Important Instruction 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 principle components indicated in a 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 some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1 Attempt any Ten of the following **20 Marks**

a) Define resistance and State its unit.

Resistance: **(Allotted 1 Mark)**

It is defined as the opposition offered by a conductor to the flow of current. It is represented by R

OR The formula for resistance is given by

$R = \rho \times (l/a)$ OR $R = V/I$

Unit – ohm **(Allotted 1 Mark)**

b) Give Classification of D.C. Motors.

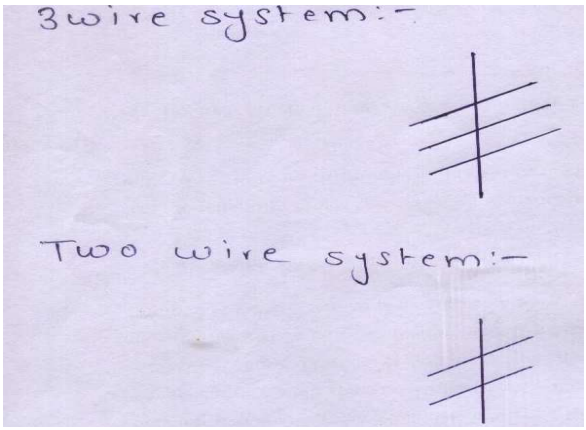
Classification of D.C. Motor: - **(Allotted 1 Mark)**

1. **Self Excited D.C Motor:**
   - i) DC Series Motor
   - ii) DC Shunt Motor
   - iii) DC Compound Motors:
     - i) Short Shunt Compound DC Motor:- a) Cumulative Compound b) Differential Compound

ii) Long Shunt Compound DC Motor: a) Cumulative Compound b) Differential Compound

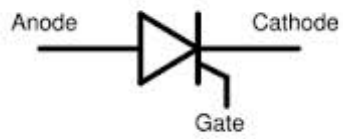
2) Separately Excited D.C Motor: **(Allotted 1 Mark)**

c) Draw the symbols for 3-Wire and 2- Wire system: ---------- (Each symbol-1 Mark)

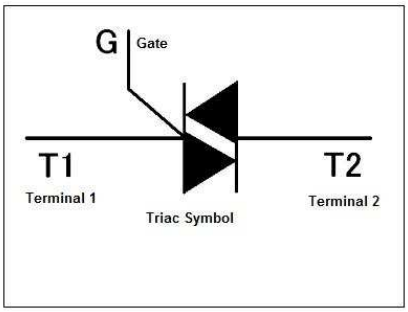


d) Draw symbol of SCR and Triac

Symbol of S.C.R :- **(Allotted 1 Mark)**



Symbol of Triac:- **(Allotted 1 Mark)**



e) Define transducer and write any 2 examples of transducer

Transducer definition:- **(Allotted 1 Mark)**

We can define a transducer as an element which converts energy in one form to another form.

Examples of transducers:- (Any two expected) **(Allotted 1 Mark)**

Bourdon tube, LVDT, thermocouple, solar cell, thermistor, strain gauge, RTD. etc

f) Define Analog and digital signal

Analog Signal:- **(Allotted 1 Mark)**

An analog signal is any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity.

Digital Signal :- **(Allotted 1 Mark)**

A digital signal is a physical signal that is a representation of a sequence of discrete values (a quantified discrete-time signal), for example of an arbitrary bit stream, or of digitized (sampled and analog-to-digital converted) analog signal.

g) Define Time period and frequency of an alternating quantity.

Time period:- **(Allotted 1 Mark)**

The time (in sec) required by an alternating quantity to complete its 1 cycle is known as time period.

Its Units: Second (sec.)

Frequency: **(Allotted 1 Mark)**

The number of cycles completed by an alternating quantity in one second is called as frequency.

