WINTER-19 EXAMINATION

Subject Name: BASIC ELECTRONICS **Subject Code:** 22225

Model Answer

Important Instructions to examiners:

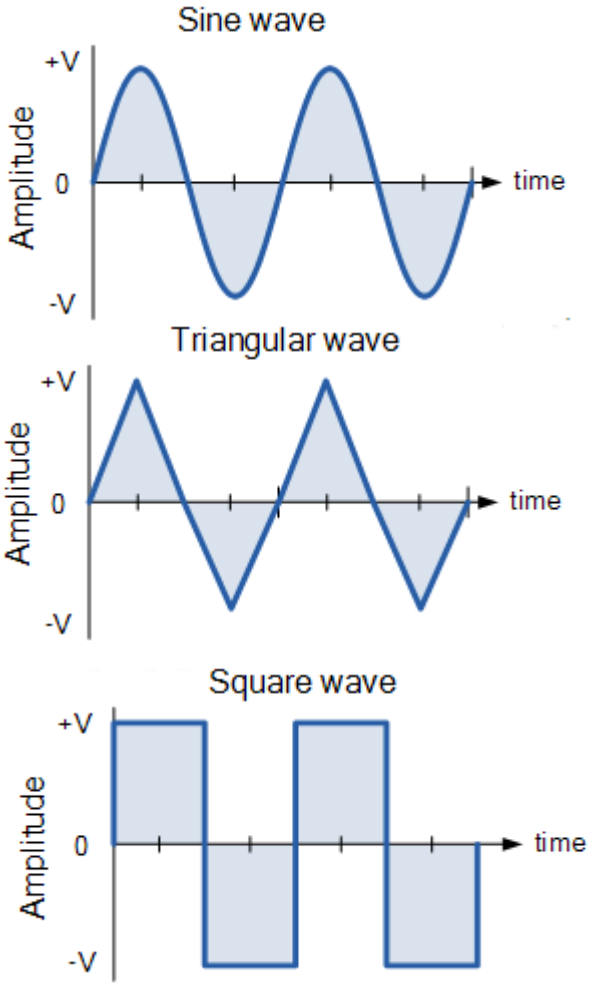
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling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

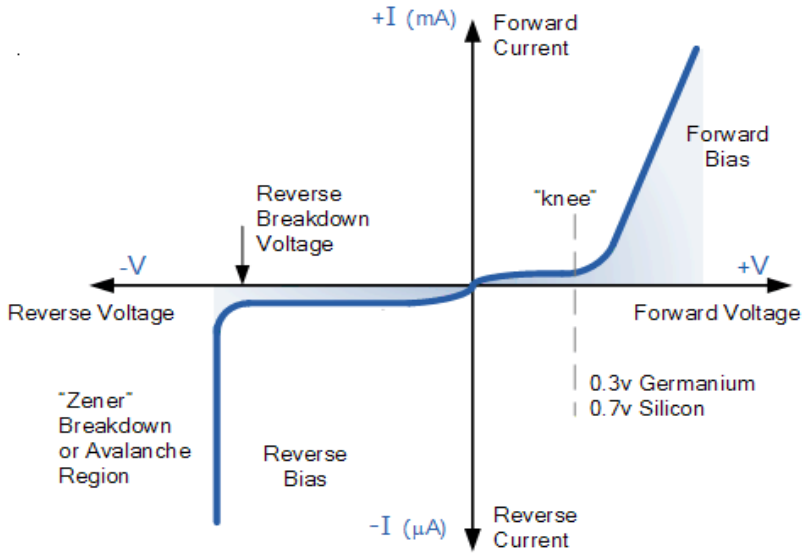
Q. No.	Sub Q. N.	Answers	Marking Scheme
1	**(A)**	**Attempt any FIVE of the following:**	**10- Total Marks**
	(a)	**Define resistor and draw symbol of variable resistor.**	**2M**
	Ans :	**Resistor:** A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. **Symbol of variable resistor:** 	**Definition: 1M** **Symbol : 1M**
	(b)	**State need of regulated power supply.**	**2M**

	Ans :	A regulated power supply is used to ensure that the output remains constant even if the input changes. But sometimes main supply voltage, load, and surrounding temperature keep changing and altering the component parameters and hence changing the output voltage. Output voltage changes are undesirable. Hence the regulated power supply is needed that will accept an AC input and give a constant DC output.	**Need : 2M**
	(c)	**List specification of BJT.**	**2M**
	Ans :	• The bipolar junction transistor (BJT) has small signal current gain, α (h_{fb}). • Maximum collector current $I_{C\,(max)}$. • Maximum collector to emitter voltage, $V_{CE\,(max)}$. • Collector to emitter breakdown voltage, BV_{CBO}. • Collector cut off current, I_{CEO}. • Maximum collector dissipation, P_D. • Collector saturation voltage, VCE (sat). • Collector to emitter cut off voltage, VCEO. • Base emitter saturation voltage, VBE (sat).	**Any four : 2M**
	(d)	**State advantages of MOSFET.**	**2M**
	Ans :	**Advantages of MOSFET** • MOSFETs provide greater efficiency while operating at lower voltages. • Absence of gate current results in high input impedance. • High switching speed. • They operate at lower power and draws no current. • They have high drain resistance due to lower resistance of channel. • They are easy to manufacture. • They are portable.	**Any four : 2M**
	e)	**Give different types of IC.**	**2M**
	Ans :	1. Analog IC 2. Digital IC 3. Thin and thick film ICs 4. Monolithic ICs	**Types : 2M** **(Any two)**

