re is the emitter resistor which is bypassed by capacitor Ce. The bypass capacitor is not used then AC signal will drop across RE , hence it will alter DC bias condition of transistor and reduces gain. 4. When the power supply is switched ON the transistor starts conducting and the collector current increases. As a result the capacitor C starts charging and when the capacitor C is fully charged it starts discharging through coil L1. This charging and discharging creates a series of damped oscillations in the tank circuit. 5. The oscillations produced in the tank circuit is fed back to the base of Q1 and it	**2M for diagram** **1M for explanation**

		appears in the amplified form across the collector and emitter of the transistor. 6. The output voltage of the transistor (voltage across collector and emitter) will be in phase with the voltage across inductor L1. Since the junction of two inductors is grounded, the voltage across L2 will be 180° out of phase to that of the voltage across L1. 7. The voltage across L2 is actually fed back to the base of Q1. The feedback voltage is 180° out of phase with the transistor and also the transistor itself will create another 180° phase difference. 8. So the total phase difference between input and output is 360° and this is a condition for creating sustained oscillations. 9. The frequency of oscillations of the colpitt's oscillator is given by, $$F = \frac{1}{2\pi\sqrt{LC}}$$ Where, C= Capacitance of capacitor in tank circuit L= Effective inductance of inductors of tank circuit=L1+L2. If they are wound on same core then consider the mutual inductance M, hence L=L1+L2+2M.	**1M for frequency formula**

Q. No.	Sub Q. N.	Answers	Marking Scheme
4.		**Attempt any Four of the following:**	**16- Total Marks**
	a)	**Compare positive and negative feedback. (four points)**	**4M**

Ans:

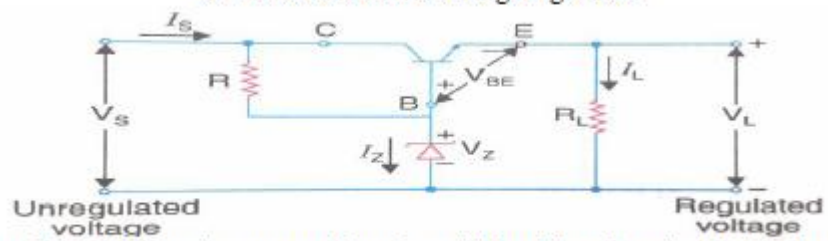
SR. NO.	PARAMETER	POSITIVE FEEDBACK	NEGATIVE FEEDBACK
1.	Overall phase shift	0° or 360°	180°
2.	Feedback and input signal	Are in phase	Are out of phase
3.	Input signal	Increases due to feedback	Decreases due to feedback
4.	Output signal	Increases due to feedback	Decreases due to feedback
5.	Gain	Increases due to feedback	Decreases due to feedback
6.	Stability	Becomes poor as feedback increases	Becomes better as feedback increases
7.	Application	Oscillators, Schmitt trigger	Amplifier, regulated power supply, bootstrapping
8.	Noise	Increases with feedback	Decreases with feedback
9.	Bandwidth	Decreases	Increases
10.	Input impedance	Decreases	Increases
11.	Output impedance	Increases	Decreases

1M each for any 4 correct comparison points

b) Draw circuit diagram of transistorized series voltage regulator and describe its working. **4M**

Ans:

Transistorized Series Voltage regulator:

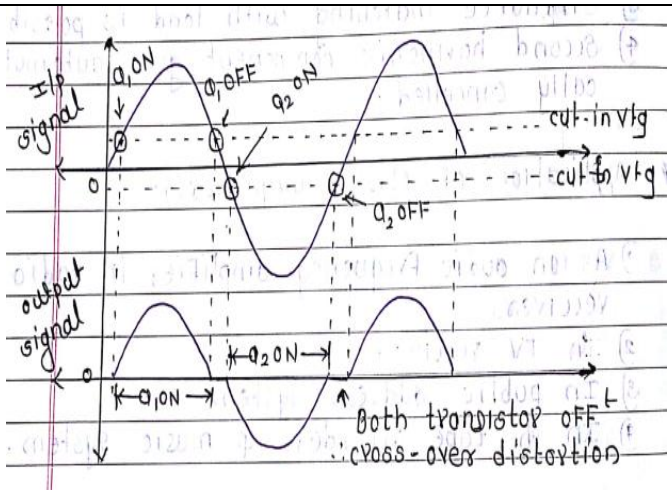


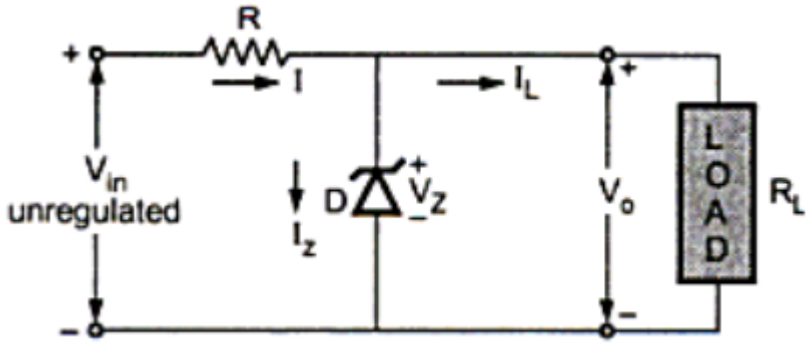
In above fig. , transistor is connected in series with load therefore the circuit is known as a series regulator.

