D.Y.PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
KASABA BAWADA KOLHAPUR-416006
(An Autonomous Institute)
F. Y. B.Tech. (All Branches) (Semester-I/II)

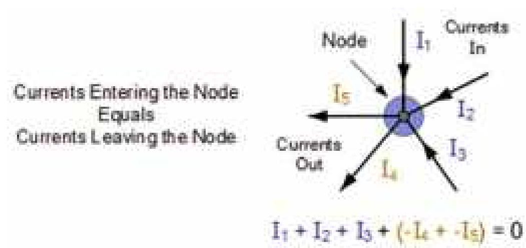
Q. Paper Code:
Set-: II

END SEMESTER EXAMINATION, April/May- 2022
COURSE NAME: Fundamental of Electrical and Electronics, COURSE CODE: 201GEL108

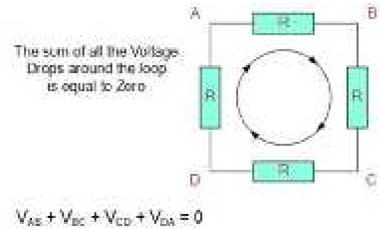
Seat No:

Day and Date: **Solution Set-II**
Time: **Max. Marks- 100**

Instructions:
i. *Question No. 1 is compulsory.*
ii. *Figure to the right indicate full marks.*
iii. *Assume suitable data if necessary.*

BT	CO's	Q.No.		Marks
		Q.1	**Attempt the following**	**40**
1	**CO108.1**	**a**	*i.)* State and Explain KVL and KCL with neat diagram **Kirchhoff's Laws:** **1. Kirchhoff's First Law:** According to Kirchhoff's Current Law, The total current entering a junction or a node is equal to the charge leaving the node as no charge is lost. Put differently, the algebraic sum of every current entering and leaving the node has to be null. This property of Kirchhoff law is commonly called as Conservation of charge wherein, I(exit) + I(enter) = 0.  In the above figure, the currents I1, I2 and I3 entering the node is considered positive, likewise, the currents I4 and I5 exiting the nodes is considered negative in values. This can be expressed in the form of an equation: **I1 + I2 + I3 – I4 – I5 = 0** Node refers to a junction or a connection of two or more current-carrying routes like cables and other components. **2. Kirchhoff's Second Law:** According to Kirchhoff's Voltage Law, The voltage around a loop equals to the sum of every voltage drop in the same loop for any closed network and also equals to zero. Put differently, the algebraic sum of every voltage in the loop has to be equal to zero and this property of	**5**

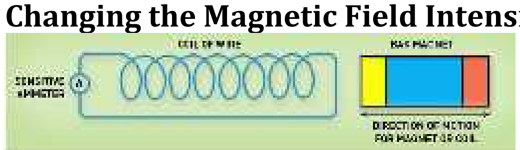
Kirchhoff's law is called as conservation of energy.



When you begin at any point of the loop and continue in the same direction, note the voltage drops in all the direction either negative or positive and return to the same point.
It is essential to maintain the direction either counterclockwise or clockwise; else the final voltage value will not be equal to zero.
When either AC circuits or DC circuits are analyzed based on Kirchhoff's circuit laws, you need to be clear with all the terminologies and definitions that describe the circuit components like paths, nodes, meshes, and loops.

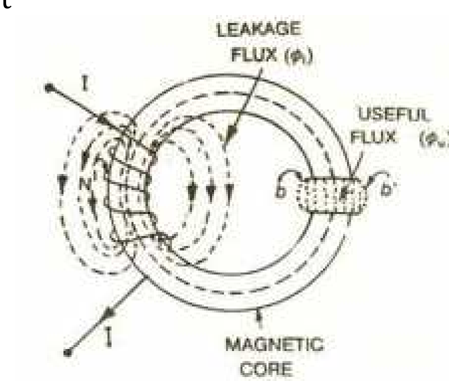
ii.) State and Explain Faradays laws of electromagnetic induction **5**

Faraday's Laws of Electromagnetic Induction
Faraday's law of electromagnetic induction, also known as Faraday's law is the basic law of electromagnetism which helps us to predict how a magnetic field would interact with an electric circuit to produce an electromotive force (EMF). This phenomenon is known as electromagnetic induction
Faraday's Laws of Electromagnetic Induction consists of two laws. The first law describes the induction of emf in a conductor and the second law quantifies the emf produced in the conductor. In the next few sections, let us learn these laws in detail.
1. Faraday's First Law of Electromagnetic Induction:
Whenever a conductor is placed in a varying magnetic field, an electromotive force is
induced. If the conductor circuit is closed, a current is induced which is called induced
current.
Changing the Magnetic Field Intensity in a Closed Loop



Magnetic field intensity in a closed loop
Mentioned here are a few ways to change the magnetic field intensity in a closed loop:

- By rotating the coil relative to the magnet.
- By moving the coil into or out of the magnetic field.
- By changing the area of a coil placed in the magnetic field.