It Unit: Hertz (Hz)

h) Write any 2 application of 3- phase induction Motor:

Application of 3-Phase induction Motor: (Any Two) **(Allotted 1 Mark each Application)**

1. Lathes Machine
2. Drilling Machines
3. Grinders
4. Various types of press machine
5. Compressors
6. Fans & Blowers
7. Conveyors
8. Water pumps
9. Laundry washing machine
10. Cement and textile mills
11. Lifts and hoist
12. Cranes
13. Rolling mills
14. Winding Machine

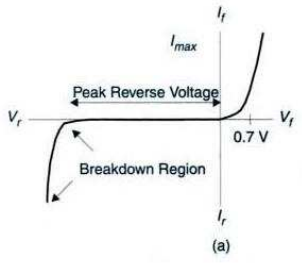
i) Differentiate Between insulating and ground return system any 2 points.

(Any two point expected Allotted-1 Mark each point)

Sr.No.	Insulated Return	Ground Return
1	Actually wire is used a return path for current	Actually ground is used as a return path for current No wire is required
2	Number of wires require Two	Number of wire required one
3	There is no disadvantage such as steel which is underground get rusting when insulated wire is used as a return path	If ground is used as a return path than there is disadvantages such as steel which is underground get rusting
4	Cost is more	Cost is less

j) Draw V-I Characteristics of P-N junction diode and define knee voltage of it.

V-I Characteristics of PN junction diode **(Allotted 1 Mark)**



Knee Voltage: - **(Allotted 1 Mark)**

It is the minimum voltage at which the device would conduct in the forward bias mode. It is the voltage at which the forward current starts increasing sharply from its leakage (almost zero) value. It is about 0.7 volt for Silicon diodes.

k) Define LVDT. State any two application of it.

Linear Variable Differential Transformer (LVDT) :- **(Allotted 1 Mark)**

It is the transducer most widely used to convert linear displacement into electrical signals.

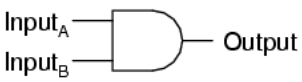
Applications of LVDT- **(Allotted 1 Mark)**

- Short displacement measurement
- Pressure Measurement
- In measurement and control systems.

l) Draw symbol of AND gate. Write down truth table for it.

Symbol of AND gate and its truth table (Allotted 1 Mark for symbol and 1 Mark for truth table)

2-input AND gate



A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

m) List any two devices for measurement of flow

Two devices for measurement of flow: - (Any two expected) **(Allotted 2 Marks)**

Turbine flow meter, Pelton wheel, Venturi meter, Orifice plate, Pitot tube, optical flow meter, vortex flow meter, Magnetic flow meters, Ultrasonic (Doppler, transit time) flow meters, etc.

n) Write any 2 applications of NPN Transistor

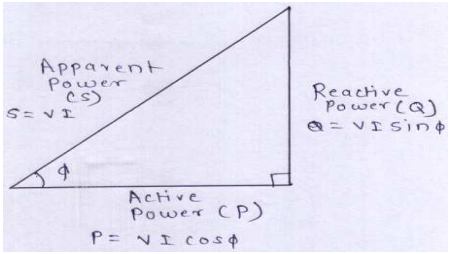
Applications of NPN Transistor: **(Allotted 2 Marks)**

1. As an amplifier
2. As an switch in various electronics circuits

Q.2 Attempt any 4 of Following **16 Marks**

a) Draw power Triangle; write formula for apparent, active and reactive power with their units. **(Diagram 1marks. Formula- 1/2 Marks and unit 1/2 Marks each)**

power Triangle



i) Apparent Power (S):

$$S = V.I.$$

Unit: Volt meter (VA) or Kilo volt Amp (KVA) or Mega volt Amp (MVA)