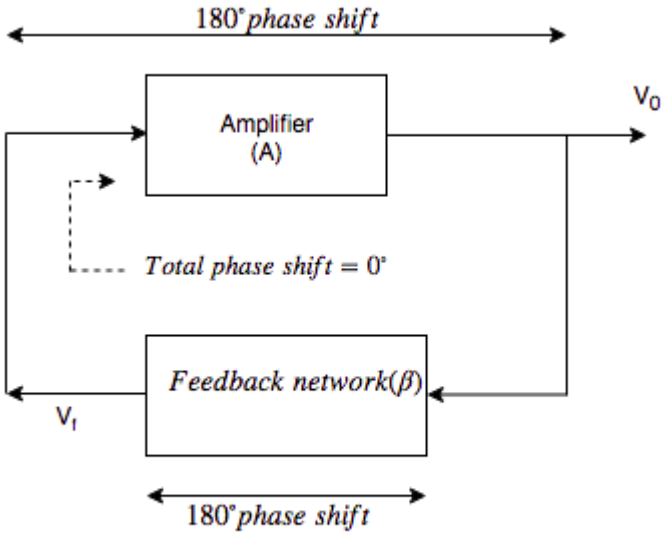
2M for diagram

		• The transistor behaves as variable resistances whose value is determined by the amount of base current. • $V_L = V_Z - V_{BE}$ OR $V_{BE} = V_Z - V_L$ **WORKING:-** • Suppose that value of load resistance is increased. Because of this, the load current decreases and load voltage (V_L) tend to increase. • From equation (1) that any increase in V_L will decrease V_{BE} because V_Z value is fixed. • As a result of this the forward bias of the transistor is reduced which reduces its level of conduction. • This increases V_{CE} of transistor which will slightly decrease the input current for the increase in the value of load resistance so that load voltage remains constant. • The output of a transistor series regulator is approximately equal to zone voltage (V_Z) • This regulator can also be used for larger load currents.	**2M for working**
	c)	**Define power amplifier. State its types. How are they classified?**	**4M**
	Ans:	**Definition of power amplifier:** A power amplifier is an amplifier, which is capable to providing a large amount of power to the load such as Loudspeaker, or motor etc. power amplifier are also known as large signal amplifiers. **Types of power amplifier:** ○ Class A ○ Class B ○ Class C ○ Class AB **Classification is based on frequencies** • Audio power amplifier • Radio power amplifier **Classification is based on mode of operation** ○ Class A ○ Class B ○ Class C ○ Class AB	**2M for definition** **2M for types and classification**
	d)	**(i) State need of Heat sink in power amplifier.**	**4M**

		(ii) Describe the concept of crossover distortion.	
	Ans:	**(i)Need of Heat Sink in power amplifier:** • Heat sinks are used with high-power semiconductor devices such as power transistors and opto-electronics such as lasers and light emitting diodes (LEDs), where the heat dissipation ability of the component itself is insufficient to moderate its temperature. • In case of transistor or power transistors if the temperature of collector base junction increases due to increase in temperature, the collector leakage current increases. Due to this the collector current increases. • The increase in collector current produces an increase in the power dissipated at the collector junction. This, in turn, further increases the temperature of the junction and so gives further increase in collector current. The process is cumulative. This action of increase in current and further increase in temperature eventually destroys the transistor. This is known as thermal runaway. • To prevent thermal runaway, the power handling capacity can be increased if suitable provision for rapid conduction of heat away from junction. This is achieved by using Heat Sink. **(ii) Concept of cross-over distortion:** 1. In class B amplifiers, the transistors are biased at cut off. 2. These transistor can enter the active region if and only if their base emitter junction is forward biased. 3. To forward bias these junctions the input voltage must be greater than the cut in voltage of the junction. The cut in voltage is 0.2V for Ge and 0.7V for the Si transistor. 4. Thus as long as the input voltage is less than the cut in voltage, the transistors will remain in the off state and the output will be zero as shown in figure. 5. The output signal gets distorted near the zero crossings. Therefore this distortion is called as the "cross over distortion".	**2M for need of heat sink in power amplifier** **2M for concept of crossover distortion**



	e)	**Describe the working of zener diode as voltage regulator and explain its working.**	**4M**
	Ans:	• Voltage regulators are used to achieve constant output voltage. • Voltage across the Zener diode remains constant equal to Vz (Zener breakdown voltage) when it is reverse biased and operated in zener region of the reverse characteristics. • This characteristic of zener diode is used for voltage regulation. • Following diagram shows the regulator circuit using Zener diode.  • Vin is the unregulated input dc voltage, R is the resistor used for current limiting and RL is the load resistor. • Since Zener diode is shunted across the load resistor it is called as Zener Shunt Regulator.	**2M for diagram** **2M for explanation**

		• The input voltage should always be higher than the breakdown voltage. When $V_{in} > V_Z$ and $I_{Z(MIN)} < I_z < I_{Z(MAX)}$ constant voltage is obtained across the zener diode equal to the breakdown voltage V_Z which is the regulated output voltage.	
	f)	**Define oscillator. Draw block diagram of oscillator and explain its working.**	**4M**
	Ans:	An oscillator is a electronic circuit that produces periodic waveform of desired frequency with only dc supply voltage as an input that is without any ac input signal The block diagram of oscillator is shown in following figure.  Block diagram of oscillator • An oscillator consists of an amplifier with gain A & feedback network with gain β. • Feedback network is basically phase shifting network. • Amplifier receives the output of phase shifting network. The amplifier then amplifies it add 180° phase shift. • This phase shifted o/p of amplifier is applied to the input of feedback(phase shifting network). Feedback networks shift the amplifier o/p through 180°. • Thus, due to total 360° phase shift, the feedback becomes a positive feedback. This gives rise to the oscillations, if the Barkhausen criterion is satisfied.	**2M for definition** **2M for block diagram of oscillator and working**

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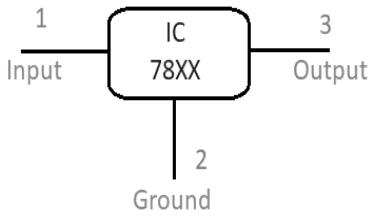
Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any FOUR of the following :**	**16- Total Marks**
Q. No.	Sub Q. N.	Answers	Marking Scheme
	a)	**Draw the functional pin diagram of IC 78XX and state the function of each pin. Draw +5V regulator using 7805 IC.**	**4M**
	Ans:	**Functional pin diagram of IC 78XX:-** 	**1M**
		Function of each pin of 78XX:-	**1M**
		Pin No. 1:- In this pin of the IC positive unregulated voltage is given in regulation.	
		Pin No. 2:- In this pin where the ground is given. This pin is neutral for equally the input and output.	
		Pin No.3:- The output of the regulated voltage is taken out at this pin of the IC regulator.	
		+5V regulator using 7805 IC:-	