			By moving a magnet towards or away from the coil. **2. Faraday’s Second Law of Electromagnetic Induction** Faraday’s second law of electromagnetic induction states that The induced emf in a coil is equal to the rate of change of flux linkage. The flux is the product of the number of turns in the coil and the flux associated with thecoil. The formula of Faraday’s law is given below: Where, e is the electromotive force F is the magnetic flux $e=-N\Delta\phi\Delta t$ N is the number of turns The negative sign indicates that the direction of the induced emf and change in the direction of magnetic fields have opposite signs. Increase in the number of turns in the coil increases the induced emf Increasing the magnetic field strength increases the induced emf Increasing the speed of the relative motion between the coil and the magnet, results in the increased emf	
2	**CO108.1**	**b**	*i.)* Explain The Terms magnetic leakage & fringing. **Magnetic Leakage** **Leakage flux** is defined as the magnetic flux which does not follow the particularly intended path in a magnetic circuit Taking an example of solenoid you can explain the **leakage flux** and the fringing both. When a current is passed through a solenoid, magnetic flux is produced by it  Most of the flux is set up in the core of the solenoid and passes through the particular path that is through the air gap and is utilized in the magnetic circuit. This flux is known as **Useful flux** fu. As practically it is not possible that all the flux in the circuit follows a particularly intended path and sets up in the magnetic core and thus some of the flux also sets up around the coil or surrounds the core of the coil, and is not utilized for any work in the magnetic circuit. This type of flux which is not used for any work is called **Leakage Flux** and is denoted by f*l*. Therefore, the total flux **F** produced	**6**

by the solenoid in the magnetic circuit is the sum of the **leakage flux** and the useful flux and is given by the equation shown below:

$$\varphi = \varphi_u + \varphi_l$$

- **Fringing**

The useful flux when sets up in the air gap, it tends to bulge outward at (b and b’) as shown in above figure, because of this bulging, the effective area of the air gap increases and the flux density of the air gap decreases. This effect is known as Fringing. Fringing is directly proportional to the length of the air gap that means if the length increases the fringing effect will also be more and vice versa.

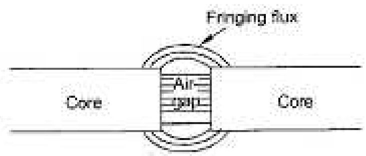


Fig. 2.5 *Flux fringing at air-gap*

ii.) Write a short note on

1. Resistance

Resistance

Resistance is a measure of the opposition to current flow in an electrical circuit. **Resistance** is measured in ohms, symbolized by the Greek letter omega (Ω).

4 (1 mark each)

2. Capacitance

Capacitance is the ratio of the amount of electric charge stored on a conductor to a difference in electric potential. There are two closely related notions of **capacitance**: self-**capacitance** and mutual **capacitance**.

3. Magnetic flux

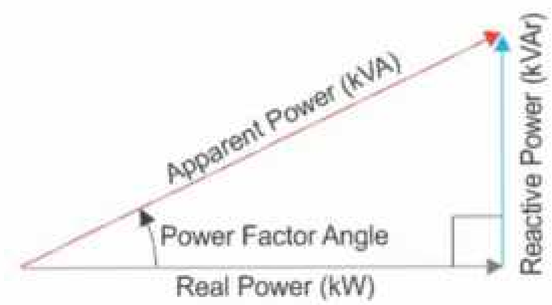
The magnetic flux:

The magnetic flux is analogous to the electric current. The magnetomotive force, mmf, is analogous to the electromotive force and may be considered the **factor that sets up the flux**. The mmf is equivalent to a number of turns of wire carrying an electric current and has units of ampere-turns. If either the current through a coil (as in an electromagnet) or the number of turns of wire in the coil is increased, the mmf is greater; and if the rest of the magnetic circuit remains the same, the magnetic flux increases proportionally

1. Definition of Magnetic flux :

It is defined as the number of magnetic field lines passing through a given closed surface. It provides the measurement of the total magnetic field that passes through a given surface area. Here, the area under consideration can be of any size

			and under any orientation with respect to the direction of the magnetic field. 4. Magnetic Field Strength • Magnetic field strength: The magnetic field is the area around a magnet in which there is magnetic force. Magnetic field strength, also called magnetic intensity or magnetic field intensity, the part of the magnetic field in a material that arises from an external current . It is expressed as the vector H Unit of Magnetic field strength units of Magnetic field strength amperes per meter	
2	**CO108.2**	**c**	i.) Compare the advantages of Three Phase over single phase system Three phase system has the following advantages as compare to single phase system: Power to weight ratio of 3-ø alternator is high as compared to 1-ø alternator. That means for generation for same amount of Electric Power, the size of 3-ø alternator is small as compare to 1-ø alternator. Hence, the overall cost of alternator is reduced for generation of same amount of power. Moreover, due to reduction in weight, transportation and installation of alternator become convenient and less space is required to accommodate the alternator in power houses. For electric power transmission and distribution of same amount of power, the requirement of conductor material is less in 3-ø system as compare to 1-ø system. Hence, the 3-ø transmission and distribution system is economical as compare 1-ø system. Let us consider the power produced by single phase supply and 3-phase supply at unity power factor. Waveform of power produce due 1-phase supply at unity power factor is shown in figure (C), and figure (D) shows the waveform of power produced due to 3-phase supply ii.) Express the power factor and its improvement methods Power factor and it's improvement: In general power is the capacity to do work. In electrical domain, electrical power is the amount of electrical energy that can be transferred to some other form (heat, light etc) per unit time. Mathematically it is the product of voltage drop across the element and current flowing through it. Considering first the DC circuits, having only DC voltage sources, the inductors and capacitors behave as short circuit and open circuit respectively in steady state. Hence the entire circuit behaves as resistive circuit and the entire electrical power is dissipated in the form of heat. Now coming to AC circuit, here both inductor and capacitor offer a certain amount of impedance given by Inductive reactance & capacitive reactance.	**5**