		5. Hybrid or multichip ICs	
	f)	**State selection criteria of transducer.**	**2M**
	Ans :	• **Operating Principle :** The transducers are selected on the basis of operating principle it may be resistive, inductive, capacitive, optical etc. • **Operating range :** The range of transducer should be appropriate for measurement to get a good resolution. • **Accuracy :** The accuracy should be as high as possible or as per the measurement. • **Range :** The transducer can give good result within its specified range, so select transducer as per the operating range. • **Sensitivity :** The transducer should be more sensitive to produce the output or sensitivity should be as per requirement. • **Loading effect :** The transducer's input impedance should be high and output impedance should be low to avoid loading effect. • **Errors :** The error produced by the transducer should be low as possible. • **Environmental compatibility :** The transducer should maintain input and output characteristic for the selected environmental condition.	**Any four : 2M**
	g)	**Define Analog Transducer and give examples of it (any two).**	**2M**
	Ans :	**Analog Transducer:** An analog transducer is a device that converts the input signal into a continuous DC signal of voltage or current. Examples: • Strain gauge • L.V.D.T • Thermocouple • Thermistor	**Definition : 1M** **Examples (any two) : 1M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
2		**Attempt any THREE of the following:**	**12- Total**

			Marks
	a)	**State different types of electrical signal and draw all types of waveforms.**	**4M**
	Ans :	**Types of electrical signals** 1) Sine wave 2) Triangular wave 3) Square wave **Waveforms** 	**Types : 1M** **Each waveform : 1M**
	b)	**Define PIV, TUF, ripple factor, efficiency of rectifier.**	**4M**

	Ans :	**Peak Inverse Voltage (PIV):** The maximum value of reverse voltage (for the diode in a rectifier) occurring at the peak of the negative cycle of the input cycle is called Peak Inverse Voltage. **Transformer Utilization Factor (TUF):** It is the ratio of dc power delivered to the load and the ac rating of the transformer secondary. **Ripple factor:** The factor which represents ac component present in the rectifier output, with respect to dc component is called Ripple Factor. OR The ratio of r.m.s. value of a.c. component to the d.c. component in the rectifier output is known as ripple factor. **Efficiency of rectifier** : This is defined as the ratio of dc power delivered to the load to the ac input power from the secondary winding of the transformer.	**Each definition : 1M**
	c)	**Draw VI characteristics of PN junction diode and explain it.**	**4M**
	Ans :	V-I characteristics of PN junction diode:  Explanation: Forward Bias:	**Diagram : 2M** **Explanation : 2M**

- 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.
- Diode breakdown occurs by two mechanisms: Avalanche breakdown and Zener breakdown.

d) Compare CB, CE and CC configuration of BJT. **4M**

Ans : **Any four pints : 4M**

Factor	CB	CE	CC
Input impedance	Low or 50Ω	Medium OR 600 Ω to 4K Ω	High OR 1M Ω
Output impedance	High OR 50 K Ω	Medium OR 10K Ω to 50K Ω	Low OR 50 Ω
Curent gain	Less than or equal to 1	High (100)	High (100)
Voltage gain	High	High	Less than unit
Power gain	Moderate	High	Moderate
Applications	High frequency Circuits	Audio frequency circuits (Amplifiers)	Impedance Matching

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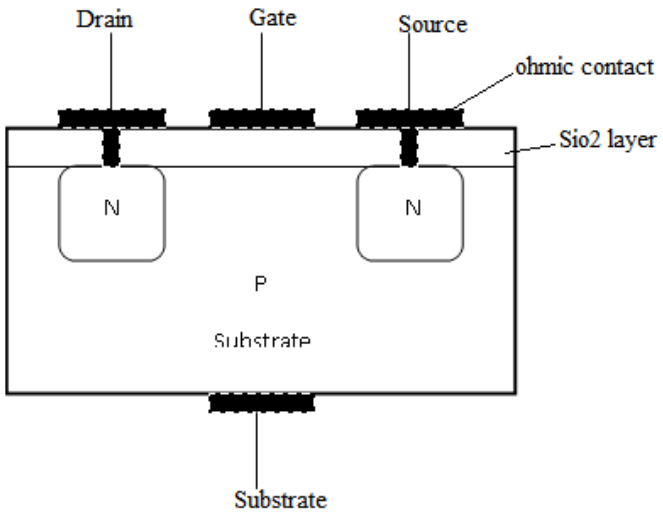
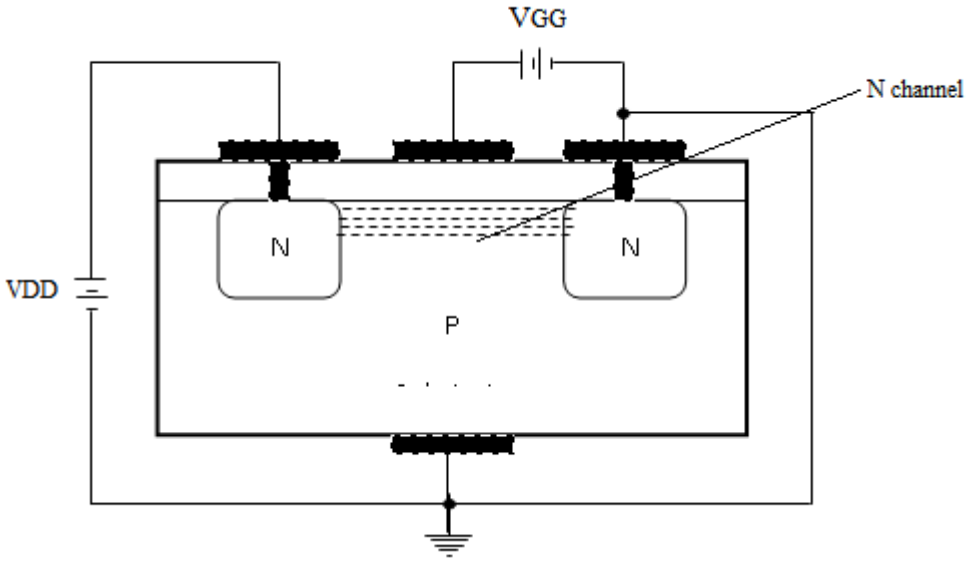
3		**Attempt any THREE of the following :**	**12- Total Marks**
	a)	**Sketch N-Channel MOSFET and describe its working.**	**4M**
	Ans :	**Note: N channel Depletion MOSFET also can be consider.** **Sketch N-Channel MOSFET:**  **Working:**	**Sketch-2M**