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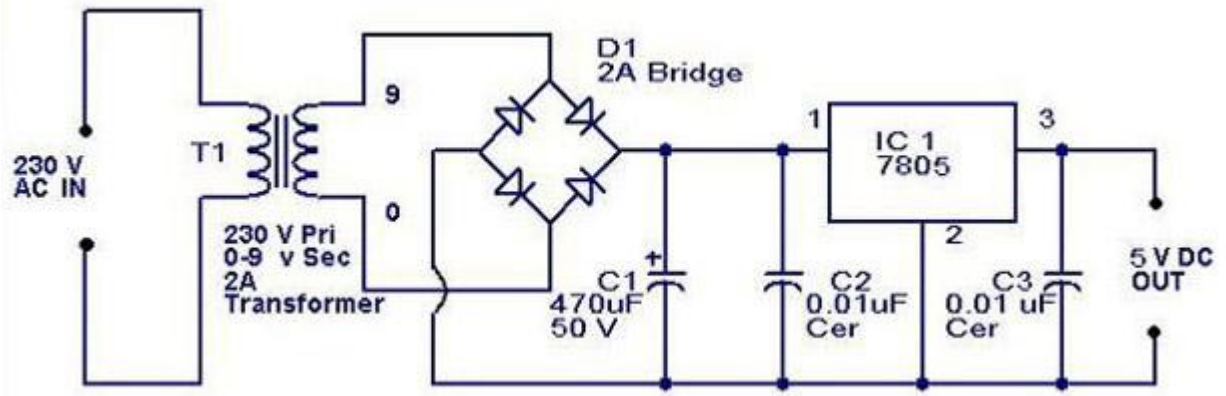

2M

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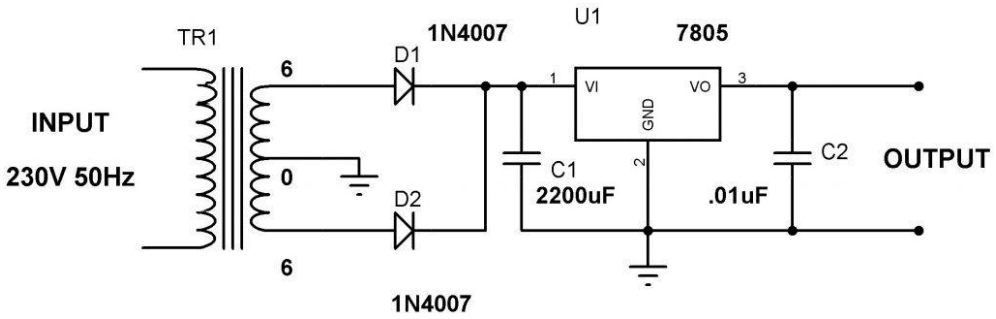