			The inductor stores electrical energy in the form of magnetic energy and capacitor stores electrical energy in the form of electrostatic energy. Neither of them dissipates it. Further, there is a phase shift between voltage and current. Hence when we consider the entire circuit consisting of a resistor, inductor, and capacitor, there exists some phase difference between the source voltage and current. The cosine of this phase difference is called electrical power factor. This factor ($-1 < \cos\varphi < 1$) represents the fraction of the total power that is used to do the useful work. The other fraction of electrical power is stored in the form of magnetic energy or electrostatic energy in the inductor and capacitor respectively. The total power in this case is:  Power Factor Triangle The term power factor comes into the picture in AC circuits only. Mathematically it is the cosine of the phase difference between the source voltage and current. It refers to the fraction of total power (apparent power) which is utilized to do the useful work called active power. There are three main ways to improve power factor: • Capacitor Banks • Synchronous Condensers • Phase Advancers **Capacitor Banks** Improving power factor means reducing the phase difference between voltage and current. Since the majority of loads are of inductive nature, they require some amount of reactive power for them to function. A capacitor or bank of capacitors installed parallel to the load provides this reactive power. They act as a source of local reactive power, and thus less reactive power flows through the line. Capacitor banks reduce the phase difference between the voltage and current.	
2, 3	**CO108.2**	**d**	i.) Describe the types of transformer Transducer can be categorized on the basis of four thoughts. 1. Primary and secondary type 2. Analogy and digital type 3. Active and passive type	**5**

4. Transducer and Inverse type

Primary and Secondary Transducer:

Suppose you need to measure pressure. In this case we use bourdon tube .so bourdon tube act as primary transducer it senses the pressure and converts pressure into displacement of its free end. The displacement of free end moves core of linear variable differential transducer which produces output voltage proportional to movement of core which is proportional to movement of core which is again proportional to pressure. So we are able to measure pressure. Here bourdon tube is primary transducer and LVDT is secondary transducer.

Analog and Digital Transducer:

Transducers converting input quantity to analog output in form of pulses are analog transducers. I.E. Strain gauge, thermocouple etc.

digital transducers convert input to electrical output in form of pulses.

Active and Passive Transducer:

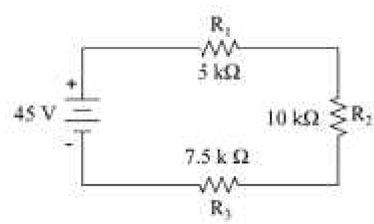
Active transducers are those which don't need auxiliary power source to produce output. The energy required for production of output signal is obtained from physical quantity being measured. I.E. piezoelectric crystals, tacho-generators etc.

Passive transducers are those which need an auxiliary power source to produce output. I.E. linear potentiometer etc.

Transducers and Inverse transducer:

Transducers, as mentioned earlier convert non electrical quantity to electrical quantity whereas inverse transducer converts electrical to non-electrical quantity. This type of transducer convert electrical signal in to required form. I.E. Piezoelectric Crystal. It coverts electrical signal in to mechanical vibration.

ii.) Verify the KVL for the circuit shown in Fig.1 **5**



Total R = 22.5k Ohm

Current I = 0.0020A or 2 mA

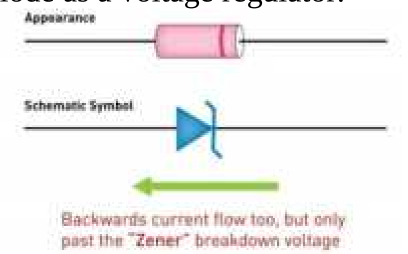
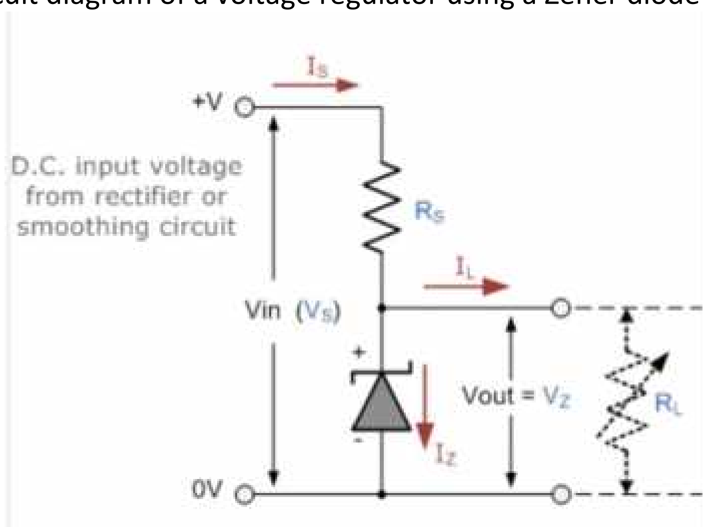
Voltage across 5k ohm= 10V

