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MODEL ANSWER

SUMMER – 2018 EXAMINATION

Subject: Basic Electronics **Subject Code:** **22225**

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 any equivalent 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.	**(a) Ans.**	**Attempt any FIVE of the following:** **List any four specifications of resistors.** **Specifications of resistors:** • Resistance Value / Resistivity • Tolerance • Power Rating • Thermal Stability • Maximum operating temperature • Maximum operating voltage	**10** **2M** ***Any four specifications ½M each***
	(b) Ans.	**State the need of filters in a regulated DC power supply.** **Need of filters:** The output of a rectifier contains dc component as well as ac component. The presence of the ac component is undesirable and must be removed so that pure dc can be obtained. Filter circuits are used to remove or minimize this unwanted ac component of the rectifier output and allows only the dc component to reach the load.	**2M** ***Relevant need 2M***

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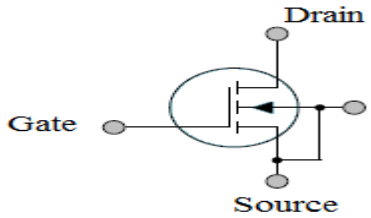
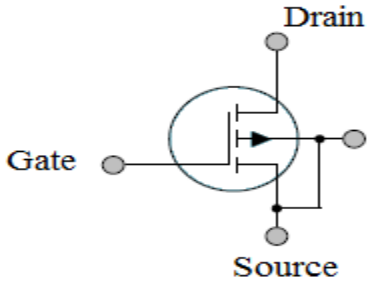
	(c) Ans.	**Define α and β of transistor.** **α (Alpha)** : This is the Common Base dc current gain. It defined as the ratio of collector current (I_C) to emitter current (I_E). $\alpha = \frac{I_C}{I_E}$ **β (Beta):** This is the Common Emitter dc current gain. It is defined as the ratio of collector current (I_C) to the base current (I_B). $\beta = \frac{I_C}{I_B}$	**2M** ***Each definition 1M***
	(d) Ans.	**Draw the symbol of N-channel and P-channel enhancement type MOSFET.** **Symbol of N- Channel Enhancement MOSFET:**  **Symbol of P- Channel Enhancement MOSFET:**  	**2M** ***Each symbol 1M***
	(e) Ans.	**List the types of signals.** **Types of signals:** 1. Analog signal 2. Digital signal 3. AC signal 4. DC signal 5. Sinusoidal signal 6. Triangular signal 7. Square signal	**2M** ***Any 2 types 1M each***

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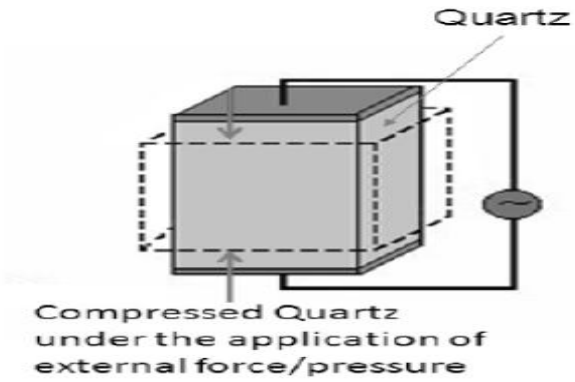
	(f) **Ans.**	**Draw constructional diagram of piezoelectric transducer.** ***(Note: Any other suitable diagram shall be considered for awarding marks)*** **Constructional diagram of piezoelectric transducer:**  	**2M** ***Diagram 2M***
	(g) **Ans.**	**State the function of proximity sensors and photodiode.** **Functions of Proximity Sensors:** 1. Detect the presence of an object through change in the current in its coil. 2. Measure the small changes in displacement/ movement through changes in current. **Function of Photodiode:** It converts the light energy into current or voltage in reverse bias condition.	**2M** ***Any one function 1M each***
2.	**(a)** **Ans.**	**Attempt any THREE of the following:** **State the advantages of integrated circuits over circuits with discrete components.** **Advantages of Integrated circuits:** • Small in size due to the reduced device dimension. • Low weight due to very small size. • Low power requirement due to lower dimension and lower threshold power requirement. • Low cost due to large-scale production. • High reliability due to the absence of a solder joint. • Increased response time and speed. • Easy replacement instead of repairing as it is economical. • Higher yield, because of the batch fabrication.	**12** **4M** ***Any 4 1M each***

	(b)	**Define the following terms with respect to rectifier:** **(i) Ripple factor** **(ii) Rectification efficiency (η)** **(iii) Transformer Utilization Factor (TUF)** **(iv) Peak Inverse Voltage (PIV)**	**4M**
	Ans.	**(i) 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. Mathematically, $\gamma = \frac{rms\ value\ of\ ac\ component}{dc\ component}$ $\gamma = \frac{V_{rms}}{V_{dc}} = \frac{I_{rms}}{I_{dc}}$ **(ii) Rectification efficiency (η):** 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. Mathematically, $\eta = \frac{dc\ power\ delivered\ to\ the\ load}{ac\ input\ power\ from\ the\ transformer\ secondary} = \frac{P_{dc}}{P_{ac}}$ **(iii) Transformer Utilization Factor (TUF):** It is the ratio of dc power delivered to the load and the ac rating of the transformer secondary. $TUF = \frac{dc\ power\ delivered\ to\ the\ load}{ac\ rating\ of\ the\ transformer\ secondary} = \frac{P_{dc}}{P_{ac\ (rated\ )}}$ **(iv) 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.	***Each term definition 1M***
	(c) **Ans.**	**Draw construction of LED and explain working principle.**	**4M**

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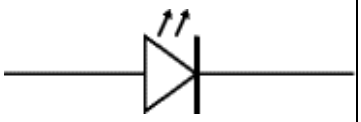
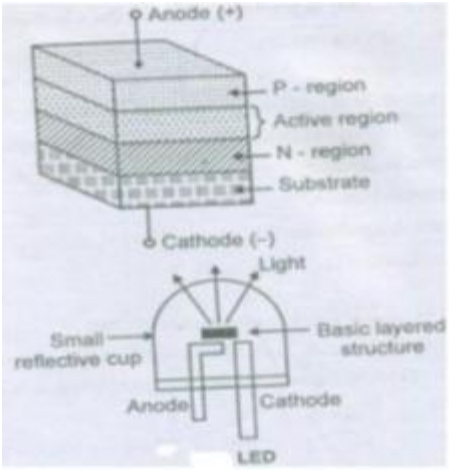
		Working principle: A PN junction diode, which emits light when forward biased, is known as a Light Emitting Diode (LED). The emitted light may be visible or invisible. The amount of light output is directly proportional to the forward current. Thus, higher the forward current, higher is the light output.   When the LED is forward biased, the electrons and holes move towards the junction and the recombination takes place. After recombination, the electrons, lying in the conduction bands of N region, fall into the holes lying in the valence band of a P region. The difference of energy between the conduction band and valence band of a P region is radiated in the form of light energy. The semiconducting materials used for manufacturing of Light Emitting Diodes are Gallium Phosphide and gallium Arsenide Phosphide. These materials decide the colour of the light emitted by the diode.	***Diagram 2M*** ***Explanation 2M***
	(d) **Ans.**	**Compare CB, CE and CC configuration on the basis of:** **(i) Input impedance (ii) Output impedance** **(iii) Current gain (iv) Application**	**4M**

Factor	**CB**	**CE**	**CC**
Input Impedance	Low **OR** 50Ω	Medium **OR** 600 Ω to 4K Ω	High **OR** 1M Ω

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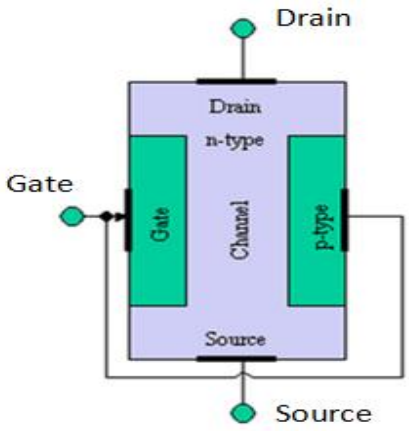
		Output Impedance	High **OR** 50 K Ω	Medium **OR** 10K Ω to 50K Ω	Low **OR** 50 Ω	***Correct comparison 1M each***
		Current Gain	Less than or equal to 1 **OR** $\alpha = \frac{I_C}{I_E}$	High (100) **OR** $\beta = \frac{I_C}{I_B}$	High (100) **OR** $\gamma = \frac{I_E}{I_B}$	
		Application	High frequency Circuits	Audio frequency circuits (Amplifiers)	Impedance Matching	
3.	**(a) Ans.**	**Attempt any THREE of the following:** **Draw and explain the construction of N-channel JFET.**  **Construction Details:** A JFET consists of a p-type or n-type silicon bar containing two PN junctions at the sides as shown in fig. The bar forms the conducting channel for the charge carriers. If the bar is of p-type, it is called p-channel JFET and if the bar is of n-type, it is called n-channel JFET as shown in fig. The two PN junctions forming diodes are connected internally and a common terminal called gate is taken out. Other terminals are source and drain taken out from the bar as shown in fig.1.Thus a JFET has three terminals such as, gate (G), source (S) and drain (D).	**12** **4M** ***Diagram 2M*** ***Explanation 2M***

	(b) **Ans.**	**State any four selection criteria for transducers.** **Selection criteria for transducers are:** 1. Operating range 2. Operating principle 3. Sensitivity 4. Accuracy 5. Frequency response and resonant frequency 6. Errors 7. Environmental compatibility 8. Usage and ruggedness. 9. Electrical aspect. 10. Stability and Reliability 11. Loading effect 12. Static characteristics 13. General selection criteria	**4M** ***Any four points 1M each***
	(c) **Ans.**	**Determine the value of resistance with the following colour code:** **(i) Red, Red, Orange, Gold (ii) Brown, Black, Black, Silver** **(i) Red, Red, Orange, Gold** Red Red Orange Gold ↓ ↓ ↓ ↓ 2 2 x 1000 ± 5% = 22 x 1000± 5% Value of resistor is 22 KΩ ± 5% OR 22000Ω ± 5% **(ii) Brown, Black, Black, Silver** Brown Black Black Silver ↓ ↓ ↓ ↓ 1 0 x 1 ±10% = 10 x 1 ± 10% Value of resistor is 10 Ω ± 10%	**4M** ***Each bit 2M***

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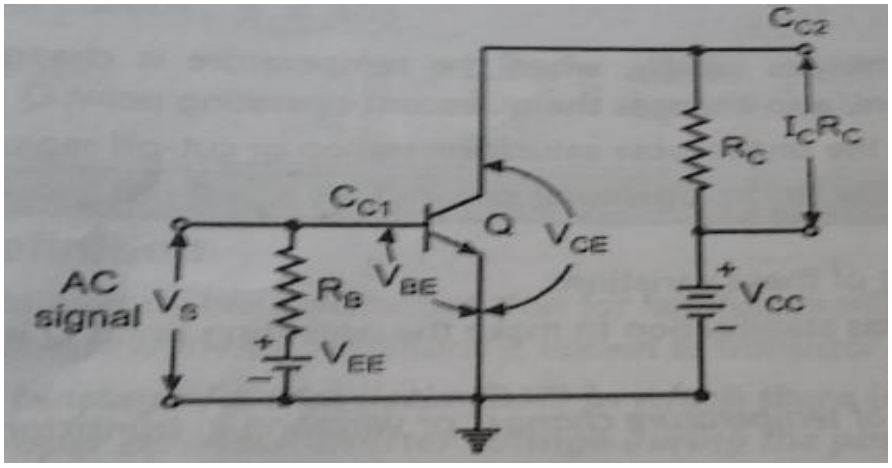
	(d)	**Explain the concept of DC load line and operating point for biasing circuit.**	**4M**
	Ans.	**DC load line**: The straight line drawn on the characteristics of a BJT amplifier which give the DC values of collector current I_C and collector to emitter voltage V_{CE} corresponding to zero signal i.e. DC conditions is called DC load line.	***1M***
			***1M***
		To plot $I_{C(MAX)}$, $V_{CE\ (MAX)}$ on output characteristics: Get $V_{CE\ (MAX)}$ by putting $I_{c\,=\,0}$ $V_{CE\,=}V_{CC} - I_c\ R_c$ $V_{CE\ (MAX)\,=}\ V_{CC}$ since $I_c = 0$ Get $I_{C(MAX)}$ by putting $V_{CE\,=\,0}$ $I_{C(MAX)} = \frac{V_{CC}}{R_C}$	