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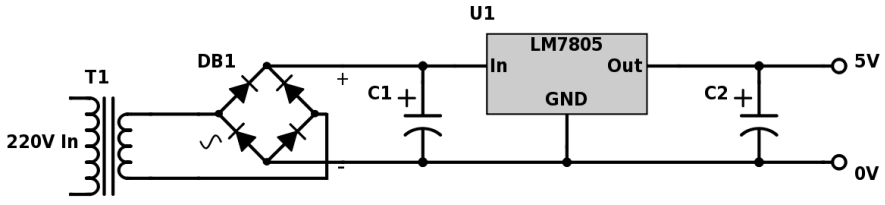
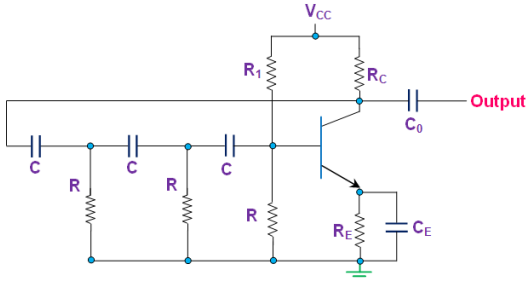
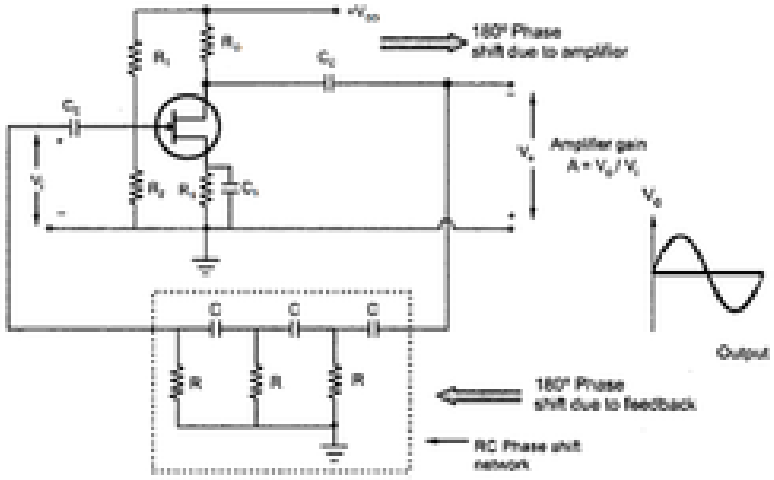
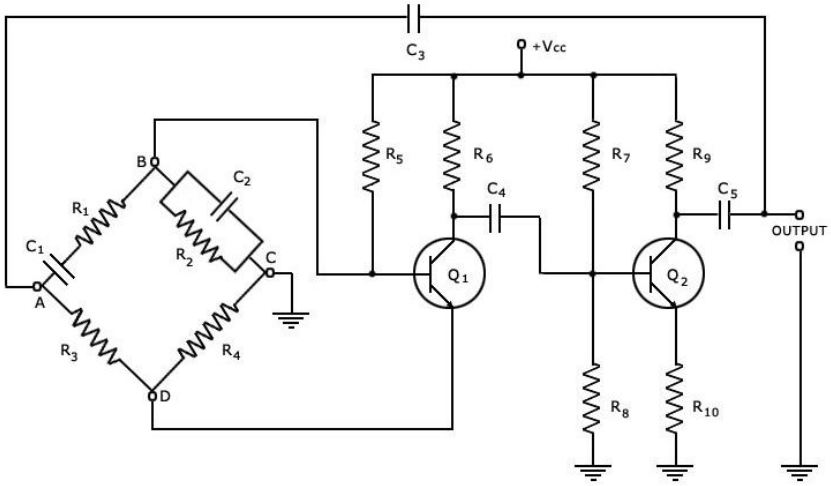
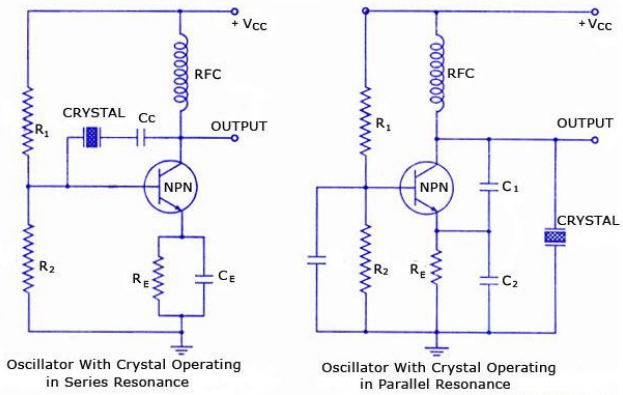
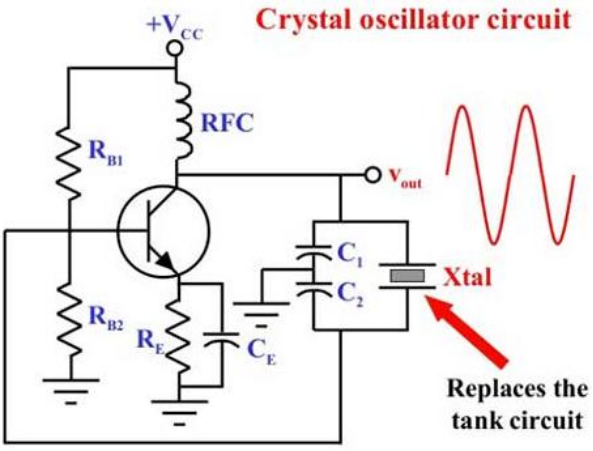
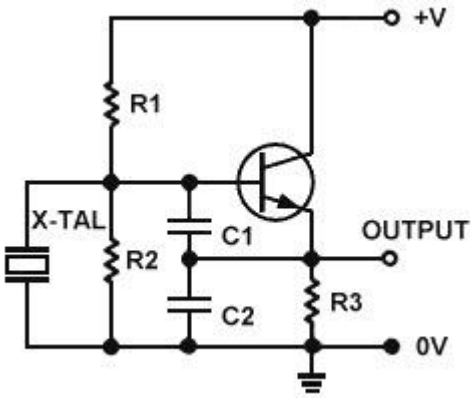
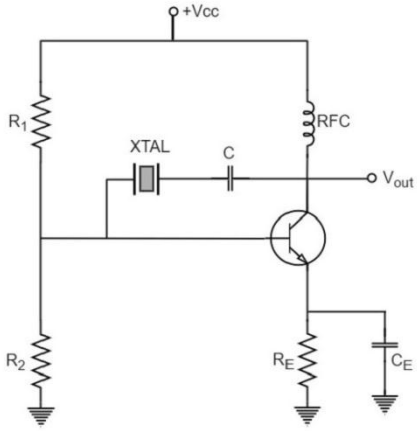


	b)	**(i) Define regulator. State its need.** **(ii) Draw neat labeled diagram of RC oscillator.**	**4M**
	Ans:	**Regulator**: - It is the circuit which keeps the output voltage constant irrespective of change in line voltage and load voltage.	**1Mark**

		OR The voltage regulator is a circuit which maintain a constant DC voltage at the output irrespective of voltage fluctuations at the input and (or) variations in the load current. In other words, voltage regulator produces a regulated DC output voltage. **Need of Regulator: -** The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage **Diagram of RC oscillator:-**  **OR**  **OR**	**for definition** **1Mark for Need of Regulator** **2Marks for Diagram**



	c)	**(i) Explain Barkhausen's criterion.** **(ii) Draw neat labeled diagram of crystal oscillator.**	**4M**
	Ans:	**Barkhausen's criterion:-** The Barkhausen's criterion for the generation of sustained oscillations. for positive feedback are: 1. β A = 1 2. Total phase shift should be 360° or 0° Where, A_V = gain of an amplifier without feedback also called open loop gain β A_V = product of feedback fraction and open loop gain. It is called loop gain. **Diagram of crystal oscillator:-**  Oscillator With Crystal Operating in Series Resonance Oscillator With Crystal Operating in Parallel Resonance	**2M** **2M**

		OR  **OR**  **OR**  	
	d)	**Compare CE, CB and CC configuration. (four points)**	**4M**

Ans:

Sr. No.	Characteristics	CE configuration	CB configuration	CC configuration
1	Input resistance	Low (50 Ω)	Very Low (40 Ω)	Very High (750K)
2	Output resistance	High (10KΩ)	Very High (1MΩ)	Low (50 Ω)
3	Current Gain	High(100)	Less than unity	High(100)
4	Voltage Gain	High(500)	Small (150)	Less than unity
5	Phase shift between i/p and o/p	180 degree	0 degree	0 degree