In fig. both V_{GS} (VGG)& V_{DS} (VDD) have been set at positive with respect to the source. The positive potential at the gate will attract the electrons from the P substrate & accumulated in the region near to the surface of Sio_2 layer. The Sio_2 layer & its insulating qualities will prevent the negative carrier (i.e. electron) from being absorbed at the gate.

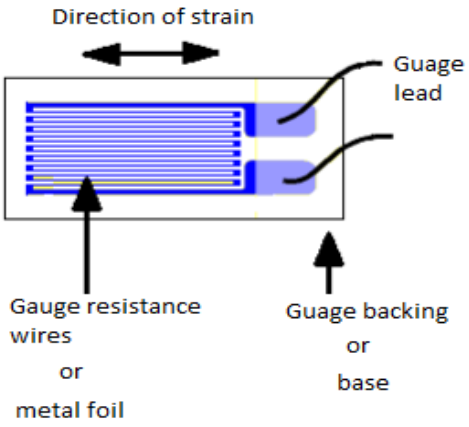
As V_{GS} increase by increasing VGG the concentration of electron near the Sio_2 surface increases & there is formation of channel & the current starts following through the circuit for further applied voltage.

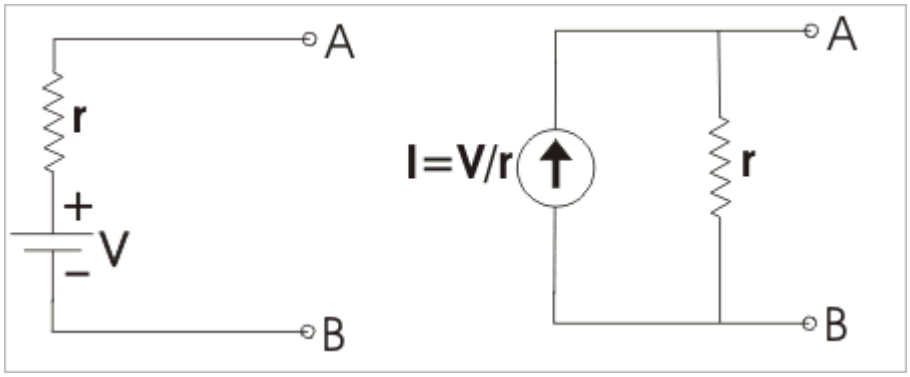
For V_{GS} = OV & negative value of V_{GS}, the absence of n channel will result zero current.

As positive value of V_{GS}, less than V_{GSth} drain current is zero. If $V_{GS} > V_{GSth}$ current starts increasing.

Working-2M

	b)	**Describe strain gauge with labelled diagram.**	**4M**
	Ans :	A Strain gauge is a sensor whose resistance varies with applied force. It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured. When external forces are applied to a stationary object, stress and strain are the result.	**Diagram-2M** **Description-2M** Note: Any

		 • The foil type strain gauges are very common in which a resistive foil is mounted on a backing material. Metal foil gauges use similar materials to wire strain gauges. • The sensing elements of foil gauges are formed from sheets less than 0.005 mm thick by photo etching processes, which allows greater flexibility with regards to shape. • The resistance of the foil changes as the material to which the gauge is attached undergoes tension or compression due to change in its length and diameter. This change in resistance is proportional to the applied strain. As this change in resistance is very small in magnitude so its effect can be only sensed by a Wheatstone bridge. • When strain is applied to the strain gauge, the resistance of the strain gauge sensor changes, the Wheatstone bridge becomes unbalanced, a current flows through the voltmeter. Since the net change in the resistance is proportional to the applied strain, therefore, resultant current flow through the voltmeter is proportional to the applied strain. So, the voltmeter can be calibrated in terms of strain or force.	other type of strain gauge can be explain.
	c)	**With the help of circuit diagram describe conversion of VG. Source to current source.**	**4M**
	Ans :	Any practical voltage source or simply a voltage source consists of an ideal voltage source in series with an internal resistance or impedance. The voltage and current source are mutually transferable i.e. voltage to current source	**Diagram- 2M** **Description- 2M**

		and current to voltage source.  Figure A represents a practical voltage source in series with the internal resistance r while figure B represents a practical current source with parallel internal resistance r Therefore, for any practical voltage source, if the ideal voltage be V and internal resistance be r, the voltage source can be replaced by a current source I (i.e. $\frac{V}{r}$) with the internal resistance(r) in parallel with the current source as shown.	
	d)	**Draw circuit diagram of single stage RC coupled CE amplifier and describe with the help of input and output waveform.**	**4M**

