WINTER– 17 EXAMINATION

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

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent Concept

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any TEN**	**20M**
	a	**Give two points of comparison of active and passive components.**	**2M**
	Ans:	**Comparison between active and passive components.**	**Any two points** **1 mark each**

Sr. No.	Active Components	Passive Components
1.	The electrical components which are capable of amplifying or processing electrical signals are called active components.	The electrical components which are not capable of amplifying or processing electrical signals are called active components.
2.	Example: Diode, Transistor etc.	Example: Inductor, Capacitor, Resistor etc.
3.	Active components can introduce gain.	Passive components cannot introduce gain.

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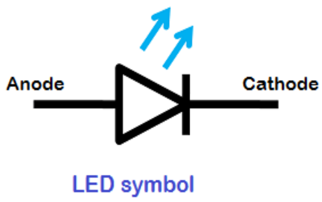
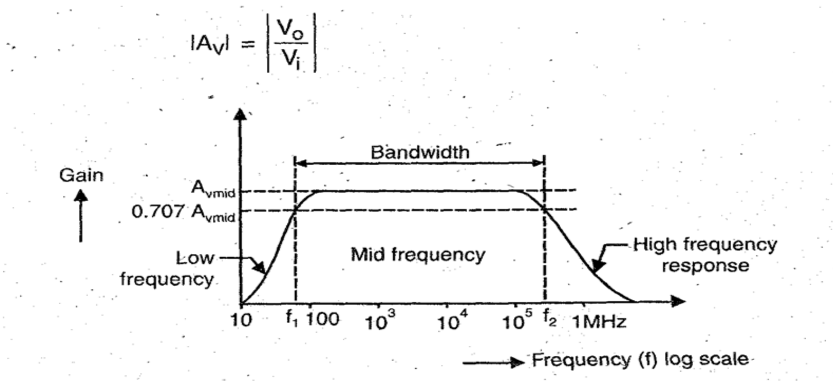
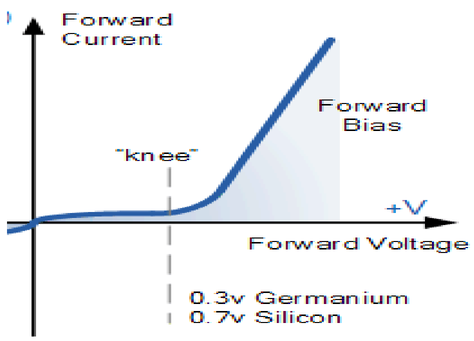
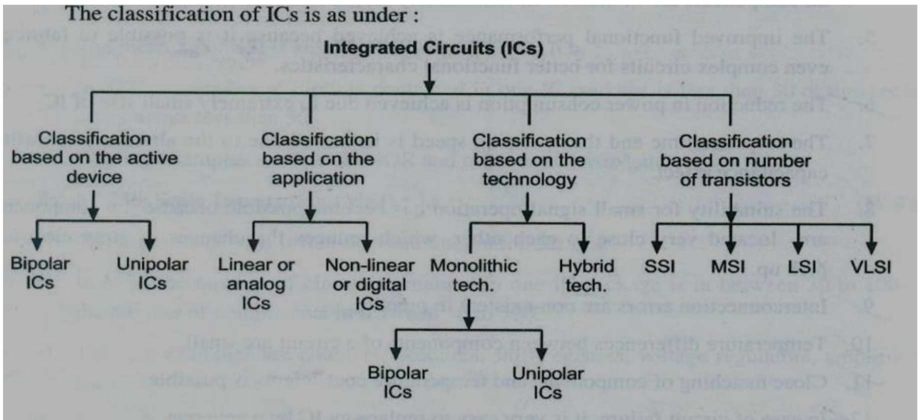
	b	**Draw symbol of P- channel and N-channel JFET.**	**2M**
	Ans:	**Symbol of P- channel and N-channel JFET:** 	**Each correct symbol 1M**
	c	**Define LED. Draw its symbol.**	**2M**
	Ans:	**LED:(Light Emitting Diode):** An **LED** is an electronic device that emits light when an electrical current is passed through it. 	**Definition 1M** **Symbol 1M**
	d	**State any two Advantages of IC's.**	**2M**
	Ans:	**Advantages of IC's:** 1. The physical size of an IC is extremely small (generally thousand times smaller) than that of discrete circuits. 2.The weight of an IC is very less as compared to that of equivalent discrete circuits.	**Any two points** **Each 1 mark**

		3. The reduction in power consumption is achieved due to extremely small size of IC. 4. Interconnection errors are non-existent in practice. 5. Temperature differences between components of a circuit are small. 6. Close matching of components and temperature coefficients is possible. 7. In case of circuit failure, it is very easy to replace an IC by a new one. 8. Active devices can be generously used as they are cheaper than passive components.	
	e	**Define Knee voltage of PN junction diode. Give its value for Si and Ge diode.**	**2M**
	Ans:	**Knee voltage:** The voltage at which the forward diode current starts increasing rapidly is known as the **knee voltage or cut in voltage** of a diode. The cut in voltage is very close to the barrier potential. The cut in voltage for a silicon diode is **0.6V to 0.7 V** and that for a germanium diode is **0.2V to 0.3 V.**	**Definition 1 M** **Correct Values Each ½ M**
	f	**Draw the Frequency response of an amplifier and define Bandwidth.**	**2M**
	Ans:	**Frequency response of an amplifier:** 	**1M** **1M**

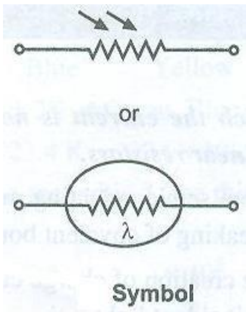
		Bandwidth : The range of frequency over which the voltage gain of an amplifier is greater than or equal to 70.7% of maximum value is known as bandwidth of the amplifier.	
	g	**Give the value of maximum rectifier efficiency in half wave and full wave rectifier.**	**2M**
	Ans:	Value of maximum rectifier efficiency in half wave rectifier is **40.6%** Value of maximum rectifier efficiency in full wave rectifier is **81.2%**	**1M each**
	h	**Define Drain Resistance and Trans - Conductance of JFET.**	**2M**
	Ans:	**Drain Resistance of JFET:** It is defined as the ratio of 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}. **Trans-conductance:** Trans-conductance 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}.	
	i	**Draw V-I characteristics of PN junction diode under forward bias. Label it.**	**2M**
	Ans:	**V-I characteristics of PN junction diode under forward bias:**  	**Neat labeled diagram-** **2 marks**
	j	**Give classification of IC's.**	**2M**
	Ans:	**Classification of IC's:**	