Any 4 relevant points

1M each

e) Draw and explain input characteristics of CE configuration. **4M**

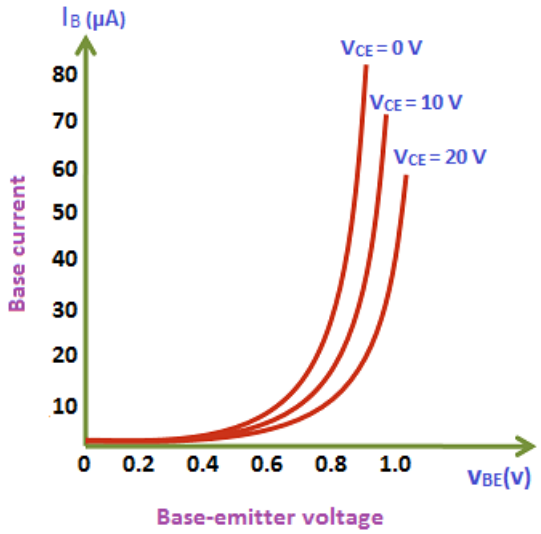
Ans:

Input Characteristics of CE configuration:-

In Common Emitter (CE) configuration, the emitter is the common terminal. Hence, the input is between the base and the emitter while the output is between the collector and the emitter.

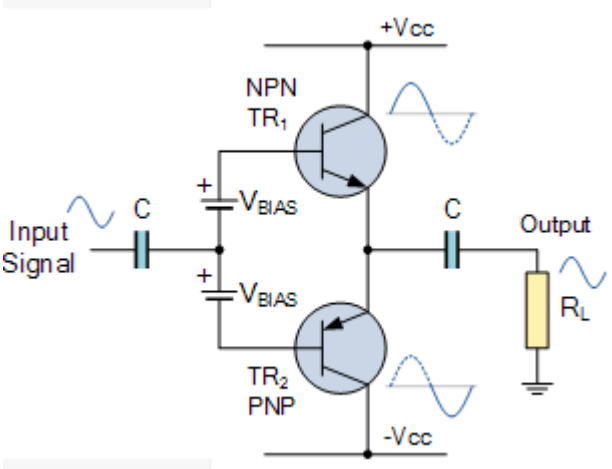
Input characteristic –

- The input characteristics describe the relationship between input current or base current (I_B) and input voltage or base-emitter voltage (V_{BE}).
- To determine the input characteristics, the output voltage V_{CE} is kept constant at zero volts and the input voltage V_{BE} is increased from zero volts to different voltage levels. For each voltage level of input voltage (V_{BE}), the corresponding input current (I_B) is recorded.
- The output voltage (V_{CE}) is increased from zero volts to certain voltage level (10 volts) and the output voltage (V_{CE}) is kept constant at 10 volts. While increasing the output voltage (V_{CE}), the input voltage (V_{BE}) is kept constant at zero volts.
- The output voltage (V_{CE}) constant at 10 volts, the input voltage V_{BE} is increased from zero volts to different voltage levels. For each voltage level of input voltage (V_{BE}), the corresponding input current (I_B) is recorded.
- This process is repeated for higher fixed values of output voltage (V_{CE})
- When output voltage (V_{CE}) is at zero volts and emitter-base junction is forward biased by input voltage (V_{BE}), the emitter-base junction acts like a normal p-n junction diode. So the input characteristic of the CE configuration is same as the characteristics of a normal PN junction diode.
- **Input Characteristics:** To obtain input resistance find ΔV_{BE} and ΔI_B for a constant $\mathbf{V_{CE}}$ on

		one of the input characteristics. Input impedance = $h_{ie} = R_i = \Delta V_{BE} / \Delta I_B$ (V_{CE} is constant) Reverse voltage gain = $h_{re} = \Delta V_{EB} / \Delta V_{CE}$ (I_B = constant)  I/P characteristics CE configuration	
	f)	**Draw the circuit diagram of class AB power amplifier and describe its working.**	**4M**
	Ans:	**(Note: - Any other Equivalent circuit of class AB power amplifier marks can be given.)** **Class AB power amplifier:-** • Class AB is a combination of class A and class B type of amplifiers. As class A has the problem of low efficiency and class B has distortion problem, this class AB is emerged to eliminate these two problems, by utilizing the advantages of both the classes. • The cross over distortion is the problem that occurs when both the transistors are OFF at	**2M**

the same instant, during the transition period.

- In order to eliminate this, the condition has to be chosen for more than one half cycle. Hence, the other transistor gets into conduction, before the operating transistor switches to cut off state. This is achieved only by using class AB configuration, as shown in the following circuit diagram.
- The conduction angle of class AB amplifier is somewhere between 180^{o} to 360^{o} depending upon the operating point selected.
- Here the biasing of the transistors is achieved by using a suitable fixed bias voltage applied the bases of TR1 and TR2.
- When the input signal goes positive, the voltage at the base of TR1 increases producing a positive output of a similar amount which increases the collector current flowing through TR1 sourcing current to the load, R_L. However, because the voltage between the two bases is fixed and constant, any increase in the conduction of TR1 will cause an equal and opposite decrease in the conduction of TR2 during the positive half cycle.
- As a result, transistor TR2 eventually turns off leaving the forward biased transistor, TR1 to supply all the current gain to the load. Likewise, for the negative half of the input voltage the opposite occurs. That is, TR2 conducts sinking the load current while TR1 turns off as the input signal becomes more negative.
- Then we can see that when the input voltage, V_{IN} is zero, both transistors are slightly conducting due to their voltage biasing, but as the input voltage becomes more positive or negative, one of the two transistors conducts more either sinking of sourcing the load current. As the switching between the two transistors occurs nearly instantly and is a smooth one, the crossover distortion which affects the Class B configuration is greatly reduced.