Voltage across 10k ohm= 20V

Voltage across 7.5 ohm= 15V

		Q.2	**Attempt the following**	**20**
2	**CO108.**	**a**	Discuss the feature of IC 78XX and LM317	**6**

	3		positive voltage regulator The 78XX voltage regulators Fig shows the connection diagram of 78XX series • Proper operation requires a common ground between the input and output voltages. • The difference between the input and output voltages (Vin – Vout) called dropout, voltage. • Capacitor Ci is required if the regulator is located an appreciable distance from a power supply filter. Even though C is not required, it may be used to improve the transient response of the regulator. Features • 3terminal positive voltage regulator with seven voltage options • High Output Current- typically 1.5A • Short circuit current limit- 750mA at 5v • Internal thermal overload protection • Low quiescent current- 6mA • Max input voltage = 35v • Minimum Input Voltage = Vout + 2.5 **LM317** Adjustable voltage regulators are those who voltage can be varied and utilized. Advantages of adjustable voltage regulators: • improved system performance • improved overload protection • improved system reliability The LM317 is a three terminal positive voltage regulator, which can be oper- ated with the output voltage regulated at any setting over the range of 1.2 V to 57 V. The three terminals are Vin, Vout and ADJUSTMENT (ADJ). Features: • Adjustable 3-terminal positive voltage regulator. • Output voltage can be set to range from 1.25V to 37V. • Output current is 1.5A. • Maximum Input to output voltage difference is 40V, Recommended 15V.	

			• Maximum output current when voltage difference is 15V is 2.2A. • Operating junction temperature is 125°C.	
2	CO108.3	b	Explain Zener diode as a voltage regulator.  **Zener Diode as a Voltage Regulator** There is a series resistor connected to the circuit in order to limit the current into the diode. It is connected to the positive terminal of the d.c. It works in such a way the reverse-biased can also work in breakdown conditions. We do not use ordinary junction diode because the low power rating diode can get damaged when we apply reverse bias above its breakdown voltage. When the minimum input voltage and the maximum load current is applied, the Zener diode current should always be minimum. Since the input voltage and the required output voltage is known, it is easier to choose a Zener diode with a voltage approximately equal to theload voltage, i.e. VZ = VL. The circuit diagram of a voltage regulator using a Zener diode is  shown:	6
2,4	CO108.3	c	Explain the construction & working of PN Junction diode with its VI Characteristics **PN Junction Diode:** A PN-junction diode is formed when a p-type semiconductor is fused to an n-type semiconductor creating a potential barrier voltage across the diode junction. A PN Junction Diode is one of the simplest semiconductor devices around, and which has the characteristic of passing current in only one direction only. If a suitable positive voltage (forward bias) is applied	8

between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction as the width of the depletion layer around the PN junction is decreased. By applying a negative voltage (reverse bias) results in the free charges being pulled away from the junction resulting in the depletion layer width being increased. This has the effect of increasing or decreasing the effective resistance of the junction itself allowing or blocking the flow of current through the diodes pn-junction. There are two operating regions and three possible “biasing” conditions for the standard Junction Diode and these are:

1. **Zero Bias** –

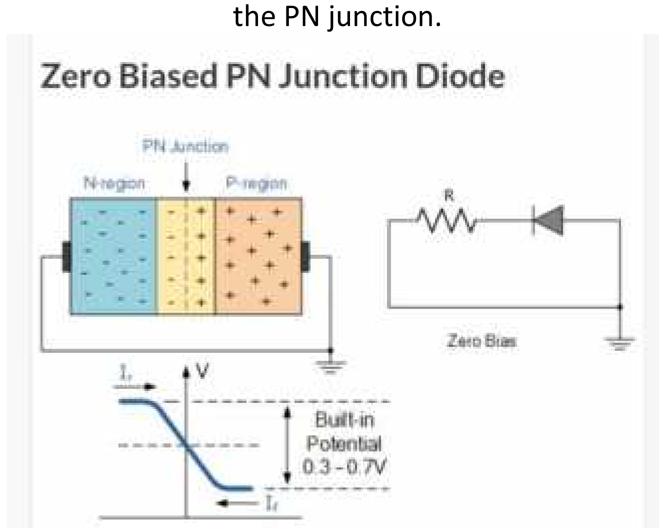
No external voltage potential is applied to the PN junction diode.