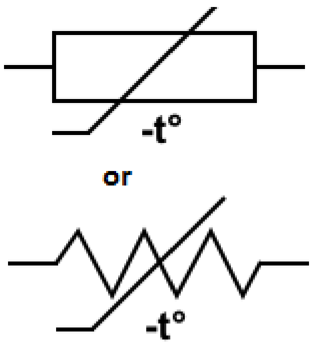
		 Classification of integrated circuits (ICs)	2M
	k	**Give two points of distinction between Zener breakdown and avalanche breakdown.**	2M
	Ans:	**Distinction between zener breakdown and avalanche breakdown:**	**Any two points** **1 mark each**

Sr no.	Zener breakdown	Avalanche breakdown
1	This occurs at junctions which being heavily doped have narrow depletion layers.	This occurs at junctions which being lightly doped have wide depletion layers.
2	This breakdown voltage sets a very strong electric field across this narrow layer.	Here electric field is not enough to produce breakdown.
3	Here electric field is very strong to break covalent bonds thereby generating electron hole pairs, so even a small increase in	Here minority carriers collide with semiconductor atoms in the depletion region, which breaks the covalent bonds and electron hole pairs are generated. Newly

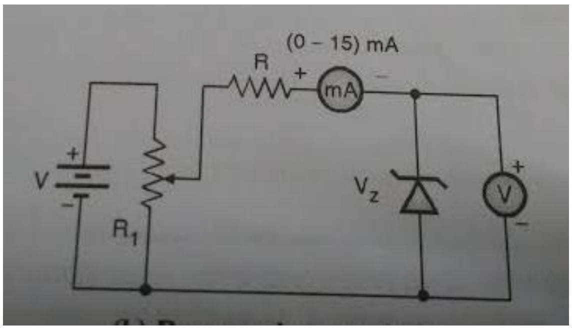
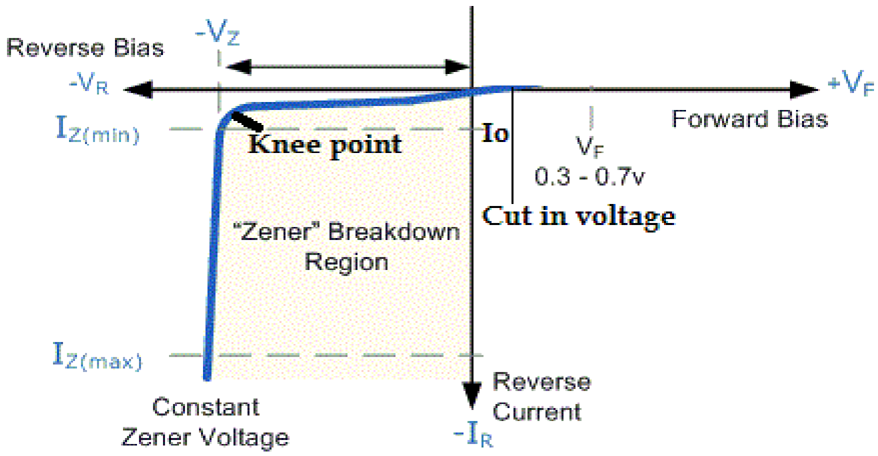
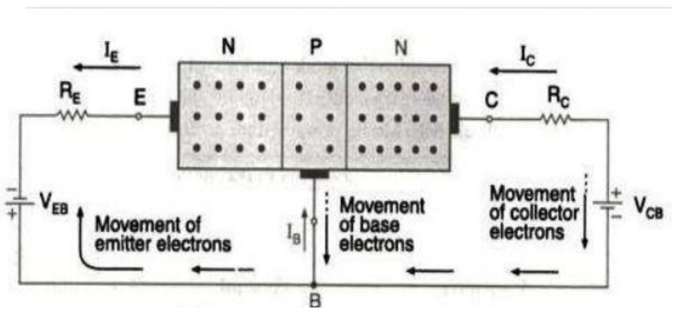
		reverse voltage is capable of producing large number of current carriers that is why junction has very low resistance. This leads to zener breakdown.	generated charge carriers are accelerated by the electric field which results in more collision and generated avalanche of charge carriers. This results in avalanche breakdown.	
		4	When Zener breakdown takes place, the junction is not destroyed.	When avalanche breakdown takes place, the junction is destroyed.
		5	It takes place at comparatively low voltage.	Takes place at high reverse voltage.

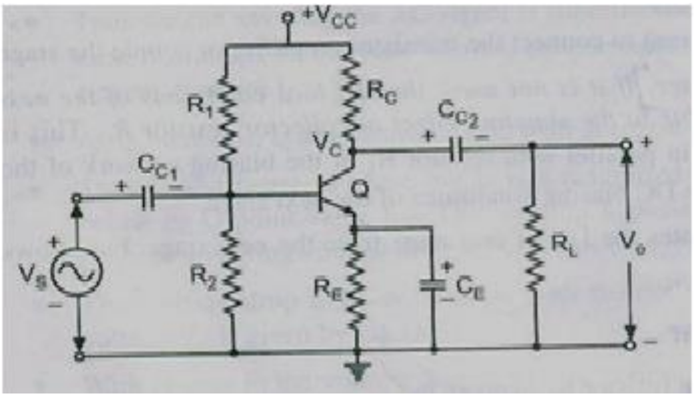
	l	**Draw the symbol of LDR and Thermistor .**	**2M**
	Ans:	**Symbol of LDR:** **Symbol of Thermistor**	**2M**





No.	Sub. Q. No.	Answer	Marking Scheme
2		**Attempt any FOUR**	**16 M**
	a)	**Give any four applications of electronics.**	**4 M**
	Ans:	**Applications of electronics in various fields are as follows:** **1. Communication and Entertainment:** a) Wire communication or Line communication. : Telegraphy, Telephony, Telex and Teleprinter. b) Wireless communication : Radio broadcasting, TV broadcasting, and Satellite communication. **2. Defence:** RADAR, guided missiles. **3. Industrial Applications:** Electronic circuits are used : To control thickness, quality, weight and moisture. To Amplify weak signals. For Automatic control of various processes. **4. Medical Sciences:** In medical equipment like ECG, EMG, EEG , X-rays, Short-wave diathermy units, etc. **5. Instrumentation:** In equipment like Cathode Ray Oscilloscope (CRO), Frequency counter, Signal generator, strain gauges,etc.	**Any four points each 1 mark**
	b)	**Draw the experimental set up for obtaining reverse characteristics of zener diode. Draw the VI characteristics for the same.**	**4 M**
	Ans:	**Experimental set up for obtaining reverse characteristics of Zener diode:**	