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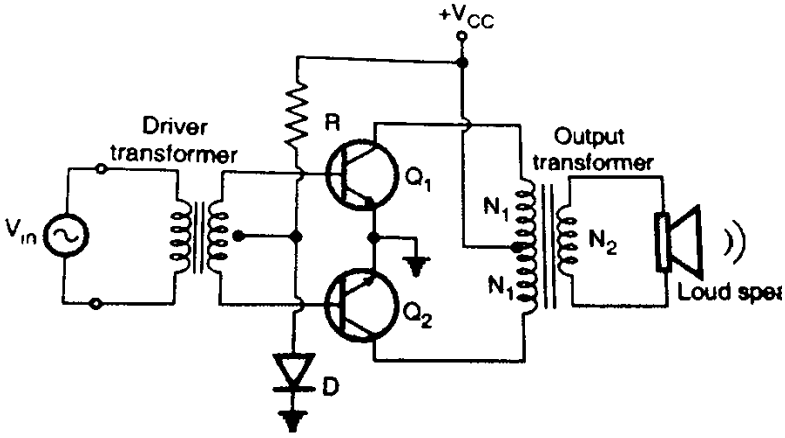
OR



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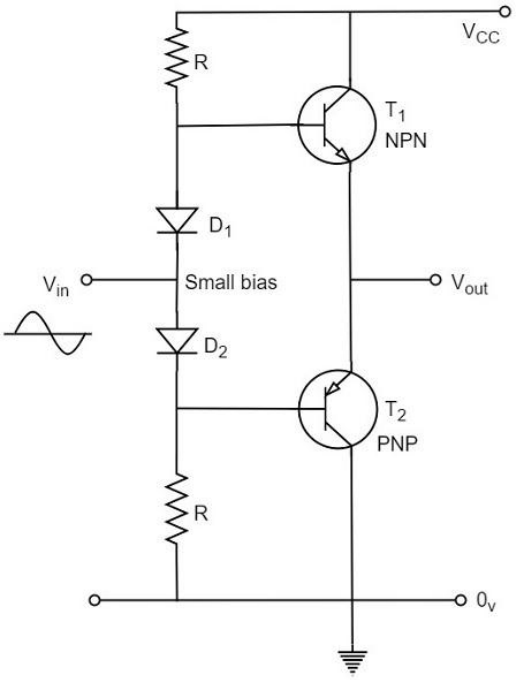

Q. No.	Sub Q. N.	Answers	Marking Scheme

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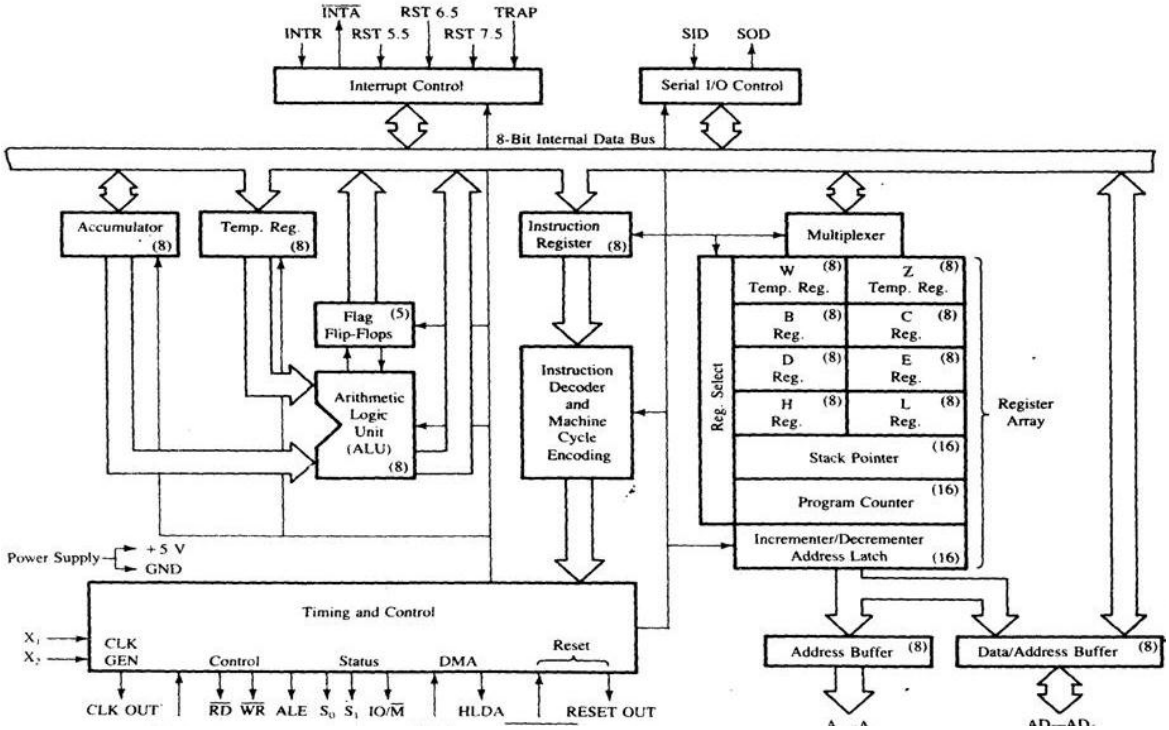
Model Answer

6.		**Attempt any FOUR of the following :**	**16- Total Marks**
Q. No.	Sub Q. N.	Answers	Marking Scheme
	a)	**Draw and explain the block diagram of Microprocessor.**	**4M**
	Ans:	**Block diagram of Microprocessor:-** 	**2M**
		Explanation:- **ALU:-** The ALU performs the actual numerical and logic operation such as 'add', 'subtract', 'AND', 'OR' etc. Uses data from memory and from Accumulator to perform arithmetic operation and always stores result of operation in Accumulator. The ALU consists of accumulator, flag register and temporary register. **Accumulator: -** The accumulator is an 8-bit register that is a part of arithmetic/logic unit (ALU). This register is used to store 8-bit data and to perform arithmetic and logical operations. The result of an operation is stored in the accumulator. The accumulator is also	**2M**

identified as register A.

Flag register: - 8085 has 8-bit flag register. There are only 5 active flags.