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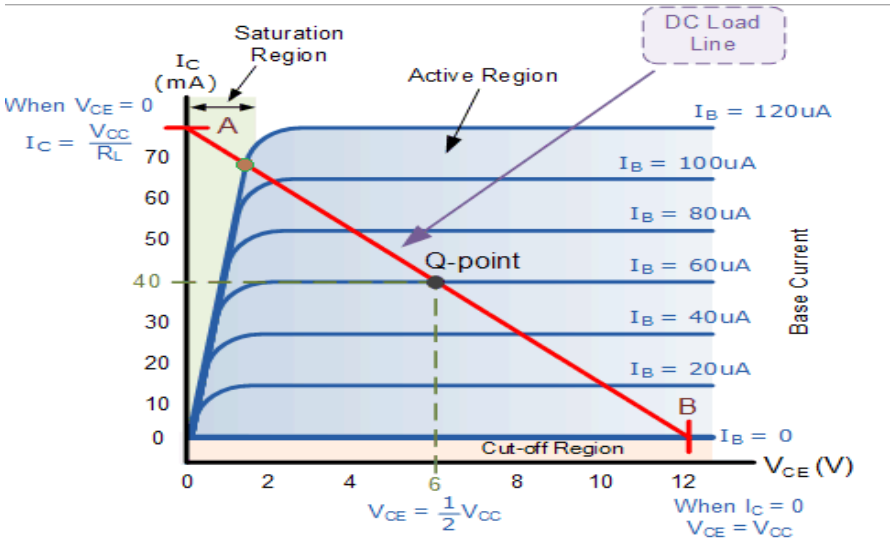
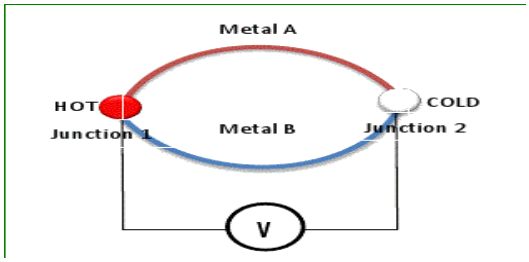
		 **Operating point or Q- point**: The fixed levels of certain currents and voltages in a transistor in active region defines the operating point on the DC load line. For normal operation of the transistor, the Q- point is to be selected at the center of the load line.	***1M*** ***1M***
4.	**(a)** **Ans.**	**Attempt any THREE of the following:** **Explain:** **(i) Seebeck effect (ii) Peltier effect** **(i) Seebeck effect:** Seebeck effect states that whenever two dissimilar metals are connected together to form two junctions out of which, one junction is subjected to high temperature and another is subjected to low temperature then e.m.f is induced proportional to the temperature difference between two junctions.  **Fig. Seedback effect**	**12** **4M** ***Seeback effect 2M***

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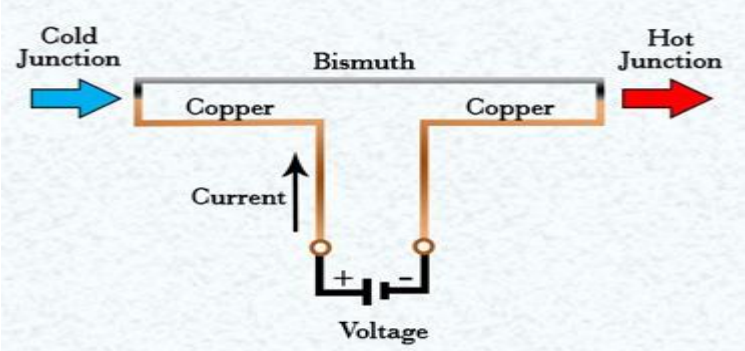
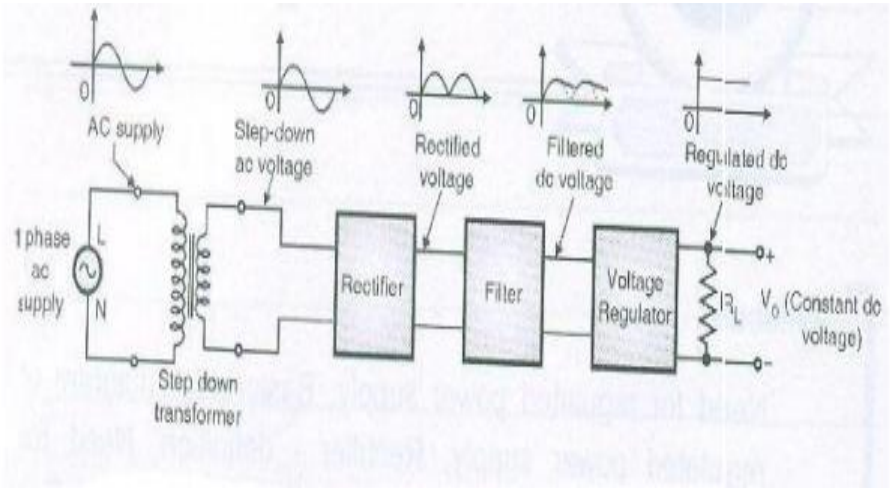
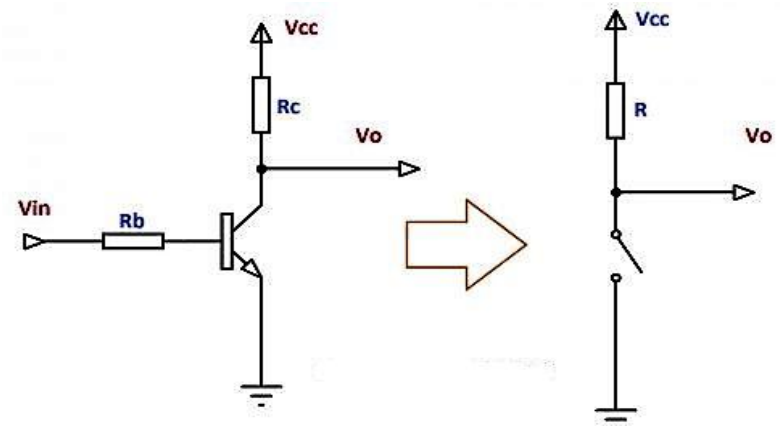
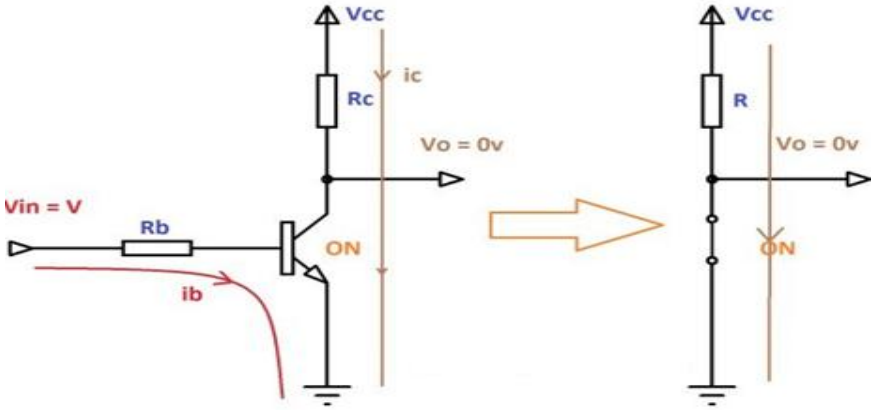
		(ii) Peltier effect: Peltier effect state that for two dissimilar metals closed loop, if current forced to flow through the closed loop then one junction will be heated and other will become cool.  	***Peltier effect 2M***
	(b) **Ans.**	**Draw the basic block diagram of regulated DC power supply. Explain the function of each block.**  **Block diagram of regulated power supply** 1.TRANSFORMER:Transformer works on the basis of ELECTROMAGNETIC INDUCTION and they are mainly classified into two: i. STEP UP TRANSFORMER ii. STEPDOWN TRANSFORMER Step up transformer up convert the input voltage where step down transformer down converts. For a DC Power Source we have to use	**4M** ***Diagram 2M*** ***Explanation 2M***

		step down transformers, to covert the high voltage AC supply to low voltage DC. 2. RECTIFIER: Rectifiers are used to convert the sinusoidal AC voltage to non-sinusoidal pulsating DC. The main component used in Rectifiers are diodes due to its switching action. They will conduct Current only in one direction, hence the voltage. So we can use them as rectifiers to make the alternating Current unidirectional. Rectifiers are classified into Three :- i. HALF WAVE RECTIFIERS ii. FULL WAVE RECTIFIERS iii. BRIDGE RECTIFIERS 3. FILTERS: Filters are used to eliminate or filter-out the unwanted ripples from the rectified output. Filters play an important role in dc Power supplies, they make the pulsating dc steady. 4. VOLTAGE REGULATOR: Voltage Regulators are used to regulate the output Voltage over load. They make the Voltage unvaried with load connected to it. This will eliminates the remaining ripples from the filter output. The output from Voltage Regulator may be the required DC. Voltage Regulators includes some safety measures such as Current Limiting, short circuit etc.	
	(c) **Ans.**	**Describe the working of transistor as a switch with circuit diagram.**  **Transistor as a Switch Circuit Diagram**	**4M**

From the above circuit we can see that the control input Vin is given to base through a current limiting resistor Rb and Rc is the collector resistor which limits the current through the transistor. In most cases output is taken from collector but in some cases load is connected in the place of Rc.

- ON = Saturation
- OFF = Cutoff

Transistor as a Switch – ON:



Transistor as a Switch ON

Transistor will become ON (saturation) when a sufficient voltage V is given to input. During this condition the Collector Emitter voltage Vce will be approximately equal to zero, ie the transistor acts as a short circuit. For a silicon transistor it is equal to 0.3v. Thus collector current Ic = Vcc/Rc will flows.

ON switch 2M

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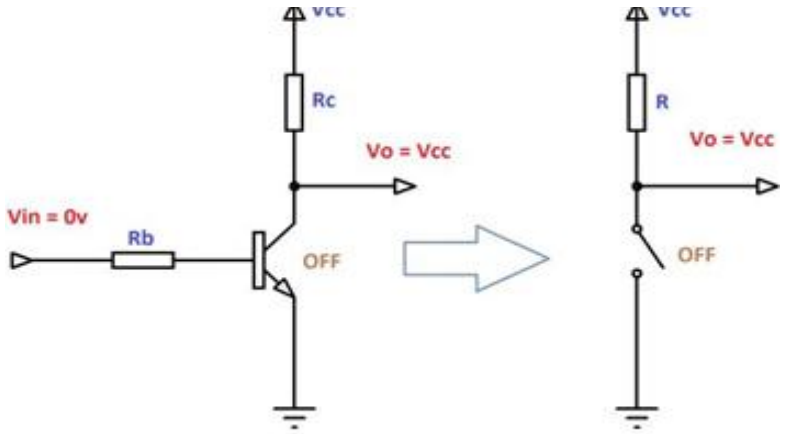
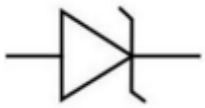
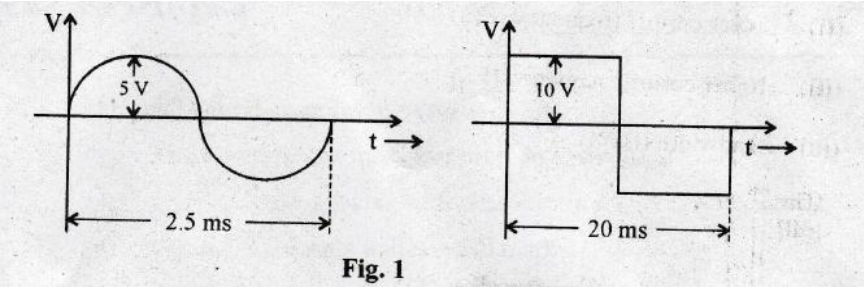
		Transistor as a Switch – OFF:  **Transistor as a Switch OFF** Transistor will be in OFF (cutoff) when the input Vin equal to zero. During this state transistor acts as an open circuit and thus the entire voltage Vcc will be available at collector.	***OFF switch 2M***
	(d) **Ans.**	**A JFET has a drain current of 5 mA. If I_{DSS} = 10mA and $V_{GS(OFF)}$ = -6V. Find the value of** **(i) V_{GS}** **(ii) V_P** Given: I_D = 5mA I_{DSS} = 10mA $V_{GS(OFF)}$ = -6V V_{GS} = ? V_P = ? $I_D = I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_{GS\,(OFF)}}\right)^2$ $V_{GS} = \left(1 - \frac{\sqrt{I_D}}{\sqrt{I_{DSS}}}\right) X\ V_{GS\ OFF}$	**4M** ***Formula for I_D 1M***

		$V_{GS} = \left(1 - \frac{\sqrt{5mA}}{\sqrt{10mA}}\right) X - 6$ $V_{GS} = -1.756V$ $V_P = V_{GS(OFF)}$ $\therefore$ $V_P = -6V$	***V_{GS} calculation 2M*** ***V_P calculation 1M***
	(e) **Ans.**	**Compare P-N junction diode and zener diode on the basis of** **(i) Symbol (ii) Direction of conduction** **(iii) Reverse breakdown (iv) Application** **Parameter** | **Zener Diode** | **PN Diode** **Symbol** |  |  **Direction of conduction** | It conducts in both directions. | It conducts only in one direction. **Reverse breakdown** | It has quite sharp reverse breakdown. | It has no sharp reverse breakdown. **Application** | Commonly used for voltage regulation | commonly used for rectification	**4M** ***Each Point 1M***
5.	**(a)** **Ans.**	**Attempt any TWO of the following:** **Calculate peak-to-peak amplitude, frequency and wavelength of waveforms shown in Fig.1.**  **Fig. 1**	**12** **6M**