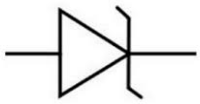
		 **Reverse characteristics of zener diode:** 	**Set up** **2 marks** **Reverse chara-cteristics** **2 marks**
	c)	**With suitable diagram, explain the working of NPN transistor.**	**4 M**
	Ans:	**Circuit diagram:** 	**Diagram** **2 marks**

<table>
<tr><td></td><td></td><td>Working:
The figure above shows an NPN transistor whose emitter base junction is forward biased and collector-base junction is reverse biased. The forward bias causes the electrons in the N type emitter to flow towards the base. This constitutes emitter current I_E.As these electrons flow through the P type material, they tend to combine with holes. The base is lightly doped and very thin, so very few electrons (2%) combine with holes to constitute the base current I_B. The remaining electrons (98%) cross over to the collector region to constitute the collector current I_C. In this way almost entire emitter current flows into the collector circuit.
We have $I_E = I_B + I_C$</td><td>Working 2 marks</td></tr>
<tr><td></td><td>d)</td><td>Draw the circuit diagram of RC coupled CE amplifier. List two advantages.</td><td>4 M</td></tr>
<tr><td></td><td>Ans:</td><td>Circuit of RC coupled CE amplifier:


Advantages:
1. The frequency response is excellent.
2. The circuit is very compact and extremely light.
3. Cost is low as it employs resistors and capacitors which are cheap.
4. It has excellent audio fidelity over a wide range of frequency.</td><td>Circuit Diagram-2M

Advantages-2M</td></tr>
<tr><td></td><td>e)</td><td>Compare zener diode and PN Junction diode.(any 4 points)</td><td>4 M</td></tr>
</table>

Ans:

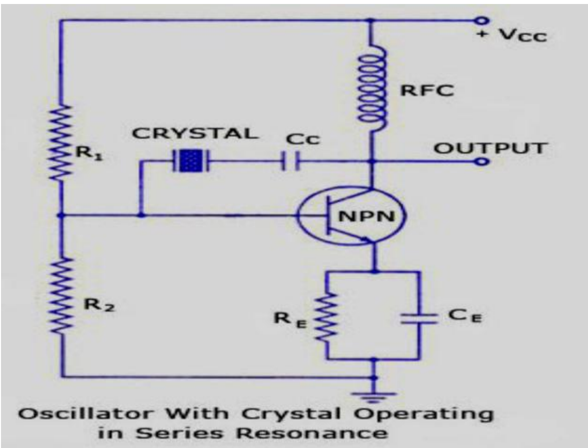
Sr. No.	Zener Diode	PN Junction Diode
1	Symbol 	Symbol. 
2	It conducts in both directions.	It conducts only in one direction.
3	It is always operated in reverse-bias condition.	It is always operated in forward-bias condition.
4	It has quite sharp reverse breakdown.	It has no sharp reverse breakdown.
5	It will not burn, but functions properly in breakdown region.	It burns immediately, if applied voltage exceeds the breakdown voltage.
6	Commonly used for voltage regulation.	commonly used for rectification

Any 4 points

Each of 1 mark

f) **With suitable circuit diagram, explain the working of crystal oscillator.** **4 M**

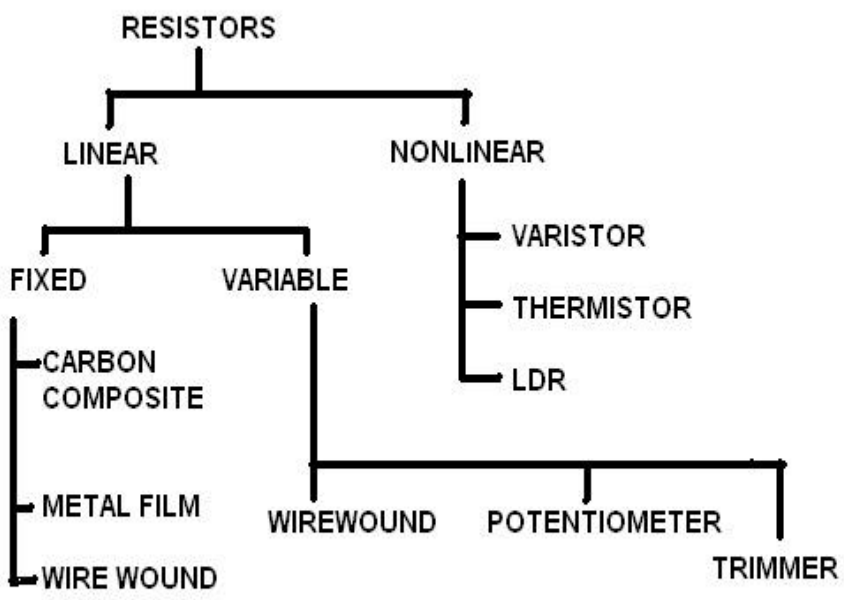
Ans: **Circuit diagram:**



Circuit diagram

2 marks

		Explanation: When the D.C power is switched on, the noise voltage of small amplitude appearing at the base gets amplified and appears at the output. 2. This amplified noise now drives the feedback network consisting of a quartz crystal and a capacitor C. Thus the crystal is excited by a fraction of energy feedback from the output to the input. 3. The crystal is made to operate as an inductor L so that the feedback network acts as a series resonant LC circuit. 4. This is possible only, if the frequency of oscillations f_o is in between the series resonant frequency f_s and the parallel resonant frequency f_p of an electrical equivalent circuit of a crystal, Thus, the frequency of oscillations is set by the series resonant frequency f_s of the crystal. This produces undamped oscillations of stable frequency fo.	**Explana-tion- 2 marks**

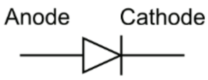
Q. No.	Sub. Q. No.	Answer	Marking Scheme
3		**Attempt any FOUR**	**16 M**
	a)	**Give the classification and use of different types of resistances.**	**4 M**
	Ans:	**Classification of the resistors:**  **Use of Resistors:** 1. Current control 2. Potential divider 3. Biasing of device 4. Amplifiers 5. Feedback network 6. Signal generators 7. Coupling Network 8. Medical Instruments **(Any other suitable applications can also be considered)**	**2M** **2M**
	b)	**Draw the symbol of :**	**4 M**

i)p-n junction diode **ii)Tunnel diode**

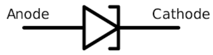
iii)Varactor diode **iv) Schottky diode**