ii) Active Power (P):-

$P = V.I.Cos\phi$ **Unit: -** Watt **OR** Kilowatt

iii) Reactive Power (Q):-

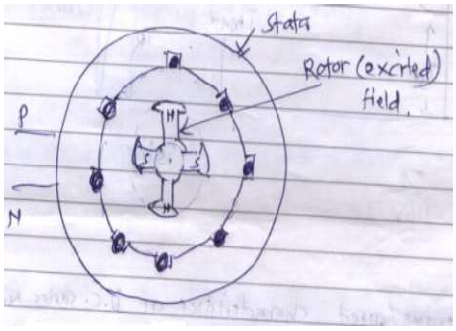
Q= V.I. sin ϕ

Units: - VAR **OR** KVAR

b) Explain principle of operation Alternator

Operation of Alternator: - **(Allotted 4 Mark)**

Working principal of Alternator is similar to D.C Generator. It also works on Faraday's Law of Electromagnetic Induction. Whenever excited rotor field is rotated by prime mover then as per Faraday's law of electromagnetic induction A.C Voltage will be induces in the Stator winding.



or equivalent dia.

OR Student may write

- Alternator are operates on fundamental principles of electromagnetic induction.
- D.C Excitation is given to rotor, so it creates flux and rotor is rotated with the help of prime mover.
- Stator winding which is stationary cuts these flux so emf is induced in stator winding according to faradays law of electromagnetic induction.

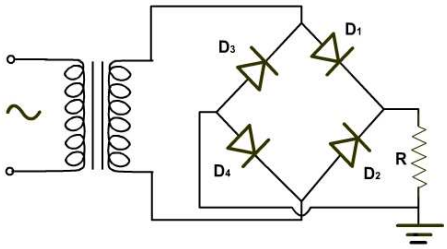
c) What is significance of colour coding in automobile wiring?

Significance of colour coding in automobile wiring: **(Allotted 4 Mark)**

Automobile wiring is complicated because of number of lamps and accessories for this color coding is necessary due to which wiring can easily identify for specific lamp and accessories and also it is easier during maintenance.

d) Explain working of full bridge rectifier. Draw output waveform for it.

Working of full bridge Rectifier: (Allotted 1 Mark for ckt. diagram and 2 Marks for working and 1 Mark for waveforms)



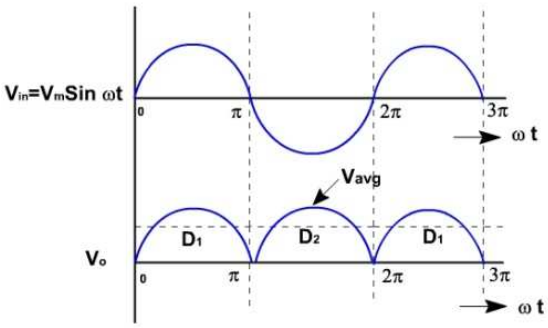
Working:-

In the positive half cycle, D1and D4 are forward biased (D2and D3 are reverse biased). In the negative half cycle, D2and D3 are forward biased (D1and D4 are reverse biased).

The output voltage is obtained in both half-cycles of input signal.

The advantage is that PIV rating of diodes are Vm and center-tapped transformer is not required. The main disadvantage is that it requires four diodes.

Waveforms:-



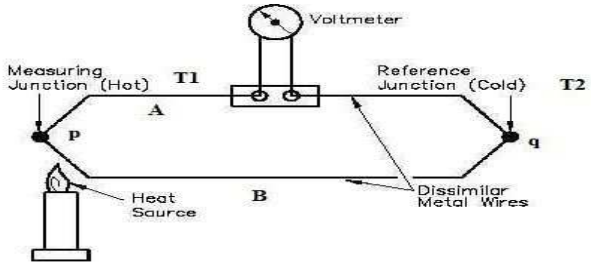
e) Explain working of thermocouple with neat circuit diagram

Thermocouple working principle- **(Allotted 2 Mark)**

Thermocouple principle is based on the Seebeck effect which states that if the two dissimilar metals having different work functions are joined together to form a junction (hot junction) and if the junction is subjected to change in temperature then the voltage is generated at

the another junction (cold junction). The thermo-e.m.f. generated which is proportional to the temperature difference between two junction.