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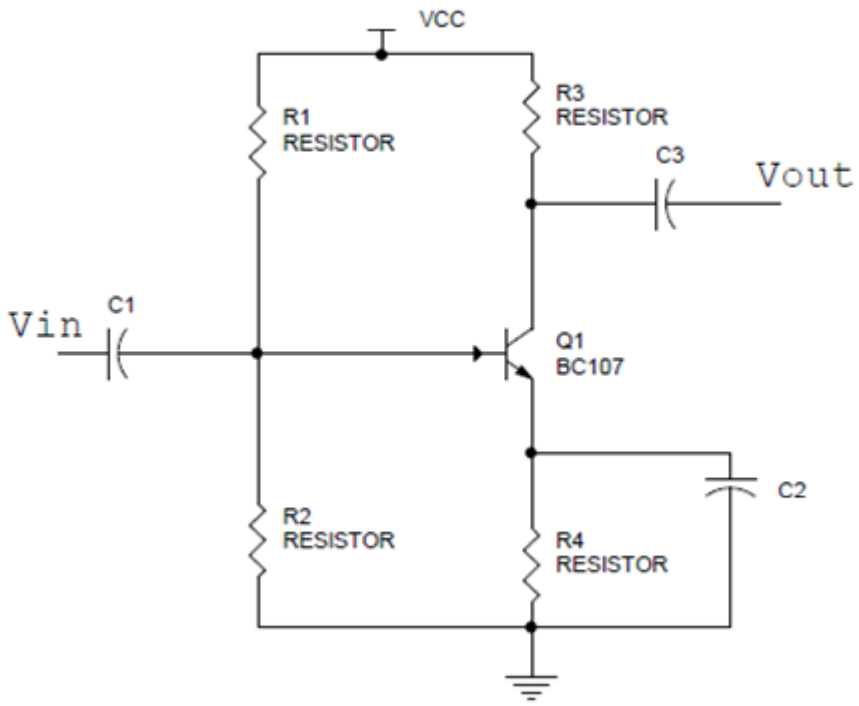
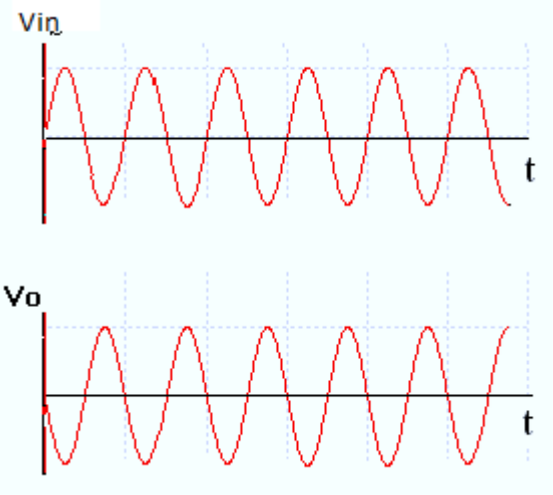
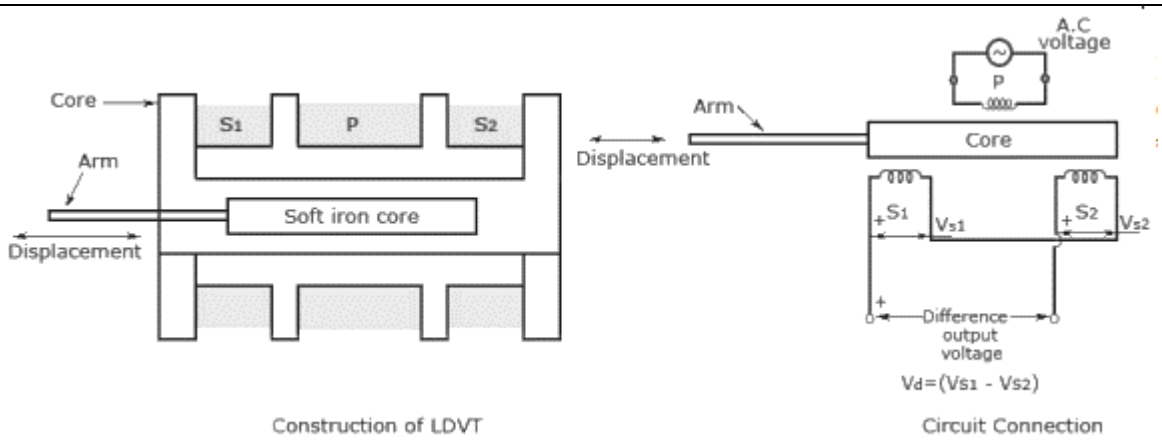
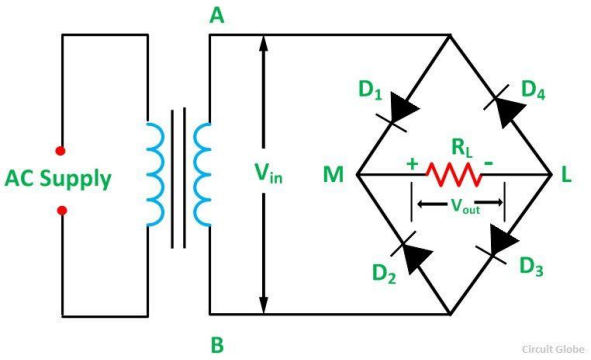
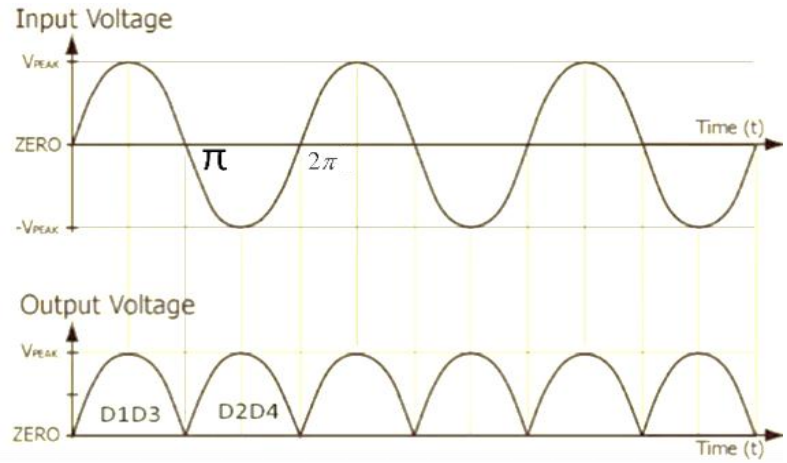
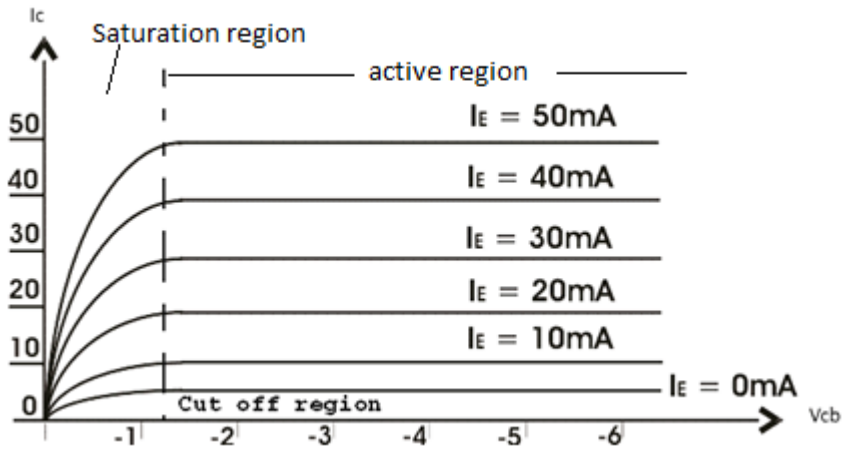
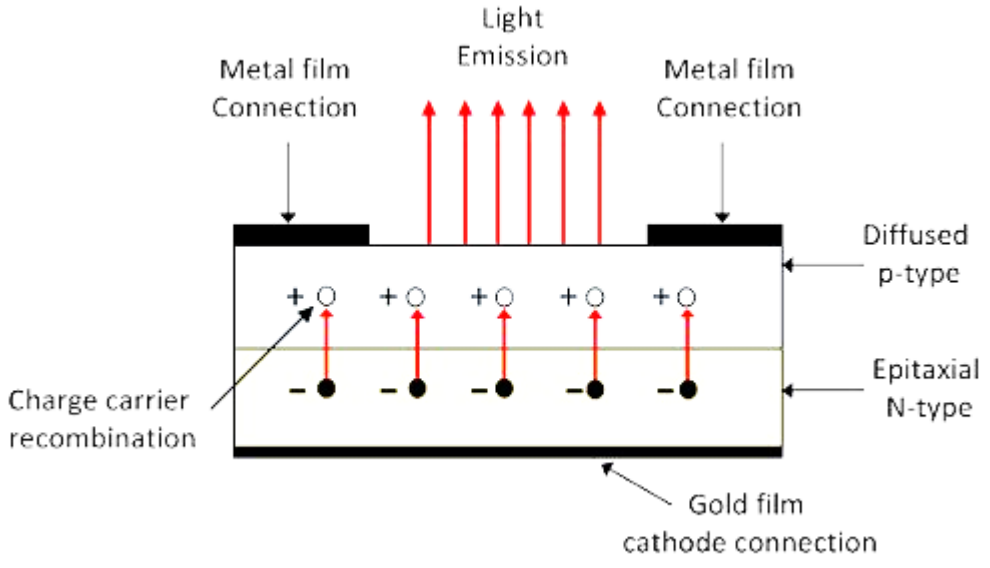
	Ans :	 The signal is fed at the input terminal and output is taken from collector and emitter end of supply. The total instantaneous output voltage Vce is given by Vce=Vcc-Ic Rc -----(1) When the signal voltage increases in the positive half cycle, the base current also increases. The result is that collector current and hence voltage drop IcRc increases. As Vcc is constant, therefore output voltage Vce decreases. As the signal voltage is increasing in the positive half cycle, the output voltage is increasing in the negative sense i.e. output is 180 degree out of phase with input as shown below. Therefore in a CE amplifier the positive half cycle of the signal appears as amplified negative half cycle in the output and vice versa. **Waeform:**	**Circuit diagram:2M** **Description:1 M** **Waveform:**