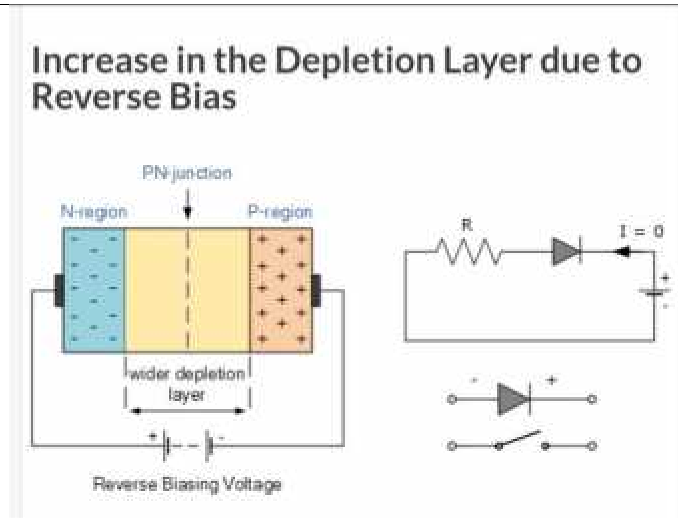
2. Reverse Bias – The voltage potential is connected negative, (-ve) to the P-type material and positive, (+ve) to the N-type material across the diode which has the effect of Increasing the Injunction diode’s width.

3. Forward Bias – The voltage potential is connected positive, (+ve) to the P-type material and negative, (-ve) to the N-type material across the diode which has the effect of Decreasing the PN junction diodes width.

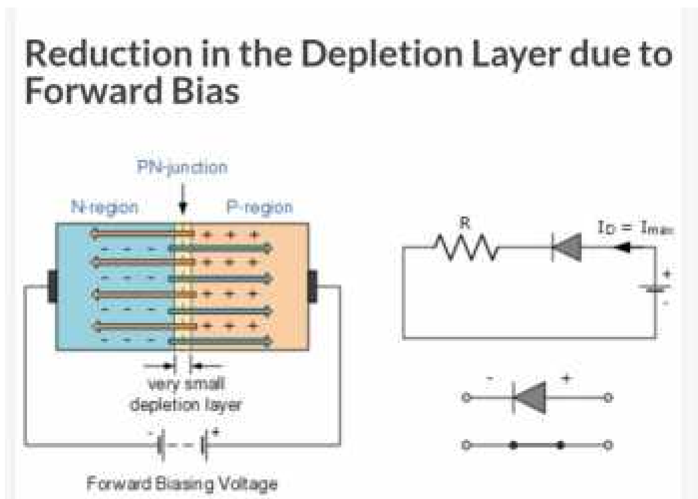
Zero Biased Junction Diode

When a diode is connected in a Zero Bias condition, no external potential energy is applied to the PN junction.



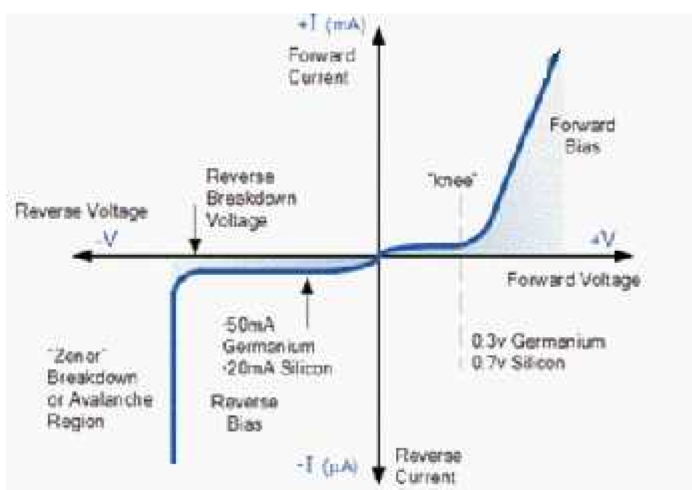


it will cause the diode’s PN junction to overheat and fail due to the avalanche effect around the junction. This may cause the diode to become shorted and will

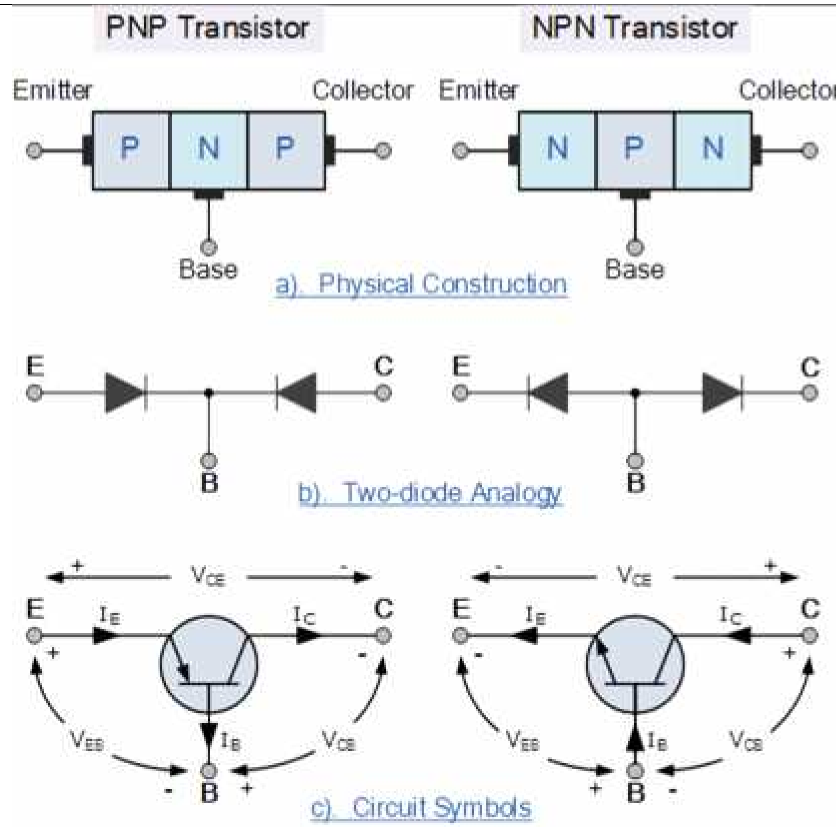
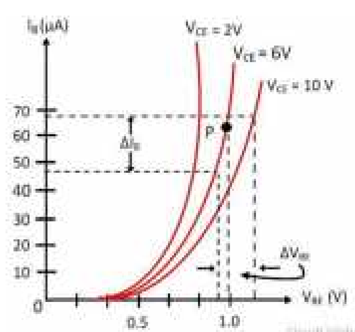