Ans: **1 M Each**

i) p-n junction diode



ii) Tunnel diode



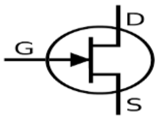
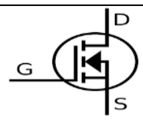
iii) **Varactor diode**

iv) **Schottky diode**

c) **Distinguish between JFET and MOSFET** **4 M**

Ans: **(Any other relevant difference should be considered)** **Any four 1 Mark for Each**

Sr. No	JFET	MOSFET
1.	Operated in depletion mode	Operated in depletion mode and enhancement mode
2.	High input impedance	Very high input impedance
3.	Gate is not insulated from channel	Gate is insulated from channel by SiO_2 layer

4.	Channel exists permanently	Channel exists permanently in depletion type but not in enhancement type.
5.	Drain resistance is high	Drain resistance is less
6.	It does not form the capacitance at the channel.	It forms the capacitance between channel and gate.
7.	Fabrication is complex and costly	Easy to fabricate and cheap.
8.	 N channel JFET	 N channel E- MOSFET

d)	**Define α and β. Derive the relation between them.**	**4 M**

Ans:

Current gain alpha(α) :

The ratio of collector current I_c to emitter current I_E for a constant collector to base voltage V_{CB} in the CB configuration is known as current gain

$$\alpha = \frac{I_C}{I_E}$$

α ranges from 0.95 to 0.998

Current gain beta(β) :

The ratio of collector current I_c to base current I_B for a constant collector to emitter voltage V_{CE} in the CE configuration is known as current gain

$$\beta = \frac{I_C}{I_B}$$

β ranges from 20 to 250

2 M Definition

2M

Relation between **α and β**

$$\beta = \frac{\Delta I_C}{\Delta I_B} \quad \ldots(1)$$

$$\alpha = \frac{\Delta I_C}{\Delta I_E} \quad \ldots(2)$$

We know that $I_E = I_B + I_C$

$\therefore$ Change in current

$$\Delta I_E = \Delta I_B + \Delta I_C$$

$$\Delta I_B = \Delta I_E - \Delta I_C$$

Substituting the above value in equation (1) gives

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{\Delta I_C}{\Delta I_E - \Delta I_C} \quad \text{----- (3)}$$

Divide equation (3) by ΔI_E, we get

$$\frac{\Delta I_C / \Delta I_E}{\frac{\Delta I_E}{\Delta I_E} - \frac{\Delta I_C}{\Delta I_E}} = \frac{\alpha}{1-\alpha} \qquad \therefore \alpha = \frac{\Delta I_C}{\Delta I_E}$$

$$\therefore \boxed{\beta = \frac{\alpha}{1-\alpha}}$$

e) **A transistor has collector current Ic=1.5mA and base current, I_B =90µA. Find α and β of the transistor.** **4 M**

Ans: Given: Ic = 1.5mA, I_B = 90µA

The current gain of a transistor

β **is given by,**

$$\beta = I_C / I_B$$

2 M for β

		$= (1.5*10^{-3}) \ / \ (90*10^{-6})$ $\beta = 16.66$ **α is given by,** $\alpha = \beta \ / \ 1+\beta$ $= (16.66) / (1+ 16.66)$ $= 0.9466$	**2 M for α**
	f)	**Define Oscillator. State its need and condition required for sustained oscillations.**	**4 M**
	Ans:	**Definition**: An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. **Need:** Any circuit that generates an alternating voltage is called an oscillator. To generate ac voltage, it takes energy from the dc source. 1. In some applications voltages of low frequency are required where as in other application voltages of higher frequency are required. 2. In industry, it is frequently necessary to heat different kind of materials. 3. Oscillators are also needed in testing laboratories. Condition for oscillations 1. Loop gain must be unity($A.\beta=1$) 2. The phase shift around the feedback loop must be 0^0 or 360^0	**1M** **2M** **1M**