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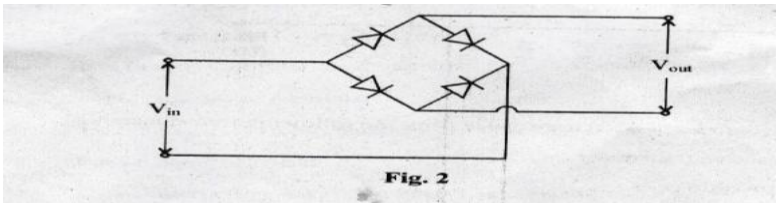
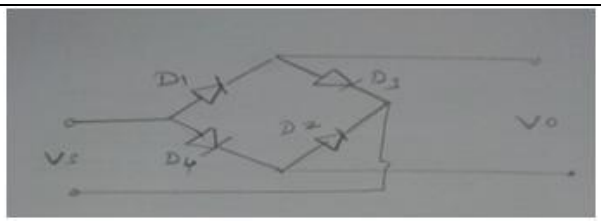
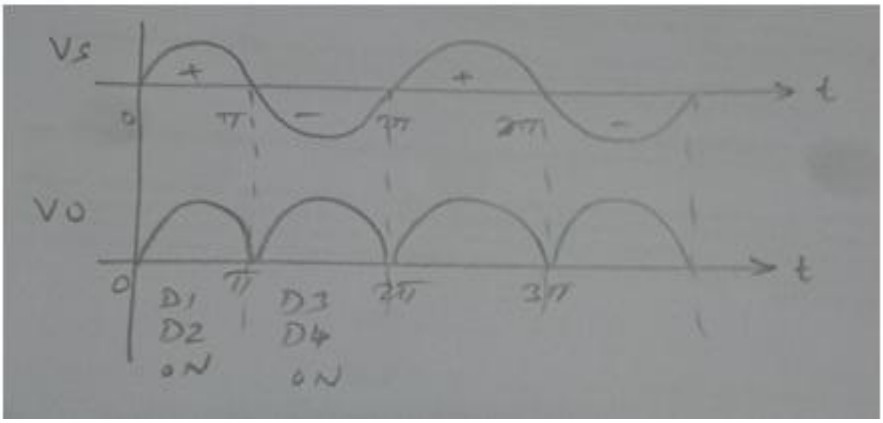
		For sine waveform: 1. Peak to peak amplitude =10 V 2. Frequency=1/T =1/(2.5ms) = 400 Hz 3. wavelength λ = Vc/f =(3*10^8)/400 =750000 m **For square waveform:** 1. Peak to peak amplitude =20 V 2. Frequency=1/T =1/(20 ms) = 50 Hz 3. wavelength λ = Vc/f =(3*10^8)/50 =6000000 m	***Each calculation 1M***
	(b) **Ans.**	**In CE configuration, if β = 100, leakage current I_{CEO} = 150 µA. If the base current is 0.2 mA, calculate the value of I_C, I_E and α.** ***(Note: Marks should be given for correct formula)*** Given data:-β =100, I_{CEO} = 150 µA. I_B is 0.2mA , To find I_C, I_E and α. **Solution :-** We know 1) α = β / (β +1) = 100/(100+1)= 0.99 2) I_C is given as, I_C= β *I_B+I_{CEO} = (100*0.2*10^{-3}) +150*10^{-6} =20.150 mA. 3) I_E is given as, I_E=I_C +I_B =(20.150 +0.2) mA =20.35 mA	**6M** ***2M for correct calculation of each parameter (Formula 1M, Calculation -1M)***
	(c) **Ans.**	**Identify the circuit shown in Fig. 2 and explain working with input-output waveforms for a sinusoidal input.**  Fig. 2 **The given circuit is Bridge rectifier**– (with diodes numbered)	**6M**

		 **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 D2 conduct in series while diodes D3 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 D3 and D4 conduct in series, but diodes D1 and D2 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. **Waveforms:-** 	***Correct Identification 2M*** ***Explanation 2M*** ***Waveforms 2M***
6.	**(a)**	**Attempt any TWO of the following:** **The following readings were obtained experiment from JFET.** **V_{GS} 0 V 0 V -0.2 V** **V_{DS} 7 V 15 V 15 V** **I_D 10 mA 10.25 mA 9.65mA**	**12** **6M**

Determine:
(i) AC drain resistance
(ii) Transconductance
(iii) Amplification factor
(Note: Formula should be given marks)

Ans.

(i) AC drain resistance is given as, $r_d = \frac{\Delta V_{DS}}{\Delta I_D}$ at V_{GS} constant

$$\frac{15V-7V}{10.25-10mA} = \frac{8V}{0.25mA} = 32K\Omega$$

(ii) Transconductance gm is given as , $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$, V_{DS} at constant

$$\frac{10.25mA-9.65mA}{0-(-0.2V)} = \frac{0.6mA}{0.2V} = 3m\ Mho$$

(iii) Amplification factor μ

$$\mu = r_d \times g_m = 32\ K\Omega \times 3m\ Mho = 96$$

2M for each (1M for Formula, 1M for calculation)

(b) **Observe the given frequency response of RC coupled amplifier in Fig. 3** **6M**

Calculate:
(i) Lower cut-off frequency (F_L)
(ii) Higher cut-off frequency (F_H)
(iii) Bandwidth (BW)

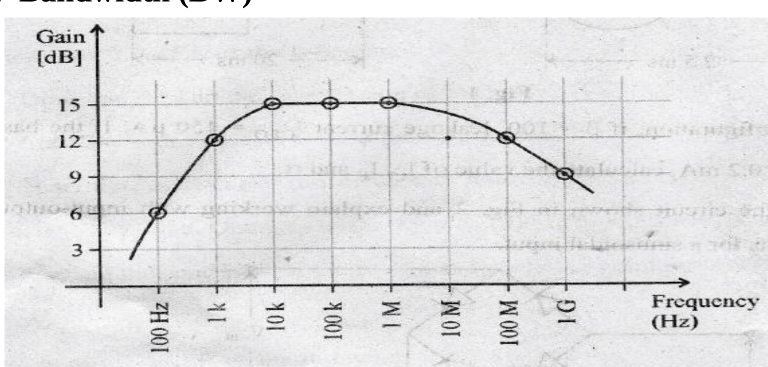


Fig. 3

Ans.

		As maximum gain is 15 dB, 3 dB down gain is 12 dB. So, (i) The lower cut-off frequency F_L= 1KHz (ii) Higher cut-off frequency F_H =100 MHz (iii) Bandwidth (BW) = F_H - F_L =(100000 -1)KHz = 99999 KHz	***2M for each proper answer***
	(c) **Ans.**	**Identify active and passive transducer from the following transducers:** **(i) Capacitive transducer** **(ii) Photovoltic cells** **(iii) Piezoelectric transducer** **(iv) Strain gauge** **(v) Thermocouple** **(vi) Thermisters** (i) Capacitive transducer-passive transducer (ii) Photovoltaic cells- active transducer (iii) Piezoelectric transducer–active transducer. (iv) Strain gauge-passive transducer (v) Thermocouple- active transducer (vi) Thermisters- passive transducer	**6M** ***1M each for right answer***

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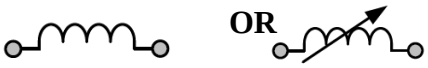
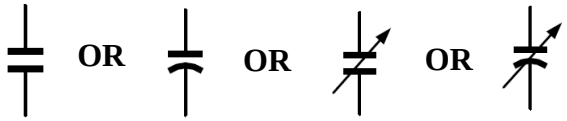
WINTER – 2018 EXAMINATION
MODEL ANSWER

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

Important Instructions to examiners:

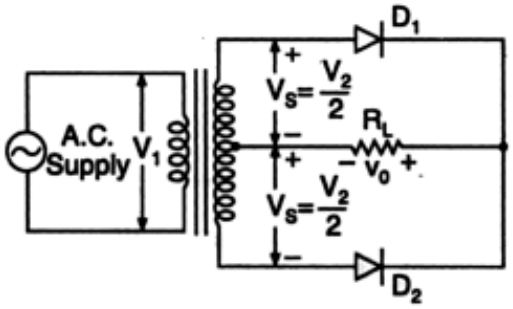
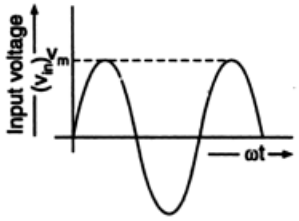
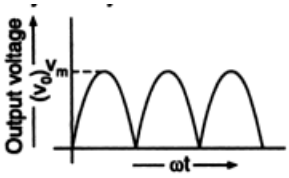
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 any equivalent 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.

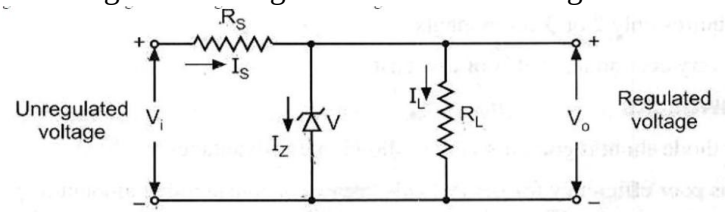
Q. No.	Sub Q.N.	Answer	Marking Scheme
1.		**Attempt any FIVE of the following:**	**10**
	(a)	**Draw the symbol of inductor and capacitor. State the unit of inductor and capacitor.**	**2M**
	Ans.	Symbol of Inductor:  **OR** Symbol of Capacitor:  **OR** **OR** **OR** Unit of Inductance : Henry OR H Unit of capacitance : farad OR F	***Each symbol ½ M*** ***Each Unit ½ M***

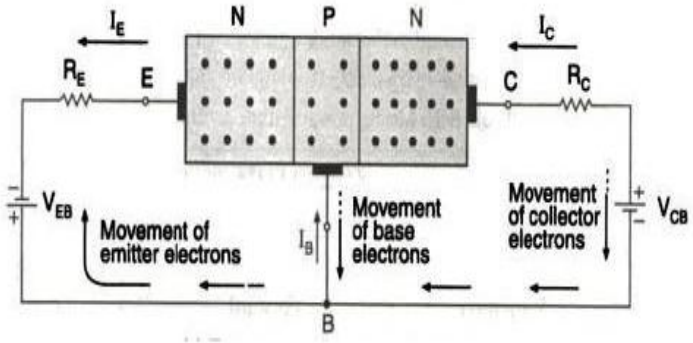
	(b) Ans	**State the need of filters. Define filter.** **Need**: In dc power supplies, the output of a rectifier contains dc component as well as ac component. The presence of the ac component is undesirable and must be removed so that pure dc can be obtained. Thus filters circuits are required. **Filters**: Filters are electronic circuits (consisting of inductors and capacitors) which remove or minimize unwanted ac component of the rectifier output and allows only the dc component to reach the load.	**2M** ***Need 1M*** ***Definitio n 1M***
	(c) Ans	**Define α and β of transistor.** **α (Alpha)** : This is the Common Base dc current gain. It defined as the ratio of collector current (I_C) to emitter current (I_E). $\alpha = \frac{I_C}{I_E}$ **β (Beta):** This is the Common Emitter dc current gain. It is defined as the ratio of collector current (I_C) to the base current (I_B). $\beta = \frac{I_C}{I_B}$	**2M** ***Each definition 1M***
	(d) Ans	**Define amplification factor and trans-conductance of JFET.** **Amplification factor:** Amplification factor (μ) of a JFET is the ratio of change in drain voltage to gate voltage keeping constant drain current. This indicates how much more control the gate voltage has over drain current compared to the drain voltage. $\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}}$ keeping I_D constant.	**2M** ***Each definition 1M***

		Transconductance: The transconductance g_m is the change in the drain current for a given change in gate to source voltage with constant drain to source voltage. $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$ keeping V_{DS} constant.	
	(e) **Ans**	**State the two advantages and disadvantages of integrated circuits.** **Advantages of Integrated circuits:** • Small in size due to the reduced device dimension. • Low weight due to very small size. • Low power requirement due to lower dimension and lower threshold power requirement. • Low cost due to large-scale production. • High reliability due to the absence of a solder joint. • Increased speed. • Easy replacement instead of repairing as it is economical. • Higher yield, because of the batch fabrication. **Disadvantages of Integrated circuits:** • IC resistors have a limited range. • Generally inductors (L) cannot be formed using IC. • ICs are delicate and cannot withstand rough handling • Limited amount of power handling. • Lack of flexibility. • Higher value capacitors cannot be fabricated.	**2M** ***Each advantage and disadvantage - ½M***
	(f) **Ans**	**Define transducer and name two passive transducers.** Transducer is a device that converts one form of energy into another form of energy. A transducer is a device which converts a physical quantity such as temperature, pressure, displacement, force etc., into equivalent electrical quantity either voltage or current. Examples of Passive transducers: • RTD • Inductive transducers	**2M** ***Definition 1M*** ***Each Example ½M***