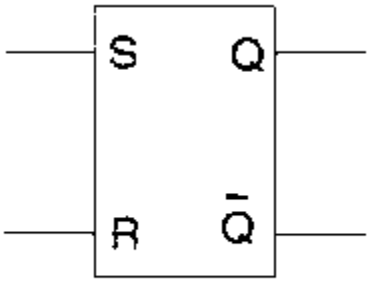
Circuit diagram **(Allotted 2 Mark)**



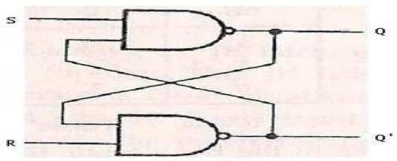
Thermocouple Circuit

f) Draw the symbol of RS Flip-flop and give truth table of it

Symbol of RS flip-flop and truth table: - (Allotted 2 Marks for symbol and 2 Marks for truth table)



Logic symbol



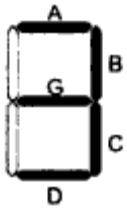
S	R	Q	Q'	
1	0	0	1	
1	1	0	1	(after S = 1, R = 0)
0	1	1	0	
1	1	1	0	(after S = 0, R = 1)
0	0	1	1	

Q.3 Attempt any Four of the following **16 Marks**

a) Give working of 7 Segment LED Display

Working of seven-segment LED display:- **(Allotted 4 Marks)**

Seven segment displays consists of Eight LEDs. Depending on the various digits and letters to be displayed, the combinations of LEDs are forward biased.

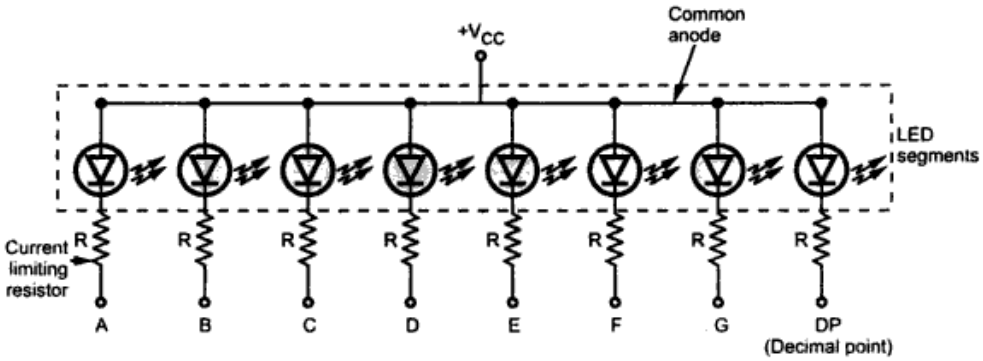


e.g. suppose we want to display the digit 3, then LED a,b,g.c,d should only be forward biased.

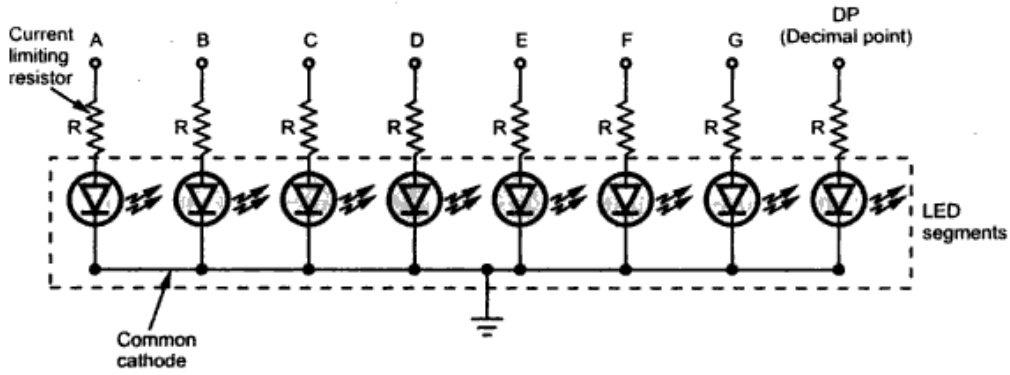
The two types of seven segment display are available-

1. Common anode type
2. Common cathode type

In common anode type, all anodes of LEDs are connected together and common point is connected to +Vcc.