S	Z		AC		P		CY

8085 flag register

Flags are flip-flops which are used to indicate the status of the accumulator and other register after the completion of operation.

These flip-flops are set or reset according to the data condition of the result in the accumulator and other registers.

Timing and control unit:-

This unit produces all the timing and control signal for all the operation. This unit synchronizes all the MP operations with the clock and generates the control signals necessary for communication between the MP and peripherals.

Instruction register and decoder:-

The instruction register and decoder are part of ALU. When an instruction is fetched from memory, it is loaded in the instruction register. The decoder decodes the instruction and establishes the sequence of events to follow. The IR is not programmable and cannot be accessed through any instruction.

Register array:-

The register unit of 8085 consists of

-Six general-purpose data registers B,C,D,E,H,L
-Two internal registers W and Z
-Two 16-bit address registers PC (program counter) and SP (stack pointer)
-One increment/decrement counter register
-And, one multiplexer (MUX)

The six general-purpose registers are used to store 8-bit data. They can be combined as register pairs BC, DE, and HL to perform some 16-bit operations.

The two internal registers W and Z are used to hold 8-bit data during the execution of some instructions, CALL and XCHG instructions.

SP is 16-bit registers used to point the address of data stored in the stack memory. It always indicates the top of the stack.

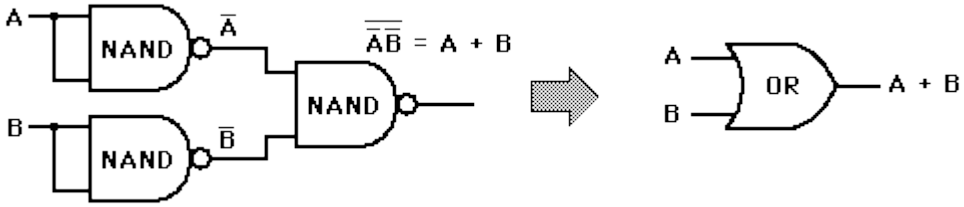
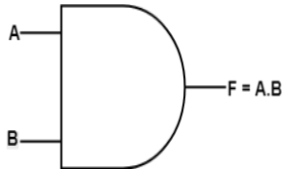
PC is 16-bit register used to point the address of the next instruction to be fetched and executed stored in the memory.

System bus:-

Data bus carries 'data', in binary form, between MP and other external units, such as memory. Typical size is 8 or 16 bits.

Address bus carries 'address' of operand in binary form. Typical size is 16-bit.

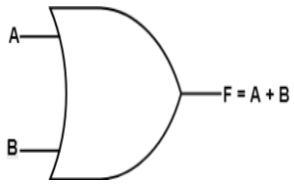
Control Bus is various lines which have specific functions for coordinating and controlling MP

		operations. E.g. Read/Write control line. **Interrupt Control:-** Interrupt is a signal, which suspends the routine what the MP is doing, brings the control to perform the subroutine, completes it and returns to main routine. May be hardware or software interrupts. Some interrupts may be ignored (maskable), some cannot (non-maskable). E.g. INTR, TRAP, RST 7.5, RST 6.5, RST 5.5 **Serial I/O Control:-** The MP performs serial data input or output (one bit at a time). In serial transmission, data bits are sent over a single line, one bit at a time. The 8085 has two signals to implement the serial transmission: SID (serial input data) and SOD (serial output data).	
	b)	**What are universal Gates? Implement OR gates using NAND only.**	**4M**
	Ans:	**Universal Gates:-** A universal gate is a gate which can implement any Boolean function without need to use any other gate type. The NAND and NOR gates are universal gates. **Implementation of OR gates using NAND:-** 	**2M** **2M**
	c)	**Draw symbol, truth table and state its logic expressions for the following gates:** **(i) AND gate** **(ii) OR gate**	**4M**
	Ans:	**(i) AND gate:-** 	**2M each**

Truth table of AND Gate:-

Input		Output
A	B	F = A.B
0	0	0
0	1	0
1	0	0
1	1	1

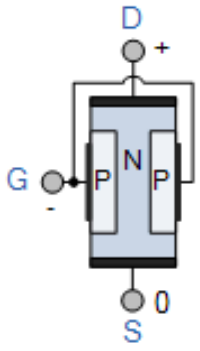
(ii) OR gate

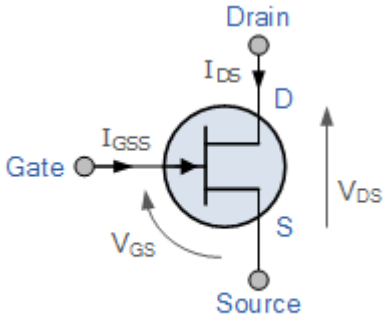


Truth table of OR Gate:-

Input		Output
A	B	F = A+B
0	0	0
0	1	1
1	0	1
1	1	1

d)	**Explain the construction and working principle of N-Channel FET.**	**4M**
Ans:	**Construction of N-Channel FET:-**	**2M**