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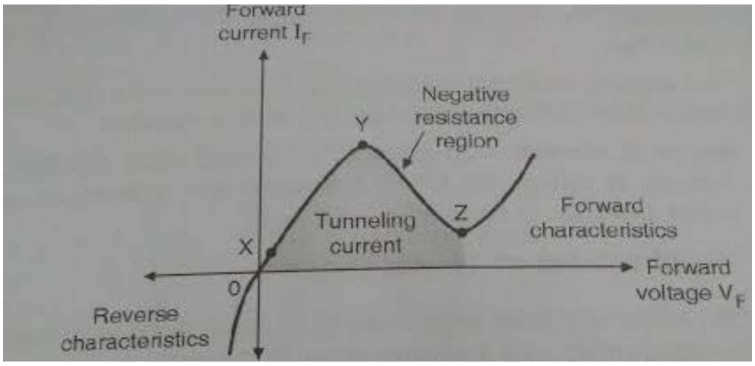
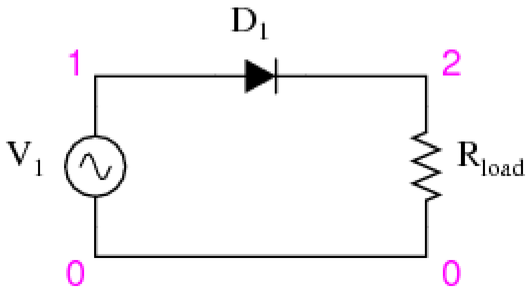
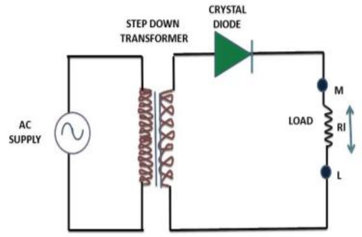
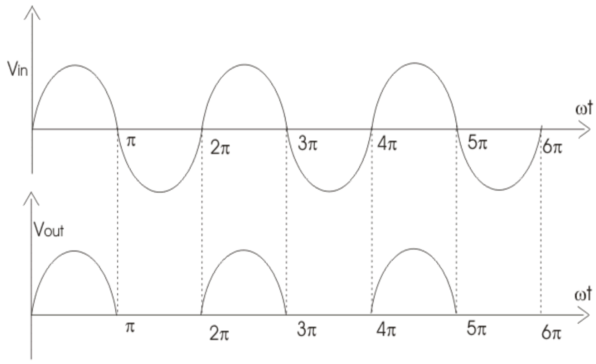
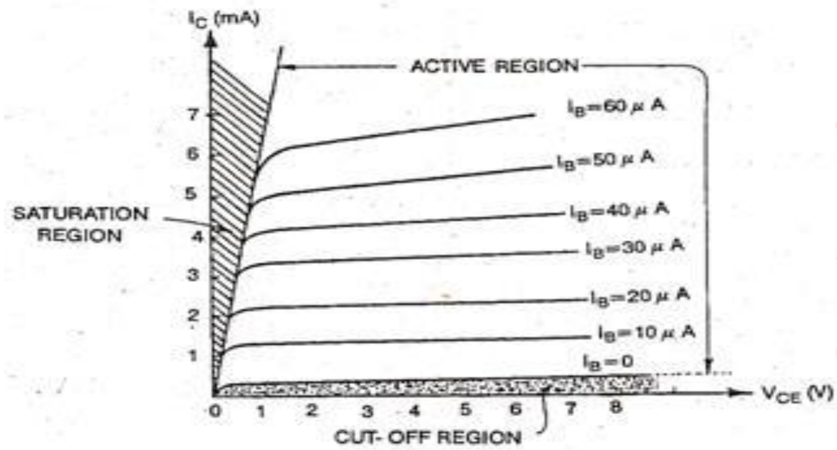
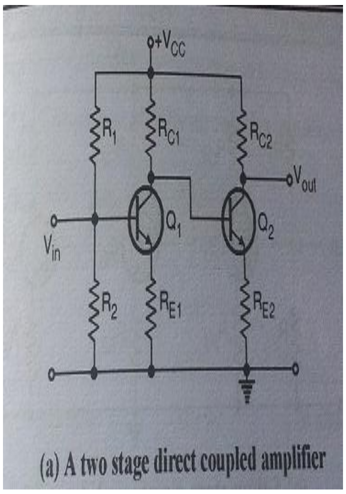
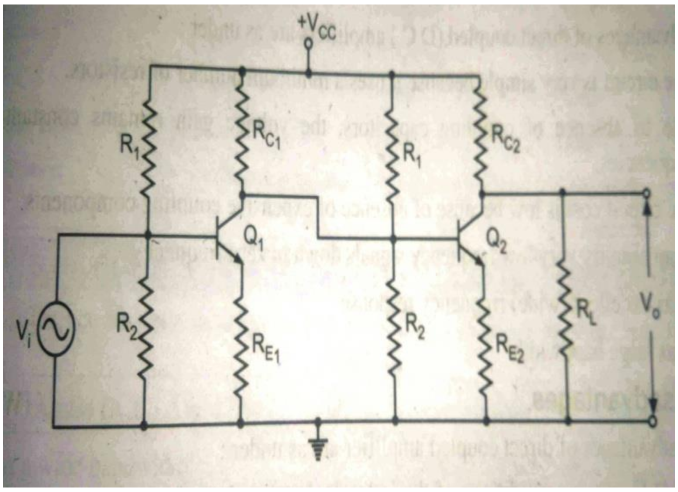
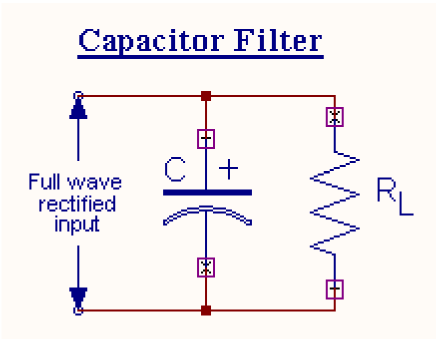
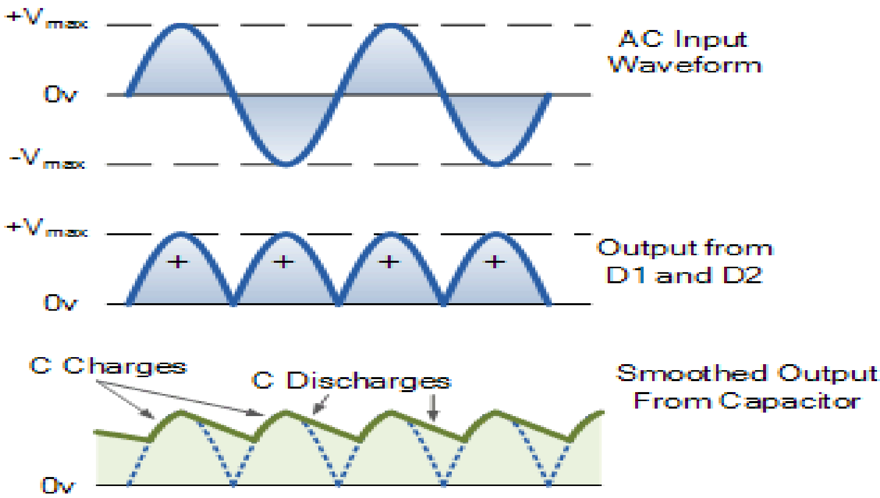
Subject Name: Basic Electronics **Model Answer** **Sub Code:** 17213

Q. No.	**Sub. Q. No.**	**Answer**	**Marking Scheme**
4		**Attempt any FOUR of following:**	**16 M**
	a)	**Draw and explain the V-I characteristics of Tunnel diode.**	**4M**
	Ans:	 Tunnel diode V-I characteristics For small forward voltages owing to high carrier concentrations in tunnel diode and due to tunnelling effect the forward resistance will be very small. As voltage increases, the current also increases till the current reaches its peak value I_p If the voltage is increased beyond the peak voltage, the current will start decreasing. This is negative resistance region. It prevails till valley point. At valley point the current through the diode will be minimum. Beyond valley point the tunnel diode acts as normal diode. In reverse biased condition also Tunnel diode is an excellent conductor due to its high doping concentrations. So it allows conduction to take place for all reverse voltages. There is no reverse breakdown as in conventional diodes.	**2M** **2M**
	b)	**With suitable circuit diagram, explain the working of half wave rectifier. Draw the necessary waveforms.**	**4 M**

		Circuit diagram of half wave rectifier:  OR 	**1M**
		Waveform of half wave rectifier: 	**1M**
		During the positive half-cycles of the input ac voltage *i.e.* when upper end of the secondary winding is positive w.r.t. its lower end, the diode is forward biased and therefore conducts current. If the forward resistance of the diode is assumed to be zero (in practice, however, a small resistance exists) the input voltage during the positive half-cycles is directly applied to the load resistance R_L, making its upper end positive w.r.t. its lower end. The waveforms of the output current and output voltage are of the same shape as that of the input ac voltage. During the negative half cycles of the input ac voltage *i.e.* when the lower end of the secondary winding is positive w.r.t. its upper end, the diode is reverse biased and so does not conduct. Thus during the negative half cycles of the input ac voltage, the current through and voltage across the load remains zero. The reverse current, being very small in magnitude, is neglected. Thus for the negative half cycles no power is delivered to the load.	**2M**