			**1M**

Q. No.	Sub Q. N.	Answers	Marking Scheme
4		**Attempt any THREE of the following :**	**12- Total Marks**
	(a)	**Describe LVDT with labelled diagram.**	**4M**
	Ans :	 **Working:** LVDT is the example of inductive transducer, in LVDT any physical displacement of the core cause the voltage of any secondary winding to increase while simultaneously reducing the voltage in the other secondary winding. The difference of the two voltages	**Diagram-2M** **Description-2M**

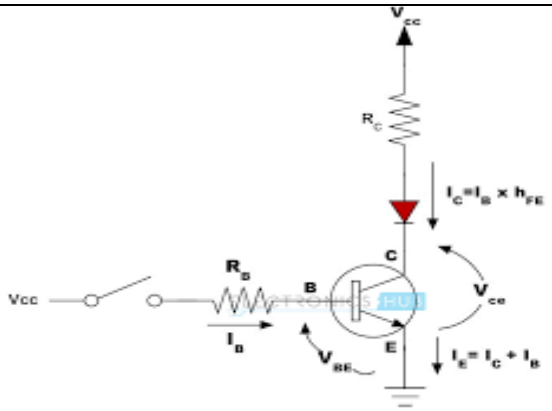
		appears across the output terminal of the transducer and gives a measurement of the physical position of the core.	
	(b)	**Draw circuit diagram of bridge rectifier. Draw its input output waveforms and describe its operation.**	**4M**
	Ans :		**Diagram-2M**
		Working: - The four diodes labelled D1 to D4 are arranged in “series pairs” with only two diodes conducting current during each half cycle. During the positive half cycle of the supply: - diodes D1 and D3 conduct in series while diodes D2 and D4 are reverse biased and the current flows through the load for the period o to π. During the negative half cycle of the supply:- diodes D2 and D4 conduct in series, but diodes D1 and D3 switch “OFF” as they are now reverse biased. The current flowing through the load is the same direction as before for the period π to 2π.	**Operation-1M**
		Waveform: 	**Waveform-1M**