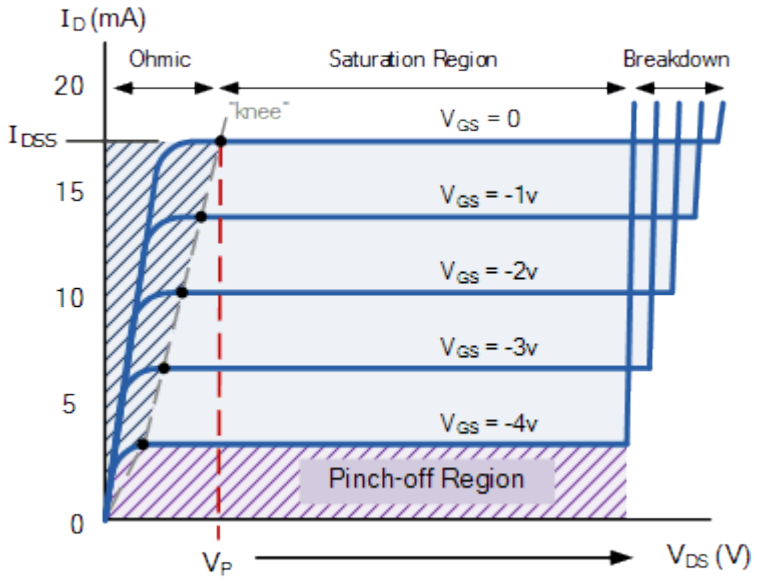
N-channel JFET

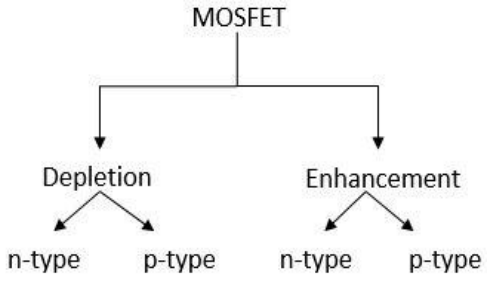
- The N-channel JFET's channel is doped with donor impurities meaning that the flow of current through the channel is negative (hence the term N-channel) in the form of electrons.
- N-channel JFET's have a greater channel conductivity (lower resistance) than their equivalent P-channel types, since electrons have a higher mobility through a conductor compared to holes.

2M

Working principle:-

- N-type semiconductor channel with a P-type region called the Gate diffused into the N-type channel forming a reverse biased PN-junction and it is this junction which forms the *depletion region* around the Gate area when no external voltages are applied. JFETs are therefore known as depletion mode devices.
- These depletion regions produces a potential gradient which is of varying thickness around the PN-junction and restrict the current flow through the channel by reducing its effective width and thus increasing the overall resistance of the channel itself.
- There is most-depleted portion of the depletion region is in between the Gate and the Drain, while the least-depleted area is between the Gate and the Source. Then the JFET's channel conducts with zero bias voltage applied (i.e. the depletion region has near zero width).
- With no external Gate voltage ($V_G = 0$), and a small voltage (V_{DS}) applied between the Drain and the Source, maximum saturation current (I_{DSS}) will flow through the channel from the Drain to the Source restricted only by the small depletion region around the junctions.
- If a small negative voltage ($-V_{GS}$) is now applied to the Gate the size of the depletion region begins to increase reducing the overall effective area of the channel and thus reducing the current flowing through it, a sort of "squeezing" effect takes place. So by applying a reverse bias voltage increases the width of the depletion region which in turn

		reduces the conduction of the channel. • Since the PN-junction is reverse biased, little current will flow into the gate connection. As the Gate voltage ($-V_{GS}$) is made more negative, the width of the channel decreases until no more current flows between the Drain and the Source and the FET is said to be "pinched-off" (similar to the cut-off region for a BJT). The voltage at which the channel closes is called the "pinch-off voltage", (V_P).	
	e)	**Draw and explain the output characteristics of JFET.**	**4M**
	Ans:	**Output characteristics of JFET:-**  **Explanation:-** • The voltage V_{GS} applied to the Gate controls the current flowing between the Drain and the Source terminals. V_{GS} refers to the voltage applied between the Gate and the Source while V_{DS} refers to the voltage applied between the Drain and the Source. • Because a **Junction Field Effect Transistor** is a voltage controlled device, "NO current flows into the gate" then the Source current (I_S) flowing out of the device equals the Drain current flowing into it and therefore ($I_D = I_S$). The characteristics curves example shown above, shows the four different regions of operation for a JFET and these are given as: • Ohmic Region – When V_{GS} = 0 the depletion layer of the channel is very small and the JFET acts like a voltage controlled resistor.	**2M** **2M**

		• Cut-off Region – This is also known as the pinch-off region were the Gate voltage, V_{GS} is sufficient to cause the JFET to act as an open circuit as the channel resistance is at maximum. • Saturation or Active Region – The JFET becomes a good conductor and is controlled by the Gate-Source voltage, (V_{GS}) while the Drain-Source voltage, (V_{DS}) has little or no effect. • Breakdown Region – The voltage between the Drain and the Source, (V_{DS}) is high enough to causes the JFET's resistive channel to break down and pass uncontrolled maximum current.	
	f)	**(i) What is MOSFET? State its types.** **(ii) State applications of FET and MOSFET.**	**4M**
	Ans:	• The MOSFET (Metal Oxide Semiconductor Field Effect Transistor) transistor is a semiconductor device which is widely used for switching and amplifying electronic signals in the electronic devices. • The MOSFET is a four terminal device with source(S), gate (G), drain (D) and body (B) terminals. The body of the MOSFET is frequently connected to the source terminal so making it a three terminal device like field effect transistor. The MOSFET is very far the most common transistor and can be used in both analog and digital circuits. **Types of MOSFET:-**  **Applications of FET:- (Any 2)** 1. Field effects transistors (FETs) are used in mixer circuits to control low inter modulation distortions. 2. FETs are used in low frequency amplifiers due to its small coupling capacitors. 3. It is a voltage controlled device due to this it is used in operational amplifier as voltage	**1M** **1M**

		variable resistors. 4. It is commonly used as input amplifiers in devices i.e. voltmeters, oscilloscopes, and other measuring devices, due to their high input Impedance. 5. It is also used in radio frequency amplifiers for FM devices. 6. It is used for mixer operation of FM and TV receiver. 7. It is used in large scale integration (LSI) and computer memories because of its small size. **Applications of MOSFET:- (Any 2)** 1. MOSFET is used for switching and amplifying electronic signals in the electronic devices. 2. It is used as an inverter. 3. It can be used in digital circuit. 4. It can be used as a high frequency amplifier. 5. It can be used as a passive element e.g. resistor, capacitor and inductor. 6. It can be used in electronic DC relay. 7. MOSFET amplifiers are extensively used in radio frequency applications. 8. High switching speed of MOSFETs makes it an ideal choice in designing chopper circuits. 9. DC motors can be regulated by power MOSFETs.	**½ M each** **½ M each**