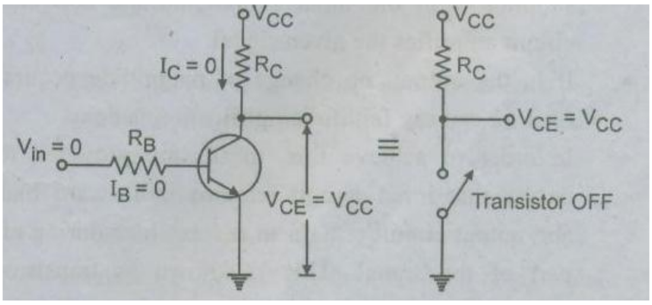
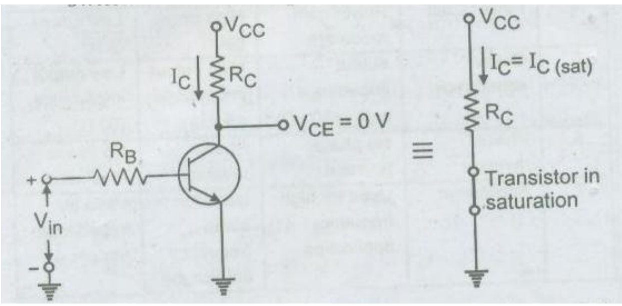
	c)	**Draw the V-I characteristics of CE configuration. Show cut-off, active and saturation regions.**	**4 M**
	Ans:	**V-I characteristics of CE configuration:**  	**4 M for Proper Naming**
	d)	**Draw the circuit diagram of direct coupled two stage amplifier. State the use of R_C and R_E .**	**4 M**
	Ans:	 (a) A two stage direct coupled amplifier **OR**  **Use of Rc:** Resistor Rc is used in the collector circuit for controlling the collector current. **Use of R_E :** **Emitter** Resistance R_E along with R_1 and R_2 forms a part biasing and stabilization network and is used for providing proper biasing voltage for the transistor to operate as an amplifier in the active region.	**2 Marks** **1M** **1M**

	e)	**With suitable diagram, explain the working of capacitor filter. Draw the necessary waveforms.**	**4M**
		 Figure above represents a capacitor filter circuit. It consists of a capacitor C placed across the rectifier output in parallel with load R_L. The rectifier output is applied to the capacitor .During the first half cycle, as the rectifier voltage increases, it charges the capacitor and also supplies current to the load. At the end of quarter cycle, capacitor is charged to the peak value of the rectifier voltage. Now as the rectifier voltage starts to decrease, the capacitor discharges through the load .The voltage across the RC combination decreases very slightly. By then in the next half cycle the capacitor is again charged by the increasing voltage. The process repeats again and again and the output voltage has very little ripple. The waveforms are as shown below:	**1M** **2M**

		Waveforms:  	**1M**
	f)	**Define:** **1) Current gain 2) Voltage gain 3) Power gain** **Give the formula for Current gain.**	**4M**
	Ans:	1) **Current gain**: The current gain is defined as the ratio of output current to the input current A_i= Output current / Input Current = I_O / I_i **2) Voltage gain:** The voltage gain A_V, is defined as the ratio of Output voltage V_O to the input voltage V_i A_V = Output Voltage / Input Voltage = V_O / V_i **3) Power gain:** The power gain is the ratio of output power to input power. A_P = Output Power / Input power = P_O / P_i **Formula for current gain :** A_i = Output current / Input Current = I_O / I_i	**1M For each definition** **1M**

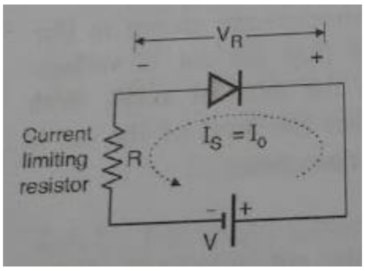
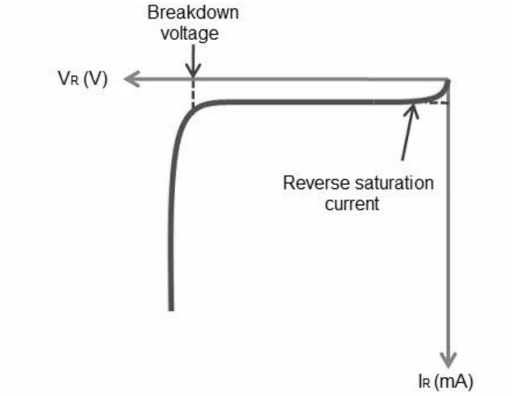
Q.5		**Attempt any FOUR :**	**16 M Marks**
	a)	**Define** **i) Peak inverse voltage** **iii) Knee voltage** ii) **Static resistance of diode** **iv) Reverse saturation current**.	**4M**
	Ans:	**Definitions :** i) **Peak inverse voltage :** Ans: The maximum value of the reverse voltage that a PN junction or diode can withstand without damaging itself is known as its Peak Inverse Voltage. ii) **Static resistance of diode** : Ans: The resistance offered by a p-n junction diode when it is connected to a DC circuit is called static resistance. **or** It is defined as the ratio of DC voltage applied across diode to the DC current or direct current flowing through the diode. iii) **Knee voltage :** Ans: The minimum voltage at which the diode starts conducting and current starts increasing exponentially is called knee voltage of a diode. **iv) Reverse saturation current :** Ans: The reverse saturation current is that part of the reverse current in a semiconductor diode caused by diffusion of minority carriers from the neutral regions to the depletion region.	**Definition : 1M each**
	b)	**Define i) Line regulation ii) Load regulation.** **Give the necessary formulae.**	**4M**
	Ans:	**Definitions :** **i.Line Regulation :** The line regulation rating of a voltage regulator is the change in output voltage that	**Definition : 1M each**

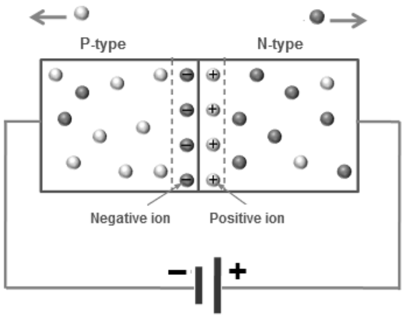
		will occur per unit change in the input voltage. It is given by : Line regulation = $\Delta V_L / \Delta V_S$, Where ΔV_L = the change in output voltage usually in microvolts or millivolts. ΔV_S = the change in input voltage usually in volts. **ii)Load Regulation :** The load regulation of a voltage regulator is the change in output voltage that will occur per unit change in load current. Mathematically, $\% \text{ Line Regulation} = \frac{V_{NL}-V_{FL}}{\Delta I_L} * 100$ where, V_{NL} = Load voltage with no load current V_{FL} = Load voltage with full load current ΔI_L = the change in load current demand. It is also expressed as: $\% \text{ Line Regulation} = \frac{V_{NL}-V_{FL}}{V_{FL}} * 100$ where, V_{NL} = Load voltage with no load current V_{FL} = Load voltage with full load current	**Formulae : 1M each**
	c)	**With suitable diagram, explain the working of transistor as a switch.**	**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	**Working : 1M**