In common cathode type, all cathodes of LEDs are connected together and the common point is connected to the ground.



b) What are the steps involved in selection of transducer in measurement system?

Steps involved in selection of transducer in measurement system (Any 4 Steps expected)

(Allotted 4 Marks)

(i) To select a transducer of proper Sensitivity;

(ii) To select a transducer of proper accuracy;

(iii) To select a transducer of proper operating range;

(iv) To select a transducer of proper ruggedness;

(v) To select a transducer of proper environmental effects;

(vi) To select a transducer of proper stability and reliability;

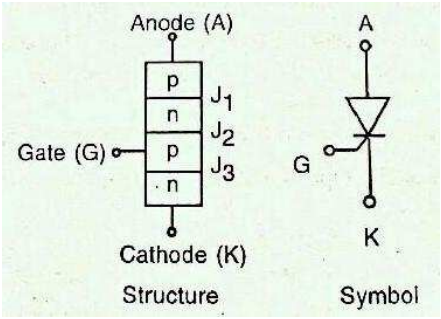
(vii) To select a transducer of proper linearity, repeatability, and high resolution;

(viii) To select a transducer of proper size and shape; and

(ix) To select a transducer of proper cost and availability.

c) State working of SCR and give any 2 applications.

Symbol and structure of S.C.R. - (Allotted 1 Mark for diagram, 2 Mark for Working and 1 Mark for Application)



Working-

When the anode is made +ve w.r.t. cathode, the junctions J1 and J3 are forward biased, whereas junction J2 is reverse biased. Due to this reverse biased junction J2, only small leakage current flows from anode to cathode. The S.C.R. is then said to be in forward blocking state.

With anode +ve w.r.t. cathode, if anode-to-cathode voltage is increased to a sufficient large value, the reverse biased junction J2 will break. The voltage at which it occurs is called forward break over voltage V_{BO}. The junctions J1 and J3 are already forward biased, hence results in free movement of carriers across all three junctions, resulting in large forward anode current. The S.C.R. is said to be in conducting state.

Without breakdown of junction J2, S.C.R. can be made ON by applying +ve voltage to gate w.r.t. cathode. Due to this, junction J3 is forward biased and conducts and gate current flows. Free movement of carriers (holes and electrons) across the junction J3 results in injection of holes into n-region and electrons into p-region. The injected electrons in p-region force this p-region to lose its identity as p-region because it was having holes as majority carriers but with injected electrons, it is having holes as well as electrons in majority. Therefore junction J2 now has majority electrons on both side and it is disappeared and S.C.R. is made ON.

Applications of S.C.R.: -

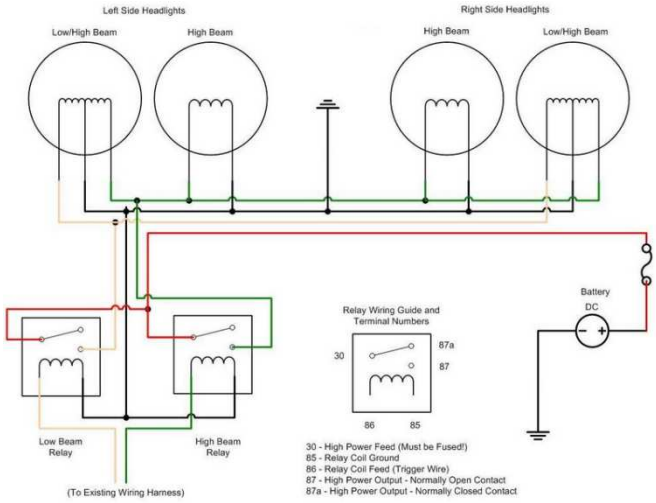
1. Chopper 2.Inverter 3.Drives, etc.

d) What is need of wiring harness in vehicle? Draw wiring diagram of headlight.