		• Capacitive transducers • LVDT • LDR • Strain gauge • Thermisters	
	(g) **Ans**	**State seebeck and Peltier effect.** **Seebeck effect**: This states that whenever two dissimilar metals are connected together to form two junctions out of which, one junction is subjected to high temperature and another is subjected to low temperature then e.m.f is induced and it is proportional to the temperature difference between two junctions. **Peltier effect**: This states that for two dissimilar metals in a closed loop, if current is forced to flow through, then one junction will be heated and other will become cool. **OR** It is the presence of heating of one junction and cooling of the other when electric current is maintained in a circuit of material consisting of two dissimilar conductors.	**2M** ***Each Definition 1M***
2.	**(a)** **Ans.**	**Attempt any THREE:** **Determine the value of capacitance with the following colour code.** **(i) Orange, Orange, Blue** **(ii) Yellow, Violet, Yellow** **(i) Orange, Orange, Blue** **Colour coding:** Orange Orange Blue ↓ ↓ ↓ 3 3 6 **Value of capacitor:** 33×10^6 pF $= 33 \times 10^6 \times 10^{-12}$F $= 33 \times 10^{-6}$ F **= 33µF**	**12** **4M** ***Colour coding 1M***

		ii) Yellow, Violet, Yellow Yellow Violet Yellow ↓ ↓ ↓ 4 7 4 Value of capacitor : 47×10^4 pF = 470KpF **OR** = $47 \times 10^4 \times 10^{-12}$F = 47×10^{-8} F = **0.47µF**	***Correct answer with unit 1M***
	(b) **Ans**	**Draw the neat sketch of center tap full wave rectifier. Draw i/p and o/p waveforms.** **Circuit Diagram**  **Input and Output Waveforms**  	**4M** ***Any other relevant circuit Diagram 2M*** ***Waveforms 2M***

	(c) Ans	**Draw and explain zener diode as a voltage regulator.** **Zener diode as voltage regulator** A reverse biased Zener diode is used to provide a constant voltage across the load resister R_L. The voltage regulator circuit diagram showing the Zener diode is as given below.  For proper operation, the input voltage Vi must be greater than the Zener voltage Vz. This ensures that the Zener diode operates in the reverse breakdown condition. The unregulated input voltage Vi is applied to the Zener diode. **Regulation with varying input voltage: (Line Regulation)** As the input voltage increases, the input current (I_S) increases. This increases the current through Zener Diode, without affecting the load current (I_L). The increase in input current will also increase the voltage drop across R_S and keeps V_L as constant. If the input voltage is deceased, the input current also decreases. As a result, the current through zener will also decrease. Hence voltage drop across series resistance will be reduced. Thus V_L and I_L remains constant. **Regulation with varying load resistance: (Load Regulation)** The variation in the load resistance R_L changes I_L, thereby changing V_L. When load resistance decreases, the load current increases. This causes zener current to decrease. As a result, the input current and voltage drop across R_S remains constant. Thus, the load voltage V_L is also kept constant. On the other hand, When load resistance increases, the load current decreases. This causes zener current to increase. This again keeps the input current and voltage drop across R_S constant. Thus, the load voltage V_L	**4M** ***Diagram 2M*** ***Explanation 2M***

		is also kept constant. Thus, a Zener diode acts as a voltage regulator and the fixed voltage is maintained across the load resistor R_L	
	(d) **Ans**	**Describe the working principle of npn transistor with the help of diagram.** **NPN Transistor:** **Diagram:**  **Working principle:** Above figure shows NPN transistor with forward biased emitter-base junction and reverse biased collector-base junction. The forward bias causes the electrons in the N-type emitter to flow towards the base. This constitutes the emitter current I_E. As these electrons flow through the P-type they tend to combined with holes. As the base is likely doped and very thin therefore only a few electrons (2%) combine with holes to constitute base current I_B. The remaining electrons (98%) cross over in to the collector region to constitute collector current I_C. In this way almost the entire emitter current flows in the collector circuit. It is clear that emitter current is sum of collector and base current. $$\mathbf{I_E = I_B + I_C}$$	**4M** ***Any other relevant diagram 2M*** ***Explanation 2M***

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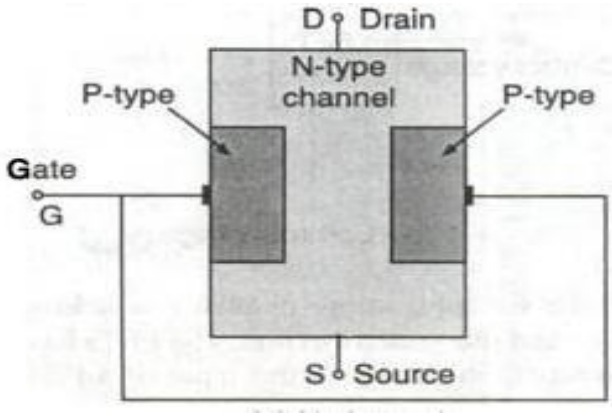
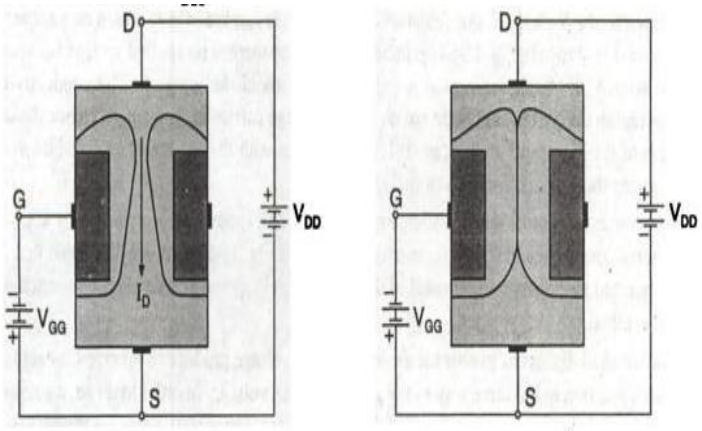
3		**Attempt any THREE:**	**12**
	(a)	**Sketch the construction of n-channel JFET and explain its working principle.**	**4M**
	Ans	**Construction of N-channel JFET**  **Working of N channel FET**  When a voltage is applied between the drain and source with a DC supply (V_{DD}), the electrons flows from source to drain through narrow channel existing between the depletion regions. This constitutes drain current ,I_D. The value of drain current is maximum when the external voltage applied between gate and source 0V.	***Construction 2M*** ***Working Principle 2M***

		When the gate to source voltage (applied by V_{GG})is increased above zero, 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) **Ans**	**Differentiate active and passive transducer on the basis of any four points.** **Parameters** / **Active Transducer** / **Passive Transducer** Working Principle: Operate under energy conversion principle / Operate under energy controlling principle Example: Thermocouple, Piezoelectric Transducer etc. / Thermistors, Strain Gauges etc. Advantage: Do not require external power supply for its operation / Require external power supply for its operation Application: Used for measurement of Surface roughness in accelerometers and vibration pick ups / Used for measurement of power at high frequency	**4M** ***Any four Comparison 1M each***
	(c)	**State the different types of resistors. State any four specifications of resistors.**	**4M**

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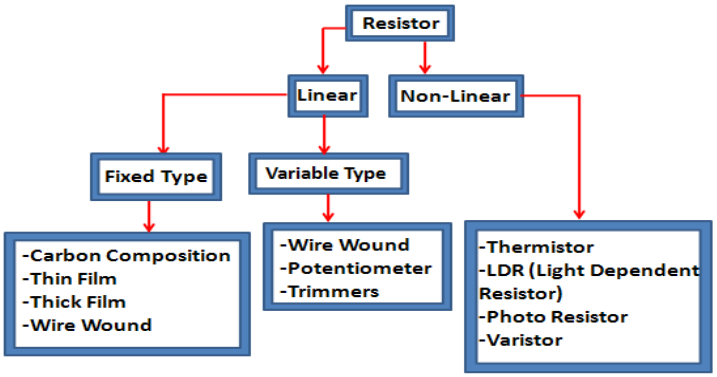
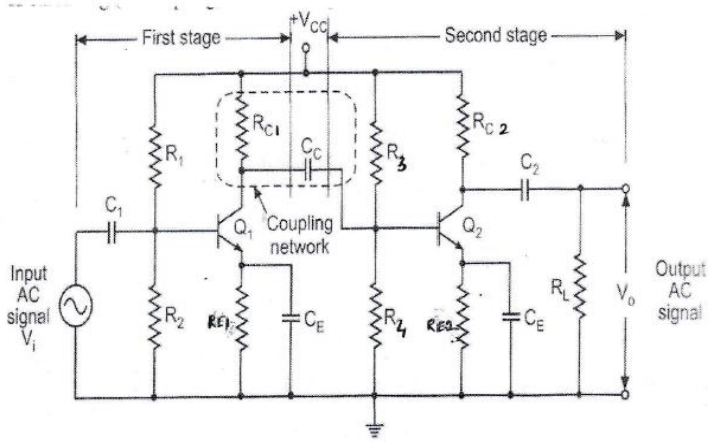
	Ans	**Different types of Resistors:-**  **Specifications of Resistor:-** • Temperature Coefficient. • Size or value of a resistor • Power Dissipation / wattage • Tolerance • Thermal Stability • Frequency Response. • Power De-rating. • Maximum Temperature. • Maximum Voltage.	***Classification 2M*** ***Any four Specifications of resistors 2M***
	(d) **Ans**	**Explain the working of two stages RC coupled amplifier with neat circuit diagram.**  	**4M** ***Diagram 2M***

		Two stages are connected with R & C components so it is called as RC Coupled amplifier. a) Resistor R_{C1}, R_3 & Capacitor C_C form the coupling network. b) R_1, R_2 , R_3, R_4 provide voltage divider bias to Q_1 & Q_2. c) R_{C1}& R_{C2} provide V_{CE} to Q_1 & Q_2. d) R_{E1} & R_{E2} provide bias stabilization. **Applications of RC Coupled Amplifier:** Excellent frequency response from 50 Hz to 20 KHz so it is very useful in the initial stage of all public address systems.	***Working with applications 2M***
4		**Attempt any THREE:**	**12**
	(a) **Ans**	**Explain any four selection criteria of transducers for temperature measurement.** ***Note: Any other relevant selection criteria shall be considered.*** 1. Ambient temperature range: It will impact on sensor accuracy as we can easily predict the ambient temperature effect on measurement taken from the sensor. 2. Stability & control precision requirement: If accuracy requirement is far better than 20F, use an RTD and if long term stability is required an RTD is better choice than Thermocouple. 3. Speed of response to temperature change requirement. Spring loaded temperature sensor and stepped thermo wells provide good speed of response. 4. Cost: Measurement failure most often results in production down time costs.	**4M** ***Any four Correct selection criteria of transducers 1M each***
	(b)	**Differentiate between P-N junction diode and zener diode.**	**4M**

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Ans

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

Any four Correct Comparison 1M each

(c) **Draw DC load line of transistor. Explain working of transistor as a switch.** **4M**

Ans

1. Q-point is the operating point of the transistor (I_{CQ}, V_{CEQ}) at which it is biased.

2. The concept of Q-point is used when transistor act as an amplifying device and hence is operated in active region of input output characteristics.

3.To operate the BJT at a point it is necessary to provide voltages and currents through external sources.

4.To draw DC load line of a transistor we need to find the saturation current and cutoff voltage.
The saturation current is the maximum possible current through the transistor and occurs at the point where the voltage across the collector is minimum.

5. The cutoff voltage is the maximum possible voltage across the collector and occurs at zero collector current.

A common emitter amplifier is shown the figure below:

Applying KVL to the collector circuit,
$V_{CC}-V_{CE} - I_C.R_C=0$

DC loadline 2M

Transistor as a switch 2M

Rearranging this equation we get,

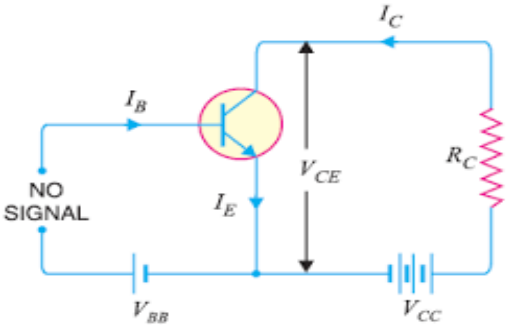
$I_C = (-1/RC).V_{CE} + (V_{CC}/R_C)$

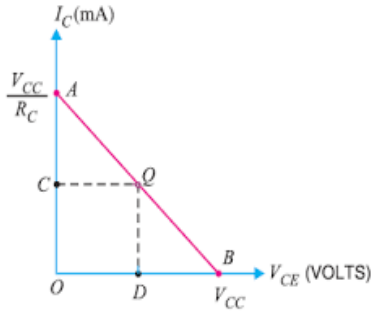
Compare the above equation with equation of a straight line ie.y=mx+c

Substituting $V_{CE}=0$, we get $I_C=V_{CC}/R_C$

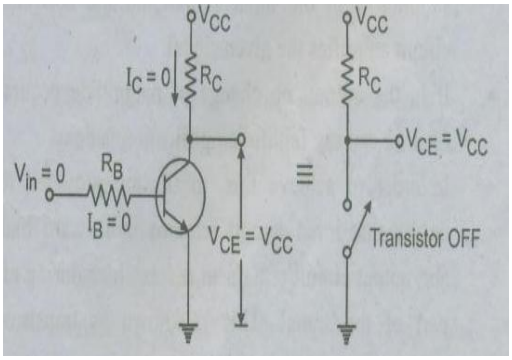
Substituting $I_C=0$, we get $V_{CE}=V_{CC}$

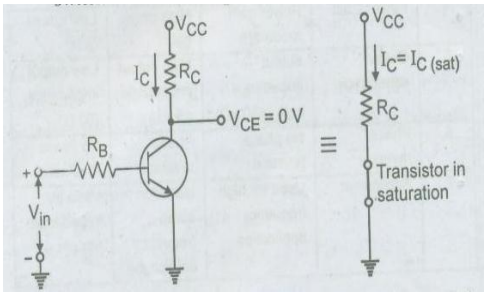
This straight line is called as DC load line