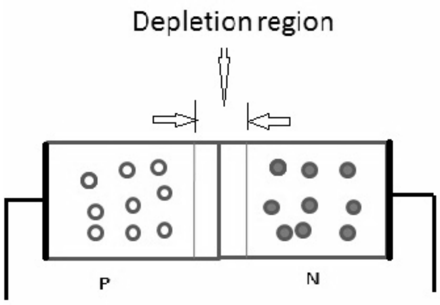
		transistor is equivalent to an open switch.  **b. Transistor in the saturation region(closed switch):** When Vin is positive a large base current flows and transistor saturates. In the saturation region both the junctions of a transistor are forward biased. The voltage drop across the transistor (V_{CE}) 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. 	**Diagram 1M** **Working : 1M** **Diagram 1M**
	d)	**With suitable diagram, explain the V-I characteristics of reverse biased p-n junction diode.**	**4M**
	Ans:	• When the diode is reverse biased, current through it is reverse saturation current which is due to minority carriers and very less. • As the reverse voltage is increased, the increase in this current is minimum.	**Diagram : 2M** **Explanatio**

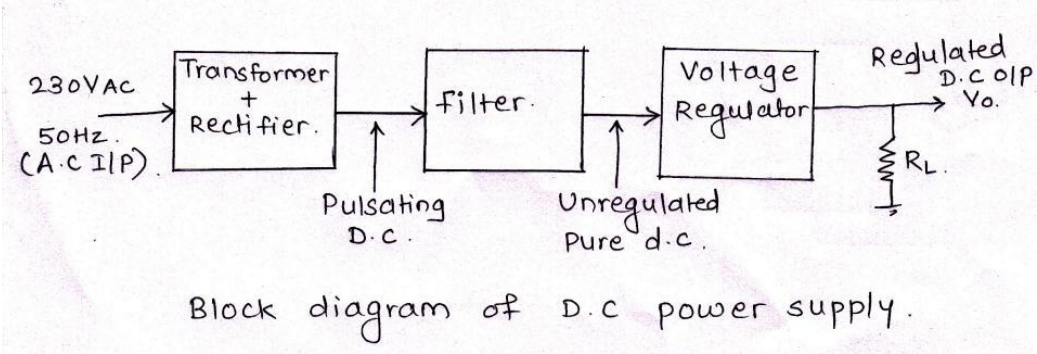
WINTER– 17 EXAMINATION

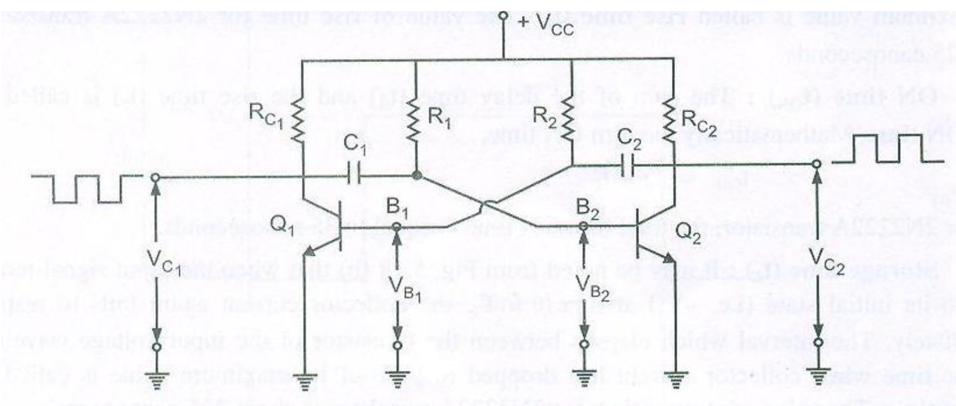
Subject Name: Basic Electronics **Model Answer** **Sub Code:** 17213

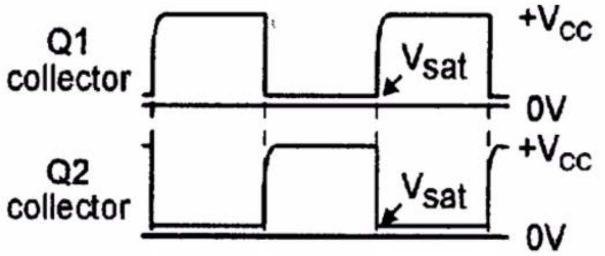
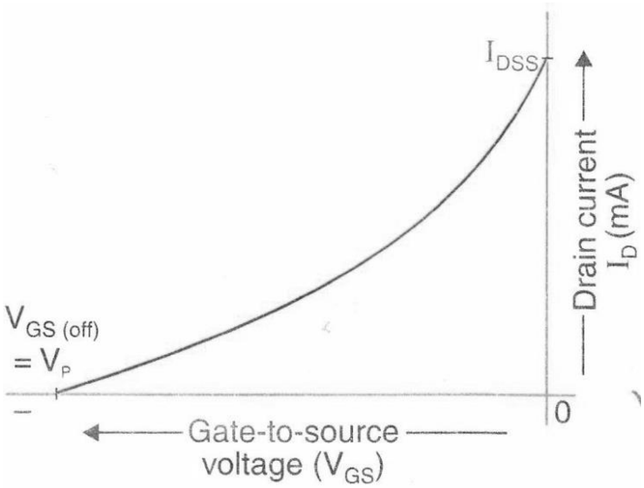
		• When the reverse voltage is increased to a value equal to the breakdown voltage, very large current flows due to avalanche effect and the junction breaks down permanently. Hence operation in break down region should be avoided.   Circuit for reverse biased pn junction characteristic	**: 2M**
	e)	**State the need of multistage amplifier. State one application each of different types of multistage amplifiers.**	**4M**
	Ans:	**Need of multistage amplifier:** The output from a single stage amplifier is usually insufficient to drive an output device. So additional amplification over two or three stages is necessary. To achieve this, output of each amplifier stage is coupled in some way to the input of the next stage. The resulting system is referred to as multi-stage amplifier or cascade amplifier, where the output of first amplifier is fed as input to second amplifier. Multistage amplifiers are designed to increase the overall gain of the amplifier . **Applications of Resistance-Capacitance (RC) coupled Amplifier:** a) It is used in tape recorders, VCRs, CD players etc. b) It is used in stereo amplifiers. c) It is used as voltage amplifiers. **Applications of Transformer coupled Amplifier:** a) It is used to transfer power to low impedance load. b) It is mostly used for impedance matching.	**Need : 1 M** **Application (any one) : 3M (1M for each type)**