Need of Wiring Harness in vehicle: **(Allotted 2 Marks)**

Automobile wiring is complicated and critical to setup, with the help of harness time required for completion of wiring is less it easy to replace and maintain other accessories like audio, video or mobile can be setup inside the vehicle, with proper instructions it can be easily installed and replace safely.

Wiring diagram of headlight: **(Allotted 2 Marks)**



OR Equivalent Fig.

e) Explain the construction of stepper motor. List its application. (Construction -2 Marks & Application -2 Marks)

Stepper Motor: -

- A stepper motor is basically an electromagnetic transducer or an incremental actuator which converts digital pulse into inputs into output shaft motion.
- The essential property of stepper motor is its ability to translate switched excitation into precisely defined increment of output shaft motion.

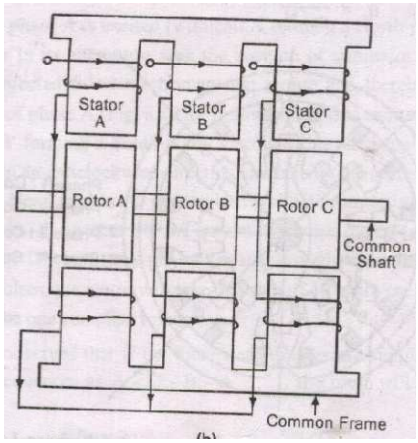
Application of Stepper Motor:-

In robotics & CNC machines

1. In computers, printers, tape recorder etc
2. Radar, satellite communication system
3. Biomedical application such as X ray machines, CT scan system
4. Position control system
5. CNC control of machine tools
6. Process control system
7. XY recorder & plotter
8. Watches

OR

1) Variable Reluctance Motors:-



or equivalent dia.

Working:-

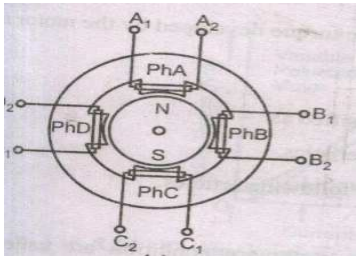
When phase A is excited rotor attempts minimum reluctance between stator and rotor and is subjected to an electromagnetic torque and there by rotor rotates until its axis coincides with the axis of phase A.

Then phase 'B' is excited disconnecting supply of phase 'A' then rotor will move 30 anticlockwise directions. The Same process is repeated for phase 'C'

In this way chain of signals can be passed to get one revolution and direction can be also changed.

OR

2) Permanent Magnet Motor:-



or equivalent dia.

Working :-

If the phase is excited in ABCD, due to electromagnetic torque is developed by interaction between the magnetic field set up by exciting winding and permanent magnet.

Rotor will be driven in clockwise direction.

Applications-

1. In Floppy disc drives.
2. In Computer printers.
3. In image scanners.
4. In compact Disc drives, etc.

f) Given Data:

1-Ph Transformer, V_1 = 240V, V_2= 2400V, F = 50 Hz, N_1= 8 K=? N2=?
& I_1 & I_2 If KVA = 100