Transistor as a switch:



		1. Transistor in cut- off region is an open switch. Here V_{in} is 0 V. 2. In the cut –off region both the junction of a transistor are reverse biased and very small reverse current flows through the transistors. 3. The voltage drop across the transistor (V_{CE}) is high. Thus, in the cut off region the transistor is equivalent to an open switch as shown in figure.  In saturation the transistor is equivalent to a 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 (VCE) is very small, of the order of 0.2 V to 1V depending on the type of transistor and collector current is very large.	
	(d)	**Draw the Drain characteristics of JFET showing different operating regions. If drain current is 5mA, I_{DSS} = 10mA & Vas $_{(off)}$ = -6V. Find the value of V_{as}.** ***Note: V_{as} is considered as V_{GS}***	**4M**

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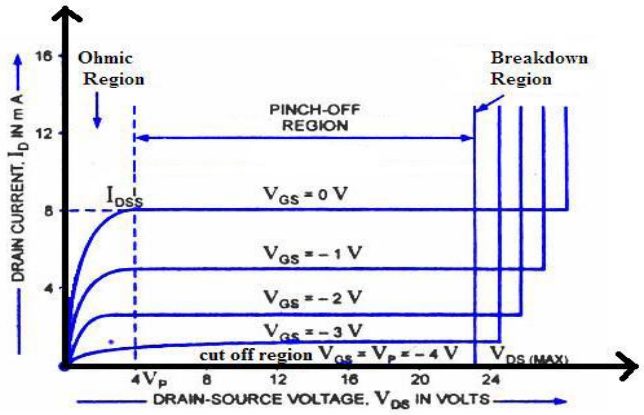
	Ans.	**Drain characteristics of JFET**  Given: $I_D = 5mA$ $I_{DSS} = 10mA$ $V_{GS(OFF)} = -6V$ $V_{GS} = ?$ $I_D = I_{DSS} \cdot \left(1 - \frac{V_{GS}}{V_{GS\ (OFF)}}\right)^2$ $V_{GS} = \left(1 - \frac{\sqrt{I_D}}{\sqrt{I_{DSS}}}\right) X\ V_{GS\ OFF}$ $V_{GS} = \left(1 - \frac{\sqrt{5mA}}{\sqrt{10mA}}\right) X - 6$ **V_{GS}= - 1.75V**	***Drain characteristics of JFET 2M*** ***Numerical Calculations 2M***
	(e) **Ans.**	**Draw the block diagram of regulated power supply and explain the working of each block.** ***Note: Any other block diagram with similar blocks shall be considered*** The block diagram of a Regulated Power supply unit is as shown below.	**4M**

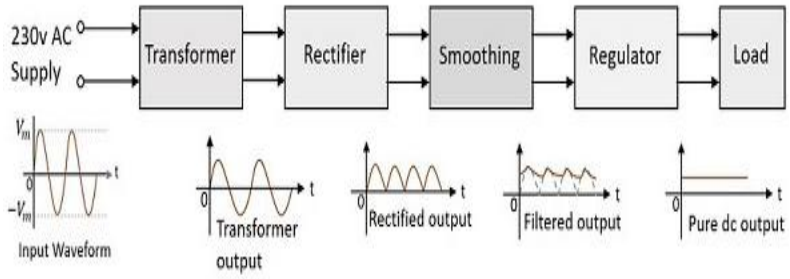


Diagram 2M

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.

Working of each block 2M

5	**(a)**	**Attempt any TWO** **Solve the following:** **(i) In the waveform shown in fig (1), state its amplitude, frequency, phase and wavelength.**	**12** **6M**

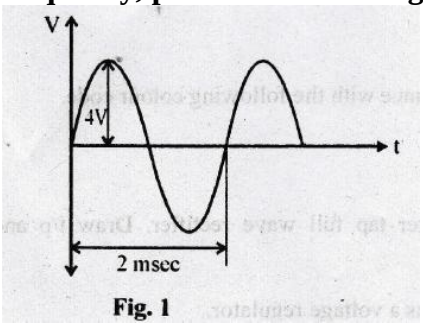


Fig. 1

	Ans	From given figure, **1. Amplitude = Vm = 4V** **2. Frequency (f) =** $\frac{1}{T}$ $\frac{\mathbf{1}}{\mathbf{2\ x\ 10^{-3}}}$ **=500Hz** **3. Phase:** =0 **4. Wavelength λ = Vc/f =(3*10 ^8)/500 = 6 x 10^5m** **(ii) Define: amplitude and frequency** **Amplitude:** The maximum value (positive or negative) attained by an alternating quantity is called its amplitude or peak value. The amplitude of an alternating voltage or current is designated by V_m or I_m. **Frequency:** The number of cycles that occurs in one second is called the frequency (f) of the alternating quantity. It is measured in cycles/ sec or Hertz(Hz)	***Each formula ½M*** ***Each final answer ½M*** ***Each definition 1M***
	(b)	**(i) In the circuit shown in fig (2), a silicon transistor with β = 50 is used. Take V_{BE} = 0.7V. Find Q point value.**	**6M**

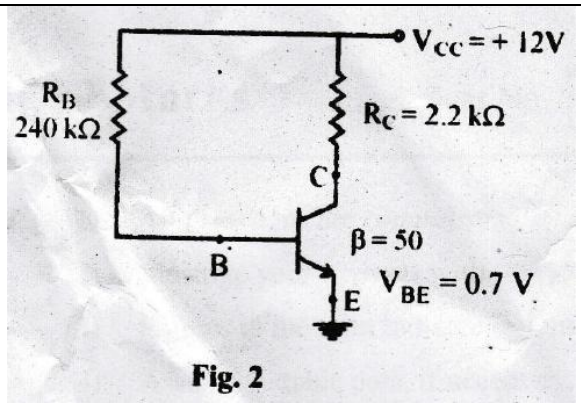


Fig. 2

Ans

Collector current at saturation:

$I_{C(SAT)} = \frac{Vcc}{Rc}$ — ***Each correct formula ½ M***

$I_{C(SAT)} = \frac{12}{2.2 \times 10^3}$

$I_{C(SAT)}$ = 5.45 mA

Value of cut-off voltage:

$V_{CE(cutoff)} = V_{CC}$

Therefore,

$V_{CE(cutoff)}$ = 12V — ***Each correct answer ½ M***

Base current , $I_B = \frac{Vcc}{RB}$

$I_B = \frac{12}{240 \times 10^3}$

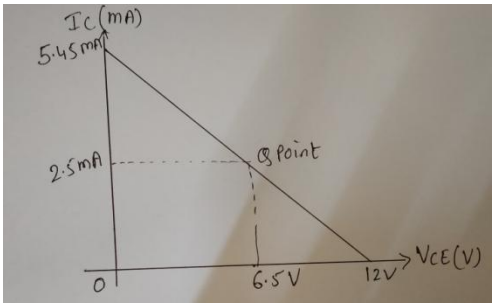
I_B = 50 µ A

Collector current,

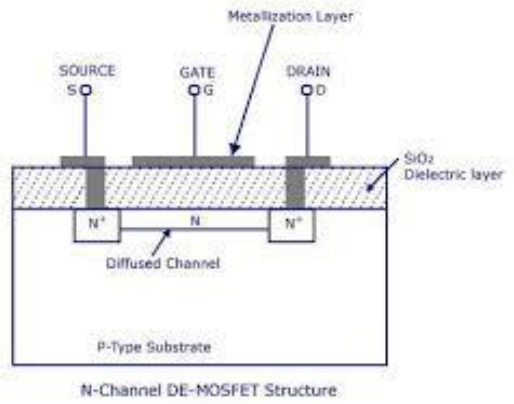
$I_C = \beta * I_B$

$I_C = 50 * 50 * 10^{\wedge -6}$

I_C = 2.5 mA

		Collector to emitter voltage , $V_{CE} = V_{CC} - (I_C * R_C)$ $V_{CE} = 12 - (2.5 * 10^{-3} * 2.2*10^3)$ **V_{CE} = 6.5 V** **Q-points are I_{CEQ} = 2.5 mA V_{CEQ} = 6.5 V** Q-point is located on the D.C. load line as shown in figure. 	
		(ii) Define operating point of the transistor. **Operating point:** For proper operation of a transistor, in any application, we set a fix level of certain currents and voltages in a transistor. These values of currents and voltages define the point, at which transistor operates. This point is called operating points or quiscent points or Q points.	***Q point definition 1 M***
	(c) **Ans**	**In full wave bridge rectifier V_m = 10V, RL = 10KΩ. find out V_{DC}, I_{DC}, ripple factor and PIV.** **In full wave bridge rectifier:** **1. $V_{DC} = 2V_m/\pi = 0.637* V_m$** Therefore, **$V_{DC} = 0.637* 10$** **$V_{DC} = 6.37$ V**	**6M** ***Each formula 1M***

		2. $I_{DC} = 2I_m/\pi = \frac{2Vm}{\pi * RL}$ Therefore, $I_{DC} = \frac{2\ x\ 10}{\pi\ x\ 10\ x\ 10^3}$ $I_{DC} = 0.636$ **mA** **3. Ripple factor** $\sqrt{\frac{I_{rms-1}}{I_{DC}}} = \sqrt{\frac{I_{m/\sqrt{2}-1}}{I_{DC}}}$ $\sqrt{\frac{V_m\ /\ _{RL\ x\ \sqrt{2}-1}}{I_{DC}}}$ 7.07×10^{-4} Therefore, **Ripple factor = 0.331** **4. PlV = Vm** Therefore, **PIV= 10 V**	***Each final answer ½ M***
6	**(a)** **Ans**	**Attempt any TWO:** **Explain working principle of N-channel depletion type MOSFET with construction diagram. Compare depletion type MOSFET & enhancement type MOSFET.**	**12** **6M**



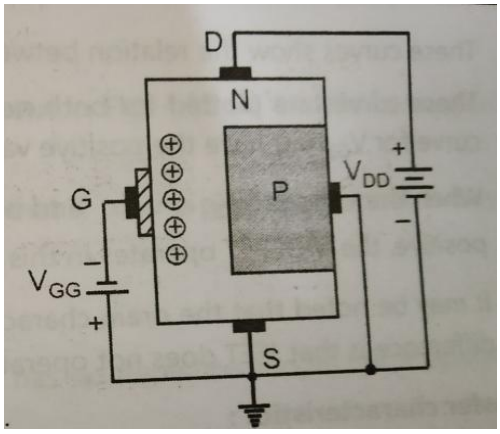
N-Channel DE-MOSFET Structure

Construction diagram 2M

Working principle:

The depletion type MOSFET can be operated in the following two ways:

1. Depletion mode:

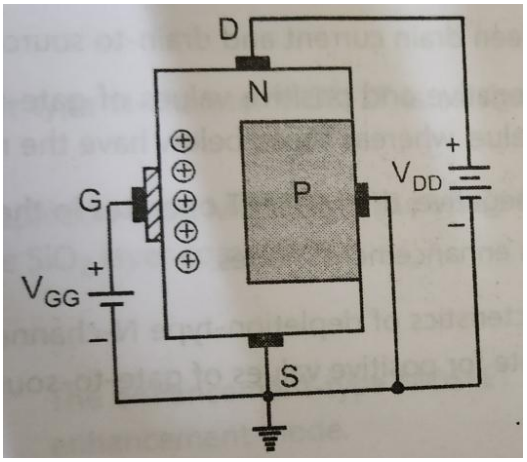


Working principle 2M

A depletion type N channel MOSFET with negative gate to source voltage is shown in figure. The negative gate voltage induces positive charges in N type channel through the insulating layer SiO2. Since, conduction of current through the N type channel is by means of majority carriers (i.e. electrons), the free electrons in the vicinity of positive charges are repelled away in the N type channel. This reduces the number of free electrons passing through the N type channel. As a result of this, the N type channel is

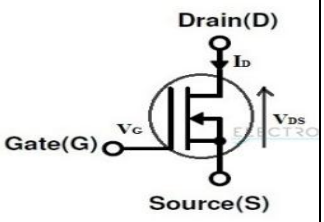
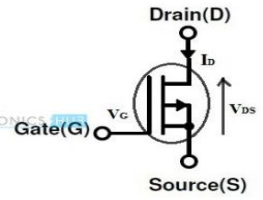
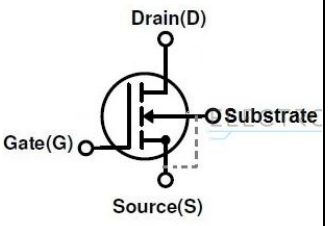
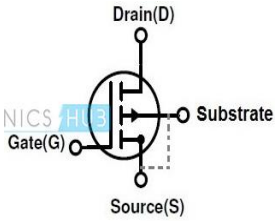
depleted of free electrons(i.e. majority carriers). Thus, it reduces the drain current flowing through the N type channel as the gate to source voltage is made more negative. As large negative gate to source voltage, the N type channel region near the drain end is totally depleted of free electrons and therefore the drain current reduces to zero.