		c) It is used in multistage amplifier as final stage. **Applications of Direct coupled Amplifier:** a) It is used as a voltage regulator in dc power amplifiers. b) It is used in analog computers. c) It is used in operational amplifiers.	
	f)	**With suitable diagram, explain the operating principle of varactor diode**.	**4M**
	Ans:	 • The varactor diode is a p-n junction diode which is operated in reverse biased region. The two sides of the a p-n junction will act as conducting plates and the depletion region between them as the dielectric material to form junction capacitance or transition capacitance C_T • $C_T = \varepsilon A/W_d$ • where A = area of p-n junction • W_d = width of the depletion region • As the reverse voltage increases, the width of the depletion region of the diode increases. Hence C_T will reduce. Therefore by changing the reverse bias on the diode it is possible to change the capacitance.	**Diagram : 2M** **Explana-tion : 2M**

Q.6		Attempt any FOUR :	16 – Total M
	a)	**With suitable diagram, explain the construction of P-N junction diode. What are majority and minority carriers?**	**4M**
	Ans:	**Construction:**  • The PN junction diode has a P-type and N-type semiconductor material which is joined by the process of alloying. Thus, both the ends of the diode has different properties. • The electrons are the majority charge carrier of the N-type material, and the holes are the majority charge carrier of the p-type semiconductor material. • The region in which both the p-type and n-type material meet is called the depletion region. This region does not have any free electrons because electrons and holes combine with each other in this region. **Majority carriers:** • The charge carriers that are present in large quantity are called majority charge carriers. The majority charge carriers carry most of the electric charge or electric current in the semiconductor. • In n-type semiconductors they are electrons, while in p-type semiconductors they are holes. **Minority carriers:** • The charge carriers that are present in small quantity are called minority charge carriers. The minority charge carriers carry very small amount of electric charge or electric current in the semiconductor.	**Diagram : 1M** **Explana-tion : 1M** **Definition : 1M each**

		• In n-type semiconductors they are holes, while in p-type semiconductors they are electrons.	
	b)	**Draw the block diagram of regulated power supply and describe each block.**	**4M**
	Ans:	 There are four basic blocks of a d.c. regulated power supply. They are 1) Step down transformer 2) Rectifier 3) Filter 4) Voltage Regulator. **Functions of each block are as follows :** **Step down transformer** : Reduces 230 volts 50Hz ac voltage to required ac voltage level. **Rectifier** : Rectifier converts ac voltage to dc voltage. It may be a half-wave rectifier, a full-wave rectifier using a transformer with centre-tapped secondary winding or a bridge rectifier. But the output of a rectifier will be fluctuating. **Filter** : Filter is a circuit used to remove fluctuations (ripple or ac) present in dc output. **Voltage Regulator** : Voltage regulator is a circuit which provides constant dc output voltage irrespective of changes in load current or changes in input voltage.	**Block Diagram : 2M** **Explanation : 2M**
	c)	**Define biasing. State the requirements of biasing.**	**4M**
	Ans:	**Definition**: **Biasing**: Transistor biasing is the application of controlled amount of voltage and current to a transistor for it to produce the desired amplification or switching effect.. **Or** Biasing a diode refers to applying a positive voltage in order to overcome the barrier potential which is developed whenever a pn junction is formed. **Requirements of transistor biasing:**	**Definition :1M**

		• Position of a Q point • Value of I_C at quiescent point(Q point) • Value of every stability factor should be as low as possible. • Transistor should be biased in the linear portion of transfer characteristics. • Forward bias the B-E junction and reverse bias C-B junction to bias the transistor in active region. • Maximum output swing without producing any distortion.	**Requirements : 3M**
	d)	**With suitable diagram, explain the working of astable multivibrator. Draw the necessary waveforms.**	**4M**
	Ans:	**Circuit diagram:**  **Astable multivibrator** **Explanation:** When Vcc is connected, one transistor will conduct more than other. Initially assume Q_1 is in saturation and Q_2 is in cut off mode ie. Vc_1 is at 0V and Vc_2 = +Vcc. C_1 charges exponentially with time constant R_1C_1 towards Vcc through R_1. V_{B2} also increases exponentially towards Vcc. When V_{B2} crosses the cut-in voltage, Q_2 starts conducting and V_{C2} fall to Vc_E (sat). At the same time V_{B1} falls, thereby driving Q_1, to OFF state. Now V_{C1} rises, causes a small overshoot in voltage in V_{B2}. Thus Q_1 is OFF and Q_2 is ON. So, $V_{C1}= V_{CC}$, $V_{B2}= V_{BE}$(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	**Circuit diagram : 1M** **Explanation : 2M** **Waveforms : 1M**

		saturation and Q_2 to cutoff. This regenerative process continues when Q_2 is ON, falling voltage V_{C2} permits 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. Total time period is given by, T = Ton + Toff $T = 0.693R_1C_1+0.693R_2C_2$ **Waveforms :** 	
	e)	**Draw the transfer characteristics of JFET. Give the meaning of Idss and Vgs(off).**	**4M**
	Ans:	**Transfer characteristics of JFET:**  **i) I_{DSS} (Drain saturation current):** The maximum drain current corresponding to zero gate to source voltage V_{GS} is known as drain saturation current I_{DSS}.	**Characte-ristic : 2M** **Definitions :2M**

		ii) 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).	
	f)	**A transistor has β = 100. If the collector current I_C = 50 mA. Find I_B and I_E.**	**4M**
	Ans:	**Given:** $\beta = 100$ $I_C = 50\ mA$ **Required:** $I_B = ?$ $I_E = ?$ **Solution:** We know that, $I_E = I_B + I_C$ And $I_C = \beta . I_B$ Therefore, $I_B = \frac{I_C}{\beta}$ ie. $I_B = \frac{50\ mA}{100} = 0.5\ mA$ $\boxed{I_B = 0.5\ mA}$ Since, $I_E = I_B + I_C$ Therefore, $I_E = 0.5\ mA + 50\ mA = 50.5\ mA$ $\boxed{I_E = 50.5\ mA}$	**I_B : 2M** **I_E : 2M**