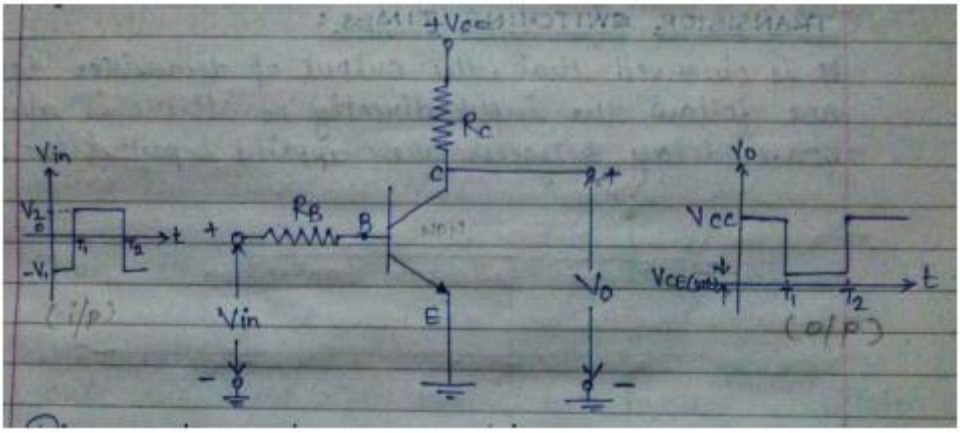
	(c)	**Draw O/P characteristics of CB configuration and explain its working.**	**4M**
	Ans :	 In common base configuration, emitter is the input terminal, collector is the output terminal and base terminal is connected as a common terminal for both input and output. The base-emitter junction is forward biased and collector-base junction is reverse biased. Keeping emitter current constant, increase Vcb from zero onward, therefore collector current will be approximately constant as shown. With the increase in emitter current, collector current is also increased as shown above. Depending on the variation of Vcb, ic also varies, based on this the curve is divided into three region i.e. saturation, active and cut off region. **Saturation region**: In this region Vcb is negative for NPN transistor. A small change in Vcb result in a large value of current **Active region:** In this region, the collector current is constant and is equal to the emitter current. **Cut off region:** In this region, a small collector current flows called leakage current when emitter current is zero.	**Characteristics-2M** **Working-2M**
	(d)	**Give the relations between AC drain resistance (rd), transconduction (gm) and amplification factor.**	**4M**

	Ans :	Since **AC drain resistance** is given as, $r_d = \frac{\Delta V_{DS}}{\Delta I_D}$ at V_{GS} constant **Transconductance** gm is given as , $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$, V_{DS} at constant **Amplification factor** μ $\mu = r_d \times g_m$ $\mu = \frac{\Delta V_{DS}}{\Delta I_D} X \frac{\Delta I_D}{\Delta V_{GS}}$ $\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}}$	**1M** **1M** **2M**
	(e)	**Sketch the constructional diagram of LED and describe its working.**	**4M**
	Ans :	**Constructional Diagram:**  • Light Emitting Diode (LED) works only in forward bias condition. When Light Emitting Diode (LED) is forward biased, the free electrons from n-side and the	**Diagram-2M** **Working-2M**

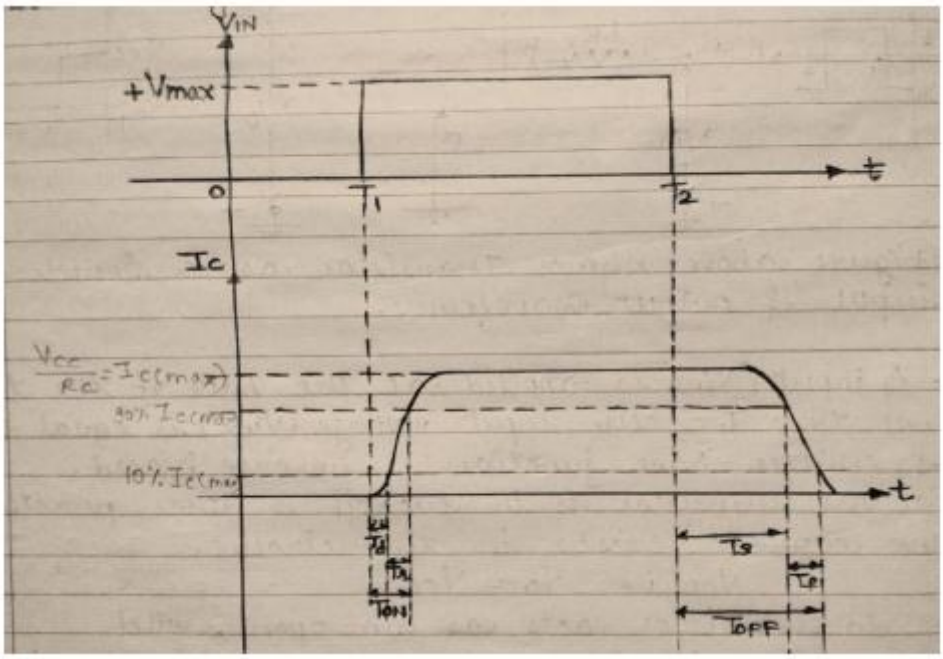
		holes from p-side are pushed towards the junction. • When free electrons reach the junction, some of the free electrons recombine with the holes in the positive ions. In the similar way, holes from p-side recombine with electrons in the depletion region. • Some free electrons from n-type semiconductor cross the p-n junction and recombines with holes in p-type semiconductor. In the similar way, holes from p-type semiconductor cross the p-n junction and recombines with free electrons in the n-type semiconductor. • Thus, recombination takes place in depletion region as well as in p-type and n-type semiconductor. • The free electrons in the conduction band releases energy in the form of light before they recombine with holes in the valence band. • In silicon and germanium diodes, most of the energy is released in the form of heat and emitted light is too small. • However, in materials like gallium arsenide and gallium phosphide the emitted photons have sufficient energy to produce intense visible light.	
Q. No.	Sub Q. N.	Answers	Marking Scheme
5.		**Attempt any TWO of the following:**	**12- Total Marks**
	a)	**State the applications and specification of** **(i) Resistor** **(ii) Capacitor** **(iii) Inductor**	**6M**
	Ans :	**Application of resistor:**	**1 M each for applications**