2. Enhancement mode:



An enhancement type N channel MOSFET with positive gate to source voltage is shown in figure. The positive gate voltage induces negative charges in N type channel through the insulating layer SiO2. Since, conduction of current through the N type channel is by means of majority carriers(i.e. electrons), the free electrons in the vicinity of positive charges are added together in the N type channel. Thus, the positive gate voltage increases the number of free electrons passing through the N type channel. This increases the drain current flowing through the N type channel as a result, it enhances the conductivity of the N channel. Thus, it increases the drain current flowing through the N type channel as the gate to source voltage become more positive. Because of the fact, the positive gate operation is called an enhancement mode.

Comparison of Depletion type MOSFET & Enhancement type MOSFET

Sr. No.	Depletion type MOSFET	Enhancement type MOSFET
1	 N-Channel P-  Channel	 N- Channel  P- Channel
2	An insulating oxide layer is present between gate and channel.	An insulating oxide layer is present between gate and substrate.
3	N or P type channel is present**.**	N or P type channel is not present**.** At a time of operation, induced channel is created.
4	For N channel V_{GS} = negative (for depletion mode) V_{GS} = positive (for enhancement mode)	For N channel V_{GS} = only positive
5	For N-channel, If V_{GS} is more negative, drain current decreases more.	For N-channel, If V_{GS} is more positive, drain current increases more.

Comparison Any four points 2M

(b) **Differentiate CE, CB, CC, w.r.t. to** **6M**

(i) Input resistance
(ii) Output resistance
(iii) Current gain
(iv) Voltage gain
(v) Phase shift between input and output
(vi) Applications

Ans

Sr. No	**Parameter**	**CB**	**CE**	**CC**
1	Input resistance	Very low (20Ω)	Low(1K Ω)	High (500K Ω)
2	Output resistance	Very high (1M Ω)	High(40K Ω)	Low(50 Ω)
3	Current gain	Less than unity	High (20 to few hundred)	High (20 to few hundred)
4	Voltage gain	Medium	Medium	Less than unity
5	Phase shift between input and output	0	180°	0
6	Applications	As pre-amplifier	As Audio amplifier	For impedance matching

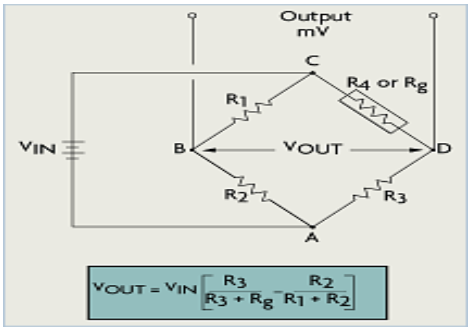
Each point 1M

(c) **List four types of electrical pressure transducers and describe one application of each one.** **6M**

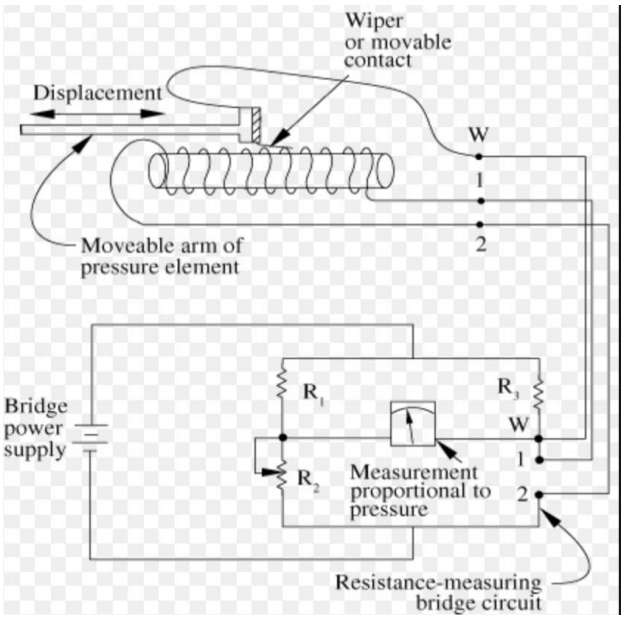
Note: ***½M may be granted for stating the application of each electrical pressure transducer without description.***

Ans **Types of electrical pressure transducers:** ***Any four Types 2M***

1.Strain gauge pressure transducers
2.Potentiometer pressure transducers
3.Piezoelectric pressure transducers
4. Reluctance pressure transducers
5. Capacitive pressure transducers

		Applications: **1.Strain gauge pressure transducers** In measurement of strain  In order to measure strain with a bonded resistance strain gauge, it must be connected to an electric circuit that is capable of measuring the minute changes in resistance corresponding to strain. Strain gauge transducers usually employ four strain gauge elements that are electrically connected to form a Wheatstone bridge circuit. The Figure shows a typical strain gauge diagram. A Wheatstone bridge is a divided bridge circuit used for the measurement of static or dynamic electrical resistance. The output voltage of the Wheatstone bridge is expressed in millivolts output per volt input. The Wheatstone circuit is also well suited for temperature compensation. The number of active strain gauges that should be connected to the bridge depends on the application. For example, it may be useful to connect gauges that are on opposite sides of a beam, one in compression and the other in tension. In this arrangement, one can effectively double the bridge output for the same strain. In installations where all of the arms are connected to strain gauges, temperature compensation is automatic as resistance change (due to temperature variations) will be the same for all arms of the bridge.	***Any one Application of each type 1M***

2.Potentiometer pressure transducers
In pressure measurement:



A potentiometric consists of a wire wound resistor with removable slide attached to it. Moving the slide will change the amount of resistance of the potentiometer. When the potentiometer is connected in an electronic circuit any movement of the slide on the potentiometer will change the resistance in the circuit. The circuit configuration most often used to make accurate measurement is the Wheatstone bridge.

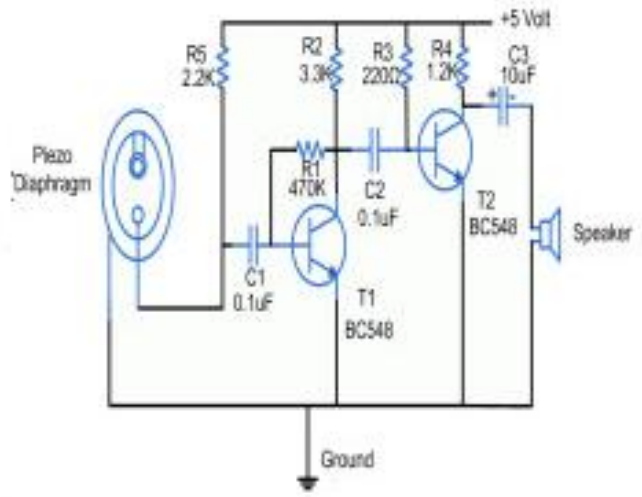
In a Wheatstone bridge, the bridge has two parallel legs. Each leg has two resistors in series. A voltage source has connected to the bridge so that current will follow through each leg. In a typical bridge, there is another circuit installed here. When the resistance of all four resistor is exactly equal the current flow through each leg is equal. In this condition, the bridge is balanced. However, if one of

these resistors is changed, current flow through each leg is no longer equal.

3. Piezoelectric pressure transducers

In detection of audio signal

The following circuit shows the piezoelectric sensor circuit diagram. The components required for this circuit are four resistors, speaker, two NPN transistor, capacitor, and piezo diaphragm. The generation of the electrical signal in the piezo diaphragm is when it is subjected to the pressure variation due to the sound in the vicinity. The output of the piezo-diaphragm is supplied to the two transistors of T1 & T2 (BC548) and the two transistors are known as a Darlington pair, it has a very high current.



Circuit Diagram of Piezoelectric Sensor

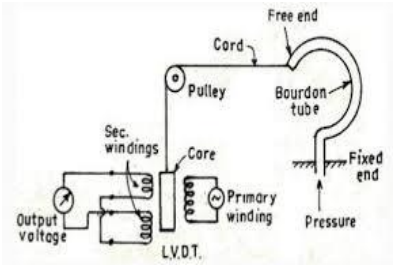
If piezo diaphragm receives any audio signals, in the opposite faces it produces the voltage difference. By using the capacitors C1 of 0.1µF the signal is filtered or a DC component. The first transistor T1 of the Darlington pair amplifiers of the input signal and the output appears at the resistor R2. For the transistor T1, base-collector bias is given by the resistor R1 of 470k. The output of the first transistor T1 is given to the base of the T2 transistor after it

is filtered by another capacitor C2.

In further the output of the transistor T1 is amplified by the transistor T2 and at the resistor R4, the amplified signal is produced. The R3 resistor is used for the necessary bias for the transistor T2. The output of the second transistor T2 is filtered with the capacitor C3 and it is connected to the speakers.

4. Reluctance pressure transducers

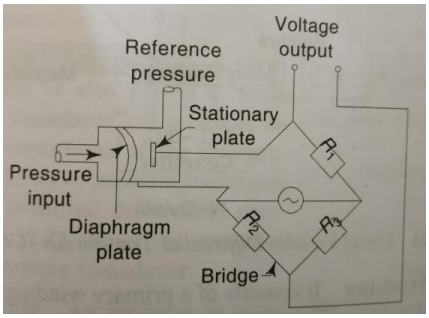
Measurement of fluid pressure in bourdon tube:



In this the, the bourdon tube act as primary transducer and LVDT which follows the output of bourdon tube act as a secondary transducer. The bourdon tube senses the pressure when liquid enters into it, it will bend depending upon the pressure of the fluid and converts it into a displacement. This set up is used for measurement of pressure which is converted into electrical signal by LVDT.

5. Capacitive pressure transducers

Measurement of pressure in pipe



		In this arrangement, in place of movable plate, diaphragm is used, which expands and contracts due to change in pressure. The diaphragm plate acts as a movable plate of a capacitor. A fixed plate is placed near the diaphragm. These plates form a parallel plate capacitor which is connected as one of the arms of a bridge. Any change in pressure causes a change in distance between the diaphragm and fixed plate, which is unbalances the bridge. The voltage output of the bridge corresponds to the pressure applied to the diaphragm plate.	

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WINTER-19 EXAMINATION

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

Model Answer

Important Instructions to examiners:

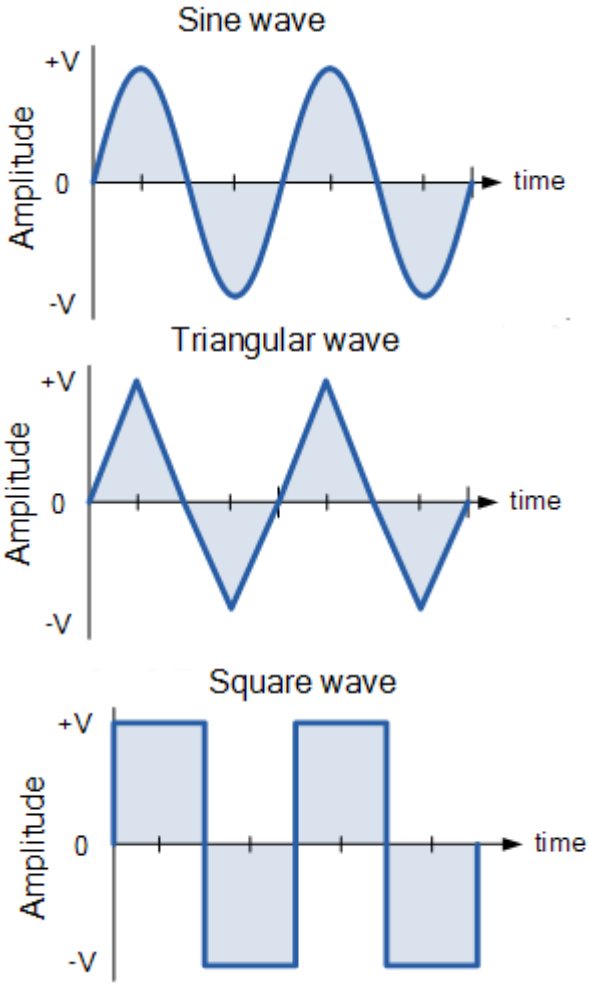
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

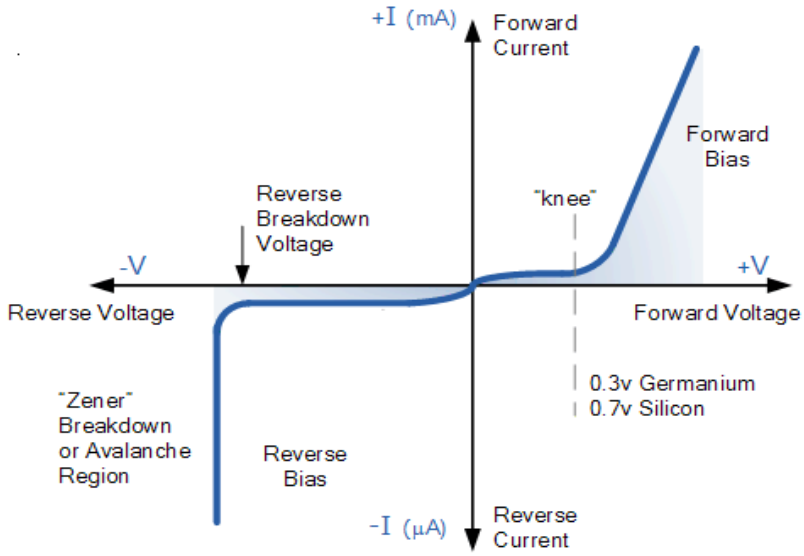
Q. No.	Sub Q. N.	Answers	Marking Scheme
1	**(A)**	**Attempt any FIVE of the following:**	**10- Total Marks**
	(a)	**Define resistor and draw symbol of variable resistor.**	**2M**
	Ans :	**Resistor:** A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic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