This condition represents the low resistance path through the PN junction allowing very large
currents to flow through the diode with only a small increase in bias voltage.

V-I Characteristics of PN junction diode:



		Q.3	**Attempt (any four questions)**	**20**
2	**CO108.3**	**a**	Explain the following terms w.r.t. DC Load line i. Quiescent Point ii. Saturation region iii. Cut off region iv. Active Region Cut off. The point where the load line intersects the IB = 0 curve is known ascut off. At this point, IB = 0 and only small collector current (i.e. collector leakage current ICEO) exists. At cut off, the base-emitter junction no longer remains forward biased and normal transistor action is lost. The collector-emitter voltage is nearly equal to VCC i.e. VCE (cut off) = VCC Saturation. The point where the load line intersects the IB = IB(sat) curve is called saturation. At this point, the base current is maximum and so is the collector current. At saturation, collector-base junction no longer remains reverse biased and normal transistor action is lost. Active region. The region between cut off and saturation is known as active region. In the active region, collector-base junction remains reverse biased while base-emitter junction remains forward biased. Consequently, the transistor will function normally in this region.	5
1,2	**CO108.3**	**b**	Describe construction and working Principle of Bipolar Junction Transistor (BJT). The **Bipolar Transistor** basic construction consists of two PN-junctions producing three connecting terminals with each terminal being given a name to identify it from the other two. These three terminals are known and labelled as the Emitter (E), the Base (B) and the Collector (C) respectively. Bipolar Transistors are current regulating devices that control the amount of current flowing through them from the Emitter to the Collector terminals in proportion to the amount of biasing voltage applied to their base terminal, thus acting like a current-controlled switch. As a small current flowing into the base terminal controls a much larger collector current forming the basis of transistor action. The principle of operation of the two transistor types PNP and NPN, is exactly the same the only difference being in their biasing and the polarity of the power supply for each type	5

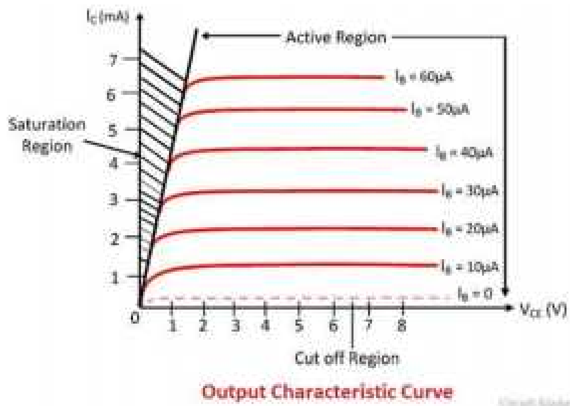
			 	
1,2	**CO108.3**	**c**	Explain CE configuration input and output characteristic. • Input Characteristic Curve • The curve plotted between base current I_B and the base-emitter voltage V_{EB} is called Input characteristics curve. • For drawing the input characteristic the reading of base currents is taken through the ammeter on emitter voltage V_{BE} at constant collector-emitter current. • The curve for different value of collector-base current is shown in the figure below.  • The base current I_B increases with the increases in the emitter-base voltage V_{BE}. Thus the input resistance of the CE configuration is high. • The input characteristic resembles like the forward characteristic of P-N junction diode	5

- The effect of CE does not cause large deviation on the curves, and hence the effect of a change in V_{CE} on the input characteristic is ignored.
- **Input Resistance:** The ratio of change in base-emitter voltage V_{BE} to the change in base current ΔI_B at constant collector-emitter voltage V_{CE} is known as input resistance, i.e.,

$$r_I = \frac{\Delta V_{BE}}{\Delta I_B} \text{ at constant } V_{CE}$$

Output Characteristic

In CE configuration the curve draws between collector current I_C and collector-emitter voltage V_{CE} at a constant base current I_B is called output characteristic.



Output Characteristic Curve

- The value of the collector current I_C increases with the increase in V_{CE} at constant voltage I_B, the value β of also increases.

- When the V_{CE} falls, the I_C also decreases rapidly.

- In the saturation region, the collector current becomes independent and free from the input current I_B

- In the active region $I_C = \beta I_B$, a small current I_C is not zero, and it is equal to reverse leakage current I_{CEO}.