		1.Resistors are used in high frequency instrument. 2.Resistor is used in power control circuit. 3.It is used in DC power supplies. 4.Resistors are used in filter circuit networks. 5.It is used in amplifiers, oscillators, telecommunication and digital multimeter. 6.It is used in wave generators. **Applications of capacitor:** 1.Use for capacitors is energy storage. 2.Additional uses include power conditioning, signal coupling or decoupling, electronic noise filtering, and remote sensing. **Applications of Inductors:** 1.Filters 2.Sensors **Specifications of Resistor:** 1.Temperature Coefficient. 2.Size or value of a resistor 3.Power Dissipation / wattage 4.Tolerance 5.Thermal Stability 6.Frequency Response. 7.Power De-rating. 8.Maximum Temperature. 9.Maximum Voltage. **Capacitor specifications:** 1.Capacitance value	**of resistor,capacitor and inductor (Any correct 2 applications- 1/2 M each)** **1 M each for spcifications of resistor,capacitor and inductor (Any correct 2 spcifications- 1/2 M each)**

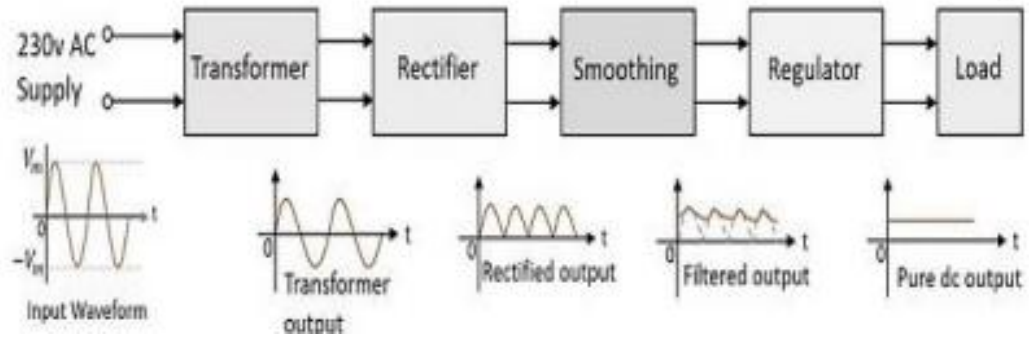
		2.Tolerance 3.Working voltage 4.Dielectric 5.Working temperature 6.Temperature coefficient **Inductor Specification:** 1.DC Resistance (DCR) 2.Maximum DC Current 3.Electromagnetic Interference (EMI) 4.Magnetic Saturation Flux Density 5.Curie Temperature	
	b)	**Describe how transistor can be used as a switch and draw waveforms.**	**6M**
	Ans :	 a)when both junctions are forward bias ,it works in saturation region & act as closed switch. b)when both junctions are reverse biased ,it works in cutoff region & act as open switch. c)If input is not given to base ,transistor remains off.diode will be off.IC=0,Acts as open switch. d)when input is applied to base above 0.7V ,transistor becomes ON,Diode is ON. IC starts flowing ,Transistor acts as close switch.	**2M for diagram** **2M – Explanation and** **2M for waveforms**



Waveform:



	c)	**Draw the block diagram of regulated power supply, explain function of each block and draw waveforms of each stage.**	**6M**
	Ans :	The block diagram of a Regulated Power supply unit is as shown below	**2M for block diagram** **2M for explanation and**



2M for waveforms at each stage

A typical Regulated Power supply unit consists of the following.

Transformer – Stp Up or Step Down input transformer for the stepping up or down AC power supply.

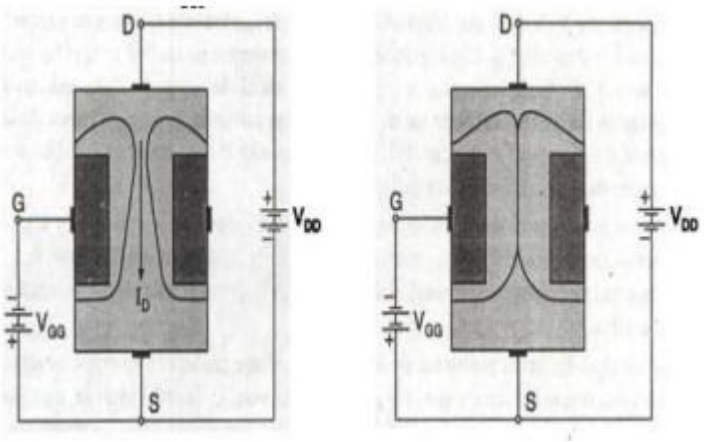
Rectifier – A Rectifier circuit to convert the AC signal into pulsating DC components.