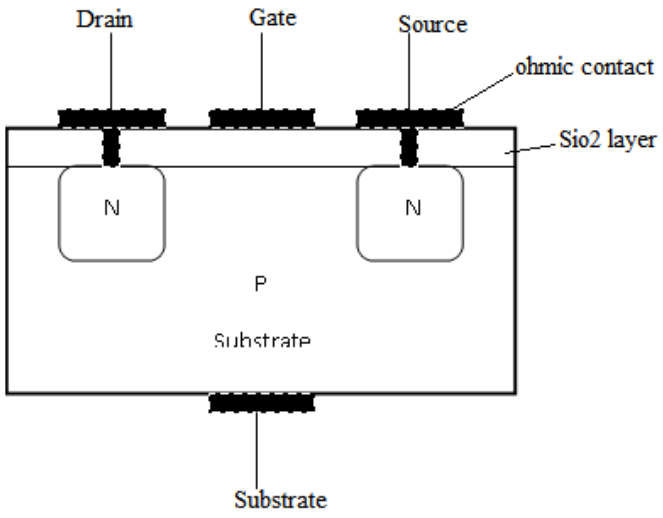
Ans : **Any four pints : 4M**

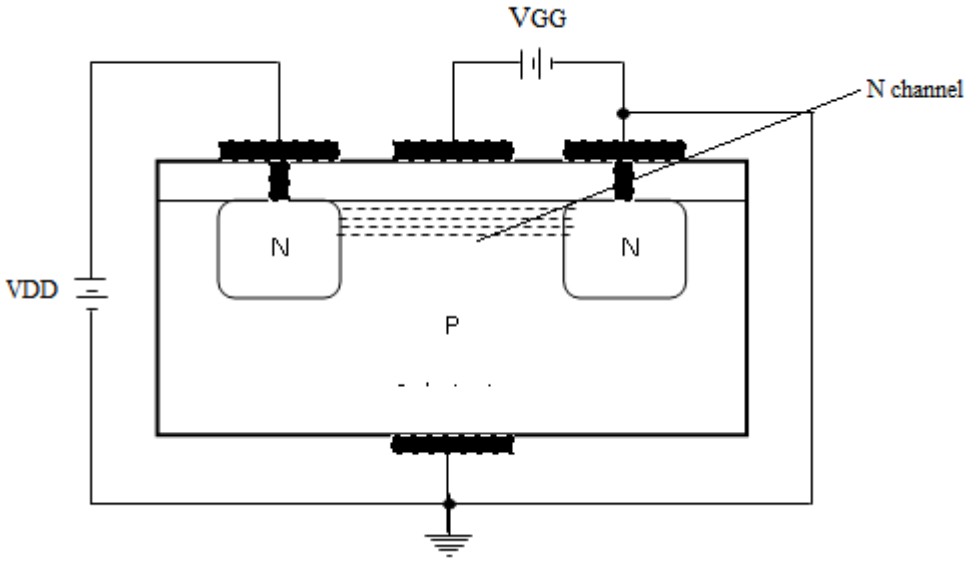
Factor	CB	CE	CC
Input impedance	Low or 50Ω	Medium OR 600 Ω to 4K Ω	High OR 1M Ω
Output impedance	High OR 50 K Ω	Medium OR 10K Ω to 50K Ω	Low OR 50 Ω
Curent gain	Less than or equal to 1	High (100)	High (100)
Voltage gain	High	High	Less than unit
Power gain	Moderate	High	Moderate
Applications	High frequency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

WINTER-19 EXAMINATION

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

Model Answer

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

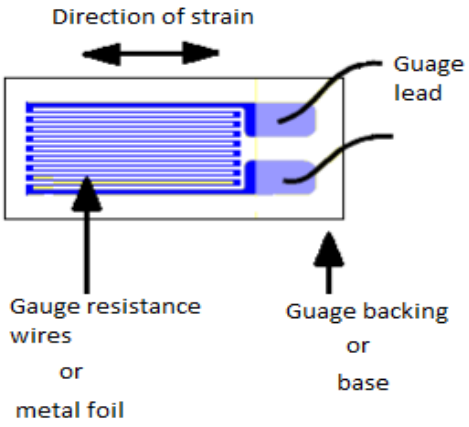
As V_{GS} increase by increasing VGG the concentration of electron near the Sio_2 surface increases & there is formation of channel & the current starts following through the circuit for further applied voltage.

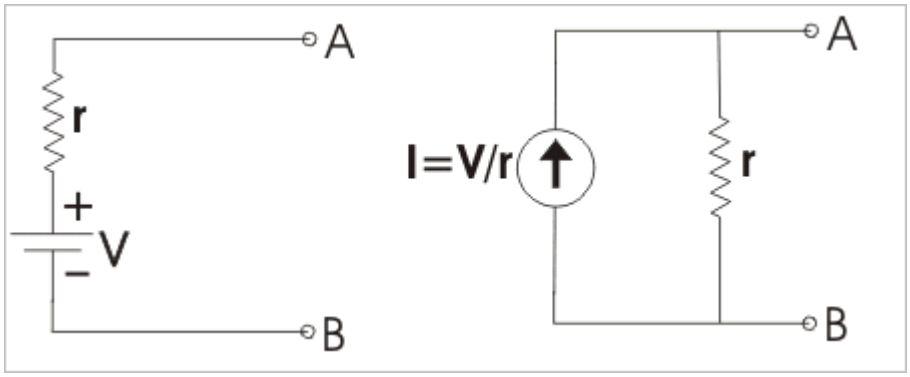
For V_{GS} = OV & negative value of V_{GS}, the absence of n channel will result zero current.

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

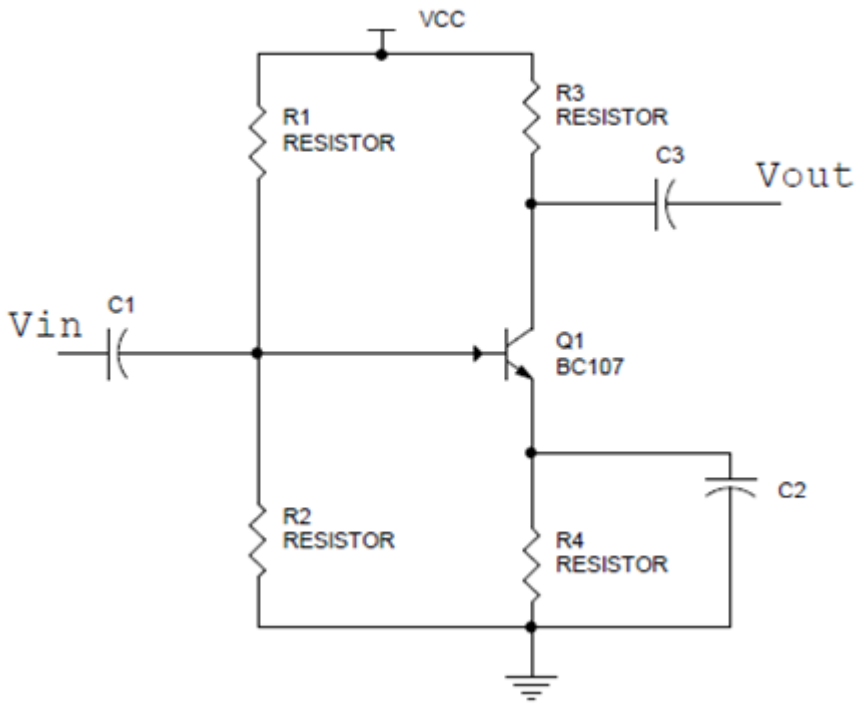
		 • The foil type strain gauges are very common in which a resistive foil is mounted on a backing material. Metal foil gauges use similar materials to wire strain gauges. • The sensing elements of foil gauges are formed from sheets less than 0.005 mm thick by photo etching processes, which allows greater 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**

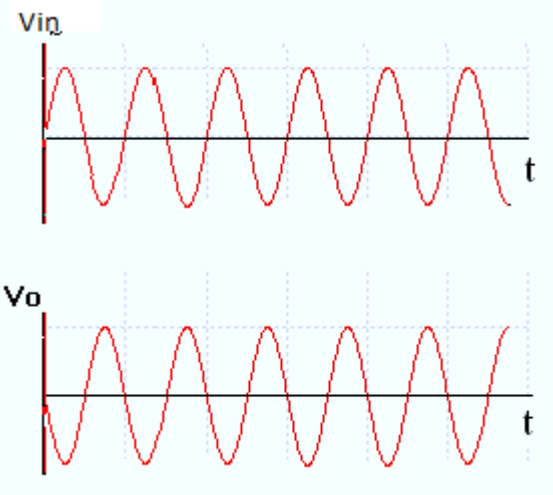
		and current to voltage source.  Figure A represents a practical voltage source in series with the internal resistance r while figure B represents a practical current source with parallel internal resistance r Therefore, for any practical voltage source, if the ideal voltage be V and internal resistance 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**

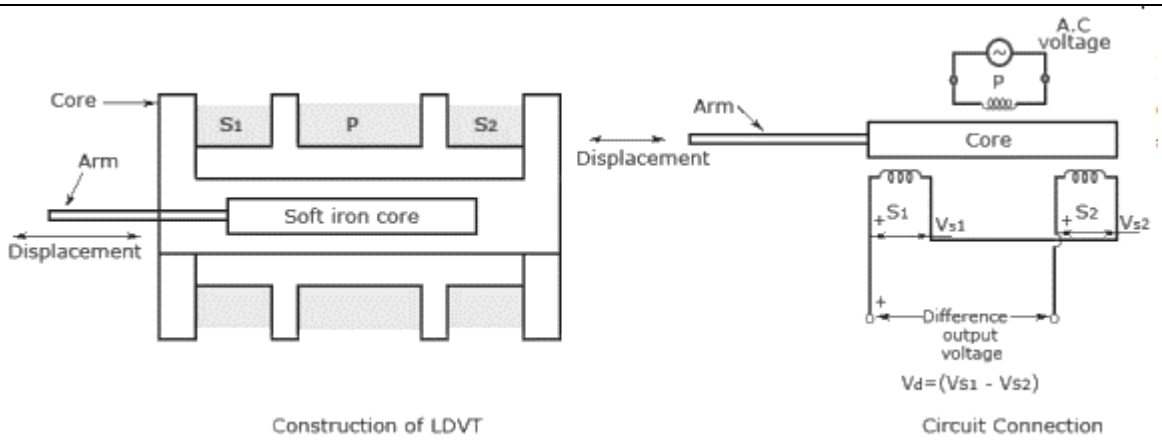
WINTER-19 EXAMINATION

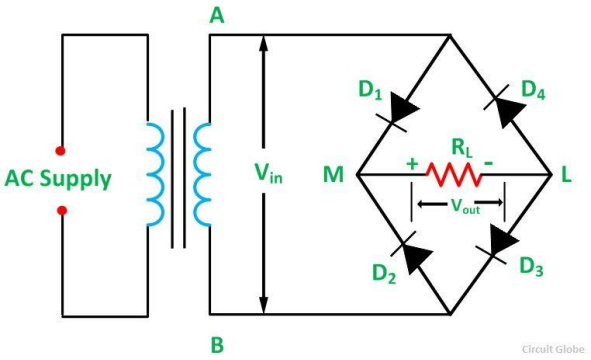
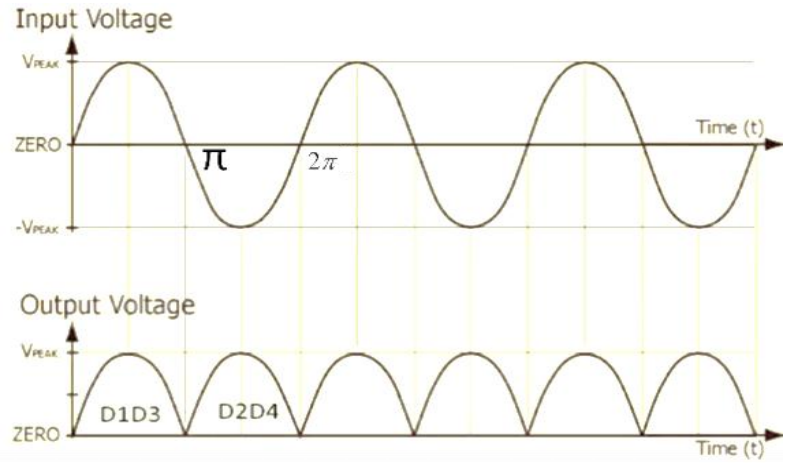
Subject Name: BASIC ELECTRONICS **Subject Code:** 22225