- **Output Resistance:** The ratio of the variation in collector-emitter voltage to the collector-emitter current is known at collector currents at a constant base current I_B is called output resistance r_o.

$$r_o = \frac{\Delta V_{CE}}{\Delta I_C} \text{ at constant } I_B$$

<table>
<tr>
<td></td>
<td></td>
<td>d</td>
<td>
Define Stabilization and explain stability factors.
Stabilization

The process of making the operating point (ie Q Point) independent of temperature changes or variations in transistor parameters is known as **Stabilization**.

Stability Factor S:

It is defined as the rate of change of collector current IC with respect to the collector base leakage current ICo, keeping both the current IB and the current gain β constant.
S = ΔIC/ΔICO by keeping IB and the current gain β constant.

Stability factor S':

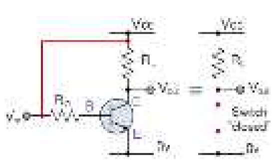
The Stability factor S' is defined as the rate of change of IC with VBE, keeping ICo and β constant.

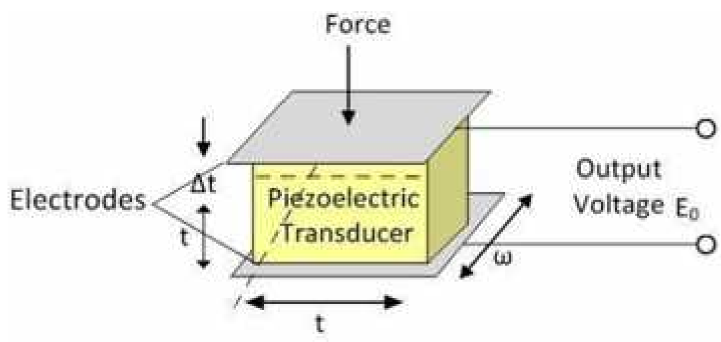
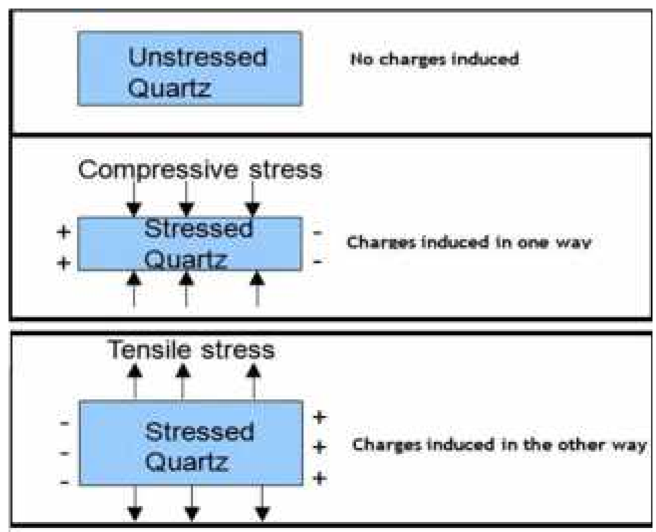
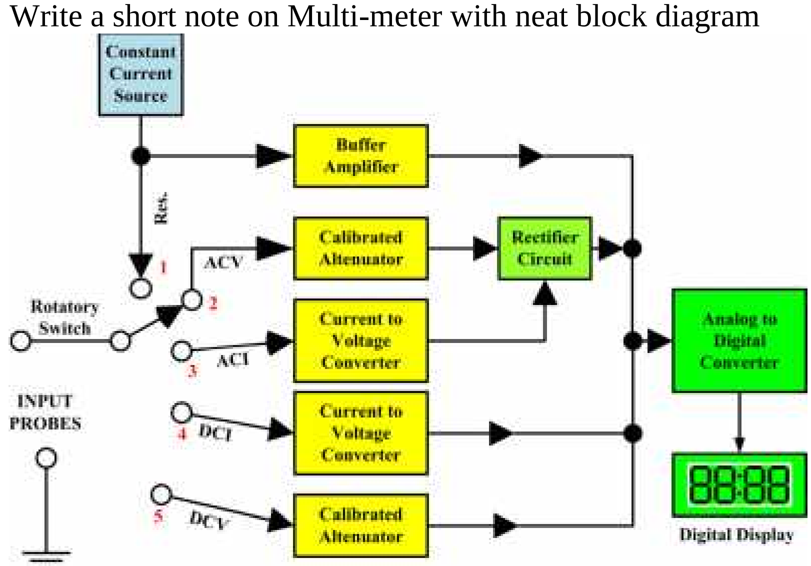
S'=ΔIC/ΔVBE| by keeping ICo and β constant.

Stability factor S'':
The stability factor S" is defined as the rate of change of IC with respect to β, keeping ICO and VBE constant.
S'' =ΔIC/Δβ| by keeping I_{Co} and V_{BE} constant
</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e</td>
<td>
Describe transistor as a switch.