Step: 1: To Find Transformation Ratio= **(Allotted 1 Marks)**

$$k = \frac{V_2}{V_1} = \frac{2400}{240}$$

$$k = 10$$

Step: 2: To Find Secondary Turns= **(Allotted 4 Marks)**

$$k = \frac{V_2}{V_1} = \frac{N_2}{N_1}$$

$$10 = \frac{N_2}{8} \qquad N_2 = 10 \times 8$$

$$N_2 = 80$$

Step: 3: To Find Primary Currents = **(Allotted 4 Marks)**

$$I_1 = \frac{KVA \times 10^3}{V_1}$$

$$I_1 = \frac{100 \times 10^3}{240}$$

$$I_1 = 416.67\ A$$

Step: 4: To Find Secondary Currents = **(Allotted 4 Marks)**

$$I_2 = \frac{KVA \times 10^3}{V_2}$$

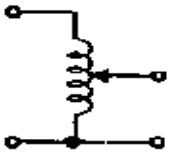
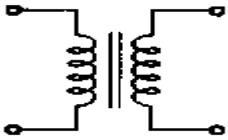
$$I_2 = \frac{100 \times 10^3}{2400}$$

$$I_2 = 41.667\ A$$

Q.4 Attempt any Four of the following **16 Marks**

a) Differentiate between autotransformer and conventional transformer any 4 points.

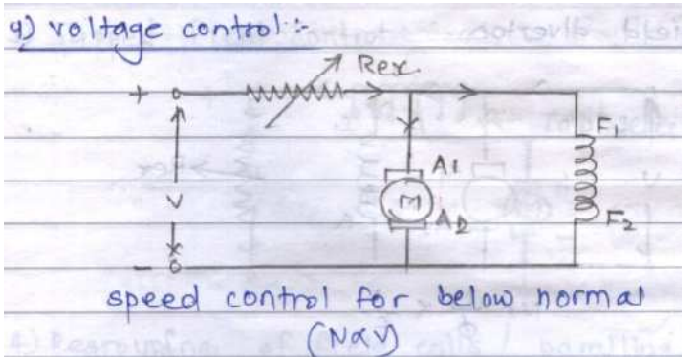
(1-Mark each point)

Sr no.	Points	Autotransformer	Conventional Transformer
1.	**Symbol**		
2.	**Number of windings**	It has one winding	It has two windings
3.	**Copper saving**	Copper saving takes more as compared to two winding	Copper saving is less
4.	**Size**	Size is small	Size is large
5	**cost**	Cost is low	Cost is high
6	**Losses in winding**	Less losses takes place	More losses takes place
7.	**Efficiency**	Efficiency is high	Efficiency is low
8.	**Regulation**	Regulation is better	Regulation is poor
9.	**Electrical isolation**	There is no electrical isolation	Electrical isolation is present in between primary and secondary winding
10.	**Movable contact**	Movable contact is present	Movable contact is not present
11.	**Application**	Variac, starting of ac motors, dimmerstat.	Mains transformer, power supply, welding, isolation transformer

b) State the methods of speed control of D.C Shunt Motor. Draw circuit diagram for it.

Speed controls of DC Shunt are 1) Voltage control 2) Flux control

1) Armature Voltage Control Method for DC Shunt Motor: - **(Marks Allotted -2)**



$$I = Ia + I_{Sh}$$

$$E_b = V + I_a R_a$$

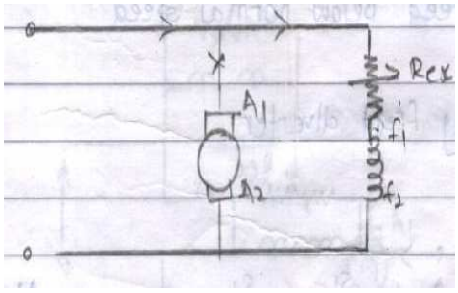
$$E_b = \frac{\phi Z N P}{60A}$$

$$E_b \alpha \phi N$$

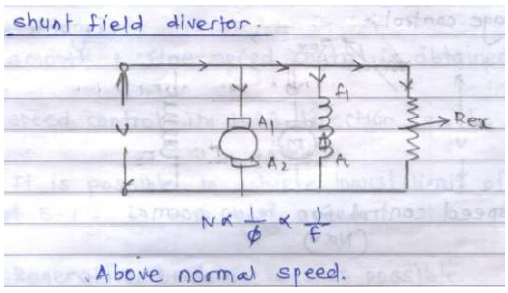
$$N\alpha = \frac{E_b}{\phi} \quad or \quad N\alpha V - I_a R_a$$

In this method speed control of DC shunt motor is directly proportional to the voltage across armature.