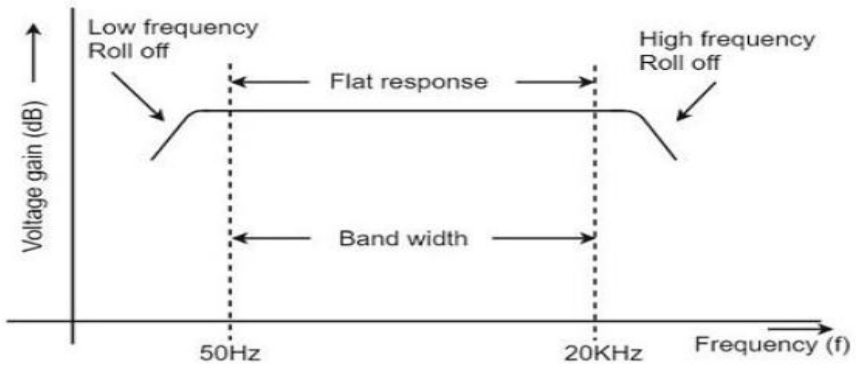
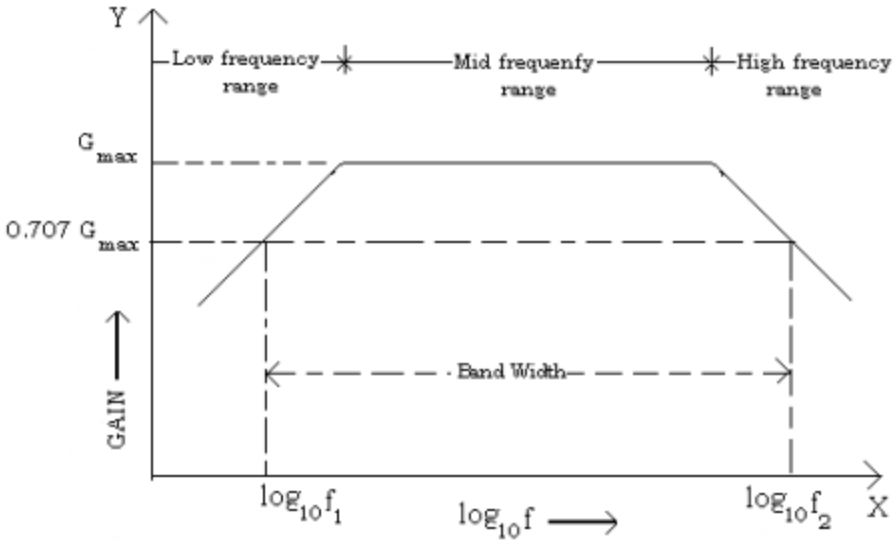
Smoothing – A filtering circuit to smoothen the variations present in the rectified output.

Regulator – A voltage regulator circuit is used to control the voltage to a desired output level against line and load variations.

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

Q. No.	Sub Q. N.	Answers	Marking Scheme
6.		**Attempt any TWO of the following :**	**12- Total Marks**
	a)	**With the help of N-channel JFET describe the effect of input voltage VGS on output current ID.**	**6M**
	Ans :	**Working of N channel FET:**	**2 M for diagram and** **4M for explanation**

		 • When a voltage is applied between the drain and source with a DC supply (VDD), the electrons flows from source to drain through narrow channel existing between the depletion regions. • This constitutes drain current, ID. • The value of drain current is maximum when the external voltage applied between gate and source 0V. • When the gate to source voltage (applied by VGG) becomes negative,, the reverse bias voltage across gate source junction is increased. • The depletion region is widened. This reduces the width of the channel and thus controls the flow of current. • The gate source voltage reaches a point where the channel gets completely blocked and the drain current becomes zero is called pinch- off voltage.	
	b)	**Draw frequency response of RC coupled two stage amplifier. Write formula to calculate bandwidth and state any two methods to improve bandwidth.**	**6M**
	Ans :	**Frequency response of RC coupled two stage amplifier:**	**3M for frequency response of RC coupled two stage RC coupled amplifier**

		Frequency response:-  **OR**  Bandwidth of the amplifier = Higher frequency – Lower frequency $=f_H - f_L$ OR f2 - f1 **Two methods to improve bandwidth:** 1.Direct coupled Amplifier 2.The basic bootstrapping principle is to use an additional buffer **amplifier** to actively	**1M for bandwidth calculation** **2M for two methods to improve bandwidth (1M each)**

charge and discharge to input capacitance as required. By doing so the effective source capacitance is reduced, enabling the overall **bandwidth** of the circuit to be increased.

c) **i) Compare** — **6M**

1) Active and Passive transducer

2) Analog and digital transducer.

ii) Differentiate following transducer in active and passive.

1) Strain gauge

2) Photovoltaic cell

3) Thermocouple

4) Thermistor.

Ans :

Sr. No.	Parameters	Active Transducer	Passive Transducer
1	Working Principle	Operate under energy conversion principle.	Operate under energy controlling principle.
2	Example	Thermocouple, Piezoelectric Transducer etc.	Thermistors, Strain Gauges etc.
3	Advantage	Do not require external power supply for its operation.	Require external power supply for its operation.
4	Application	Used for measurement of Surface roughness in accelerometers and vibration pick ups.	Used for measurement of Power at high frequency.

2M for correct comparison point of Active and passive Transducer

2M for correct comparison point of Analog and Digital Transducer

Analog Transducers	Digital Transducers
1.Output of these transducers are analog in nature	1.Output of these transducers are in the form of pulses
2.Convert the input quantity in analog Output	2.Convert the input quantity in digital output

½ M each for correct identification

		3.e.g. Strain gauge,Potentiometer | 3.e.g. Rotary encoder 1) Strain gauge:-Passive Transducer 2) Photovoltaic cell:-Active Transducer 3) Thermocouple :-Active Transducer 4) Thermistor:-Passive Transducer	