Cut-off Characteristics

<table>
<tr>
<td></td>
<td>
• The input and Base are grounded (0v)
• Base-Emitter voltage V_{BE} < 0.7v
• Base-Emitter junction is reverse biased
• Base-Collector junction is reverse biase
• Transistor is "fully-OFF" (Cut-off regi
• No Collector current flows ($I_C = 0$)
• $V_{OUT} = V_{CE} = V_{CC}$ = "1"
• Transistor operates as an "open switch
</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>
to V_{CC}
• Base-Emitter voltage V_{BE} > 0.7v
• Base-Emitter junction is forward biased
• Base-Collector junction is forward bias
• Transistor is "fully-ON" (saturation reg
• Max Collector current flows (I_C = Vcc/
• $V_{CE} = 0$ (ideal saturation)
</td>
</tr>
</table>
</td>
<td>5</td>
</tr>
</table>

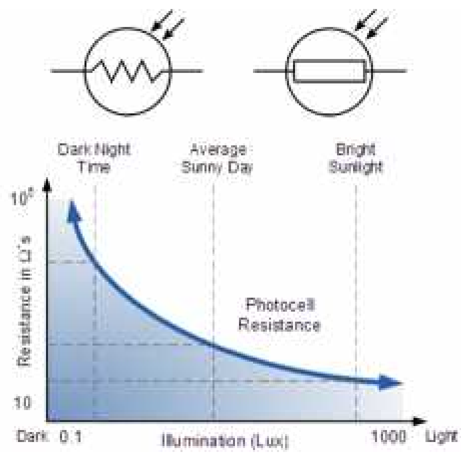
			• $V_{OUT} = V_{CE} =$ "0" • Transistor operates as a "closed switch"	
		Q.4	**Attempt the following**	**20**
3,4	**CO108.4**	**a**	Explain Pressure transducer and illustrate its advantages and disadvantages   	5
3,4	**CO108.4**	**b**	Write a short note on Multi-meter with neat block diagram  	5

c

Explain Photo transducer with its advantages and disadvantages

5

Light Dependent Resistor(LDR)



- A LDR (Light Dependent Resistor) or photo-resistor is a resistor that will change its resistance, depending on how much light is shining on it.

- As the light intensity on the LDR increases, the resistance of the LDR decreases and as decreases resistance increases

- They are also called as photoconductors, photoconductive cells or simply photocells.

Working

- It is made from a piece of exposed semiconductor material that changes its electrical resistance from several thousand Ohms in the dark to only a few hundred Ohms when light falls upon it by creating hole-electron pairs in the material.

- When the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band.

- When light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in a large number of charge carriers, hence it is said that the resistance of the device has been decreased.

- When a light dependent resistor is kept in dark, its resistance is very high. This resistance is called as dark resistance.

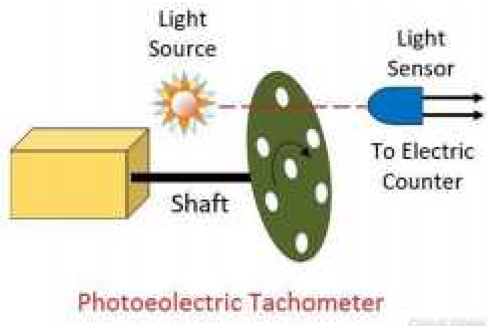
LDR advantages

- High sensitivity (due to the large area it can cover).
- Easy employment.
- Low cost.
- High light-dark resistance ratio.

LDR disadvantages

- Narrow spectral response.
- Hysteresis effect.
- Low temperature stability for the fastest materials.
- The variation of the value of the resistance has a certain delay, different if it goes from dark to illuminated or from illuminated to dark. This limits the use of LDRs in applications where the light signal varies rapidly.

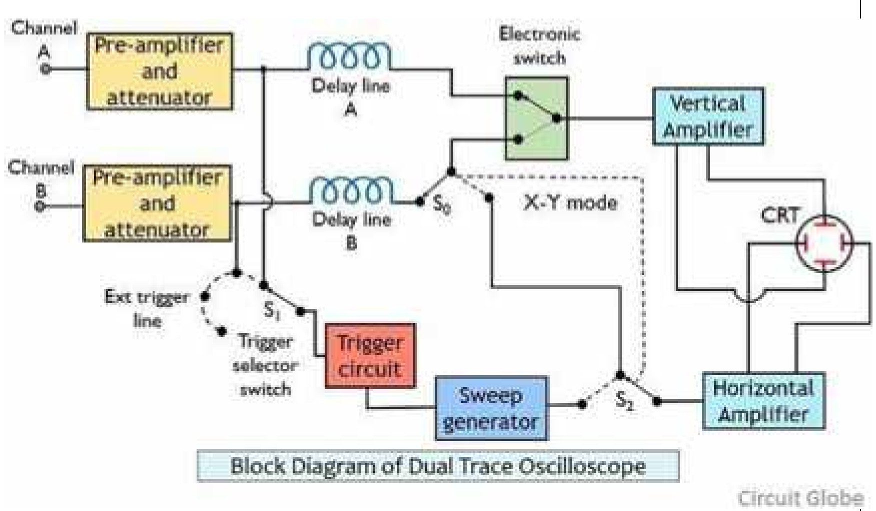
d Explain speed transducer and state advantages and disadvantages — 5



Photoeolectric Tachometer

OR

Write a short note on Dual Trace Oscilloscope



Block Diagram of Dual Trace Oscilloscope