2) Flux Control Method for DC Shunt Motor:- **(Marks Allotted -2)**



OR



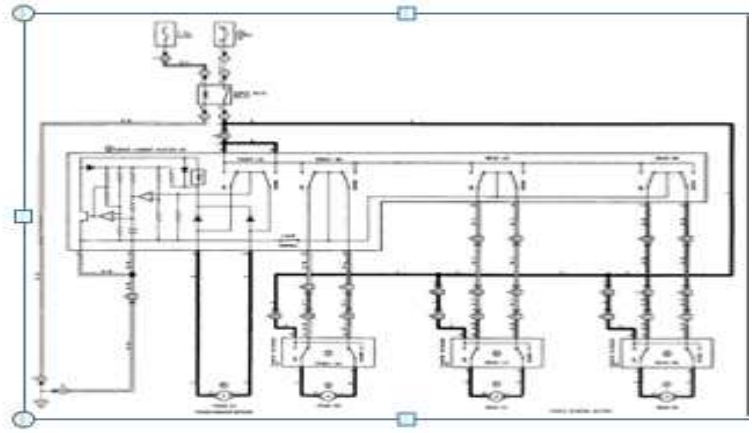
$$N\alpha = \frac{E_b}{\phi} \qquad I_f \alpha \phi \qquad I_f = field\ \ current$$

In this method speed of DC Shunt motor is inversely proportional to the Field.

c) Draw a neat sketch of wiring diagram of power circuit. Give names of for it.

(Marks Allotted -4)

In this method windows of automobile vehicles are operated on battery.



d) State 2 applications of Transistor and photodiode.

Two applications of transistor **(Allotted 2 Marks)**

1. As an amplifier
2. As a switch in various electronics circuits.

Two applications of photo diode **(Allotted 2 Marks)**

1. Photo diodes are used in consumer electronics devices such as compact disc players, smoke detectors
2. The receivers for infrared remote control devices used to control equipment from televisions to air conditioners.
3. Light measurement, as in camera light meters, or to respond to light levels, as in switching on street lighting after dark.

e) Suggest 1 Transducer for measuring pressure, temperature, speed and force

(Allotted 1 Mark for each)

Transducer for measuring pressure- strain guage

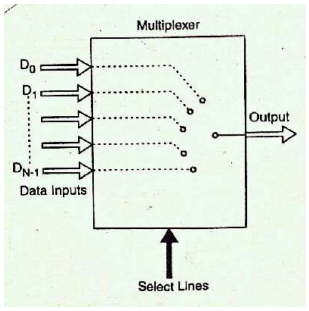
Transducer for measuring temperature- thermistor, thermocuple

Transducer for measuring speed- tachometer

Transducer for measuring force- load cell

f) What is multiplexer? Draw diagram of (4:1) multiplexer.

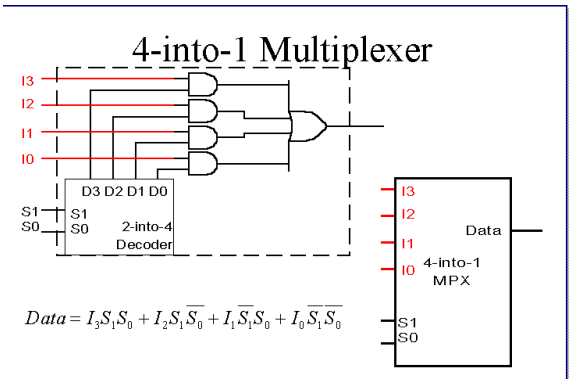
Multiplexer Working- **(Allotted 2 Mark)**



or equivalent dia.

Multiplexer has multiple inputs and