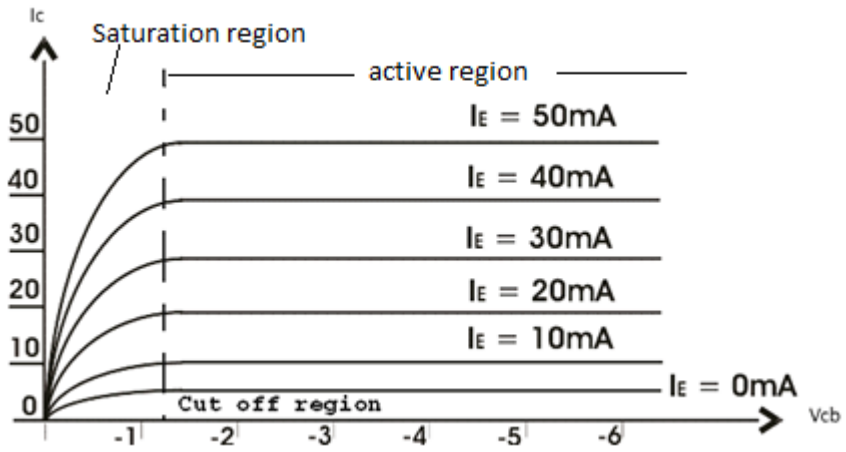
Model Answer

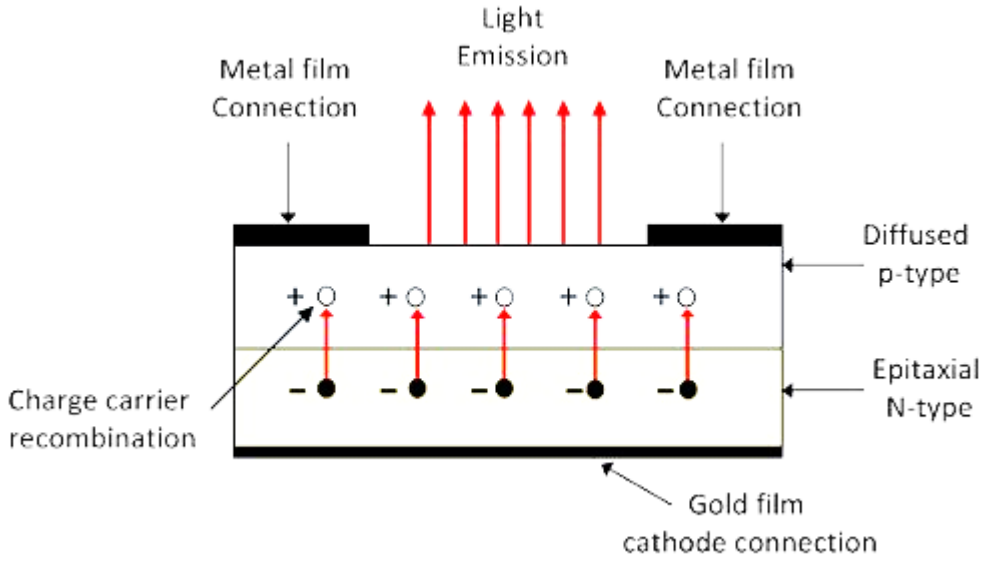
	Ans :	 The signal is fed at the input terminal and output is taken from collector and emitter end of supply. The total instantaneous output voltage Vce is given by Vce=Vcc-Ic Rc -----(1) When the signal voltage increases in the positive half cycle, the base current also increases. The result is that 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**

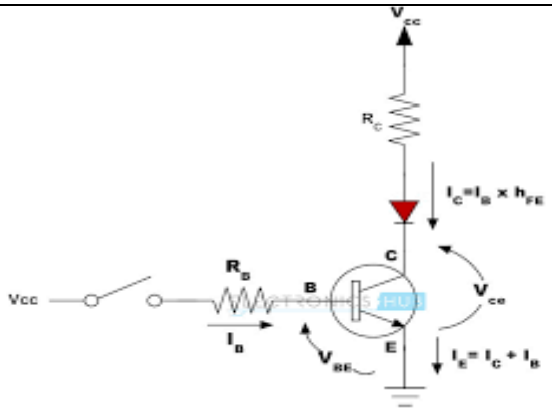
		appears across the output terminal of the transducer and gives a measurement of the physical position of the core.	
	(b)	**Draw circuit diagram of bridge rectifier. Draw its input output waveforms and describe its operation.**	**4M**
	Ans :		**Diagram-2M**
		Working: - The four diodes labelled D1 to 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**

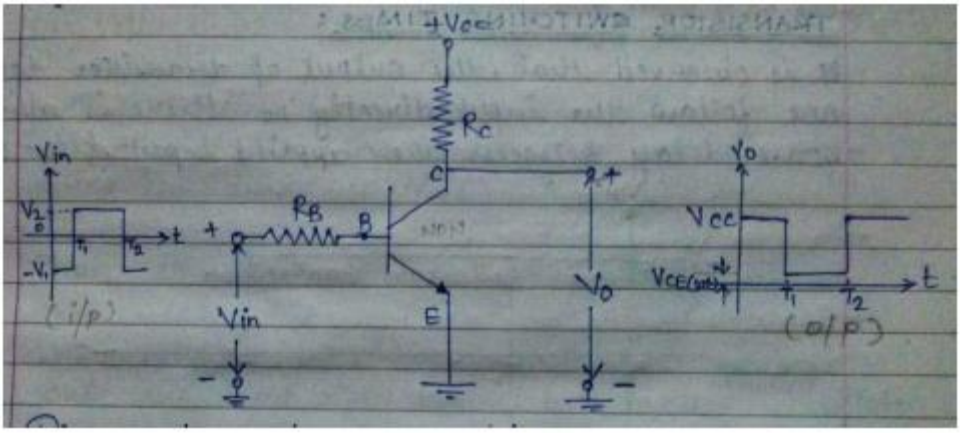
	(c)	**Draw O/P characteristics of CB configuration and explain its working.**	**4M**
	Ans :	 In common base configuration, emitter is the input terminal, collector is the output terminal and base terminal is connected as a common terminal for both input and output. The base-emitter junction is forward 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**

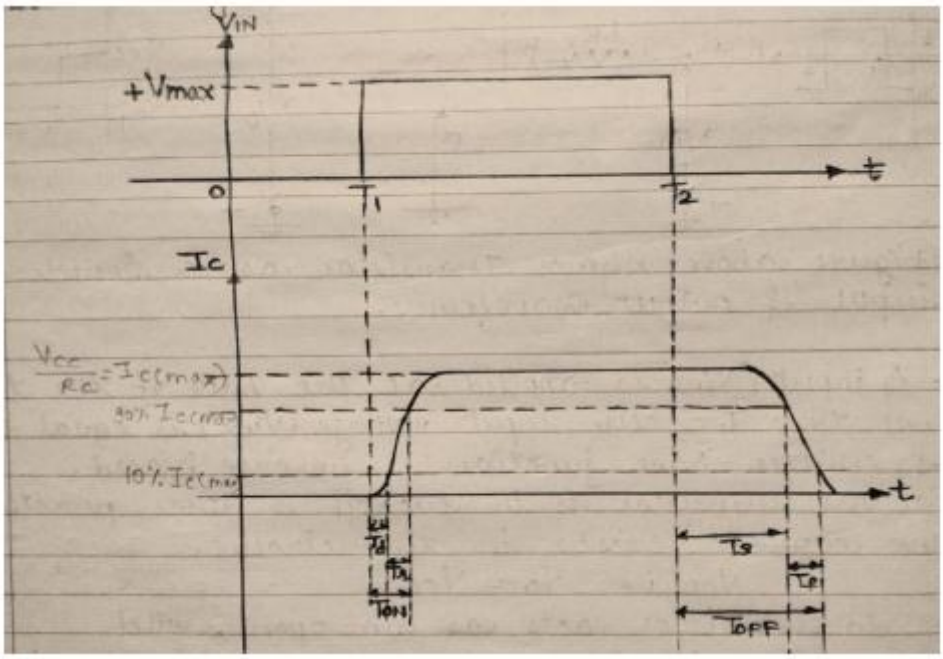
		holes from p-side are pushed towards the junction. • When free electrons reach the junction, some of the free electrons recombine with the holes in the positive ions. In the similar way, holes from p-side recombine with electrons in the depletion region. • Some free electrons from n-type semiconductor 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)**

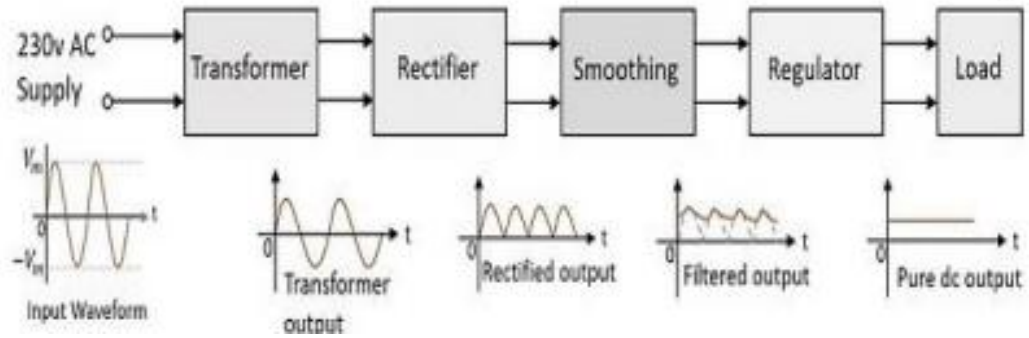
		2.Tolerance 3.Working voltage 4.Dielectric 5.Working temperature 6.Temperature coefficient **Inductor Specification:** 1.DC Resistance (DCR) 2.Maximum DC Current 3.Electromagnetic Interference (EMI) 4.Magnetic Saturation Flux Density 5.Curie Temperature	
	b)	**Describe how transistor can be used as a 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.

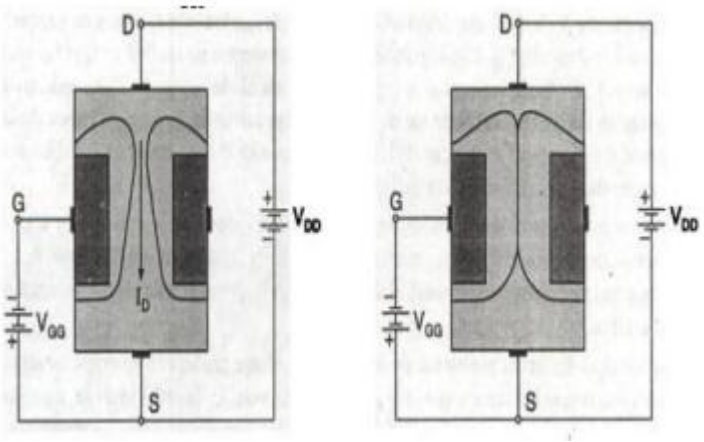
Rectifier – A Rectifier circuit to convert the AC signal into pulsating DC components.

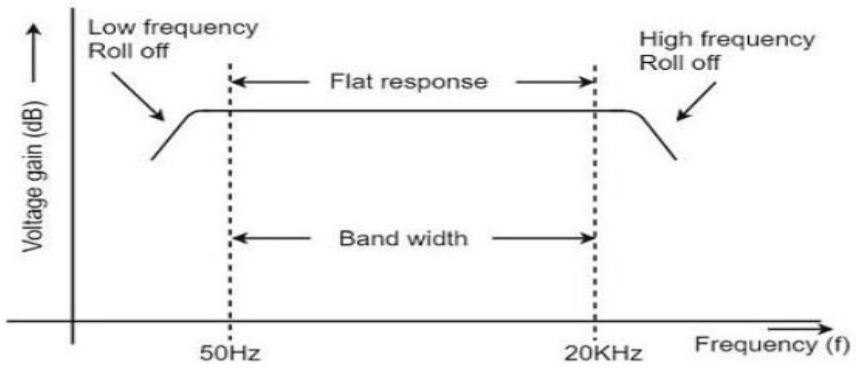
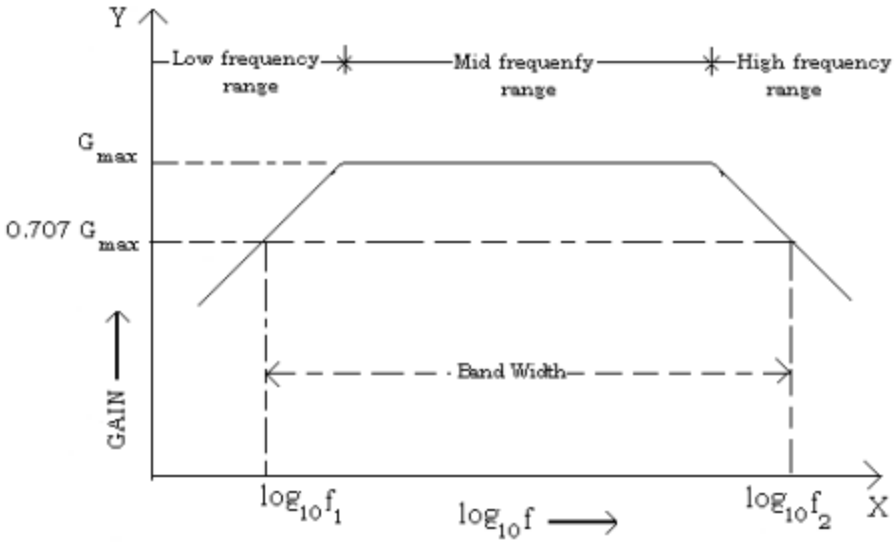
Smoothing – A filtering circuit to smoothen the variations present in the rectified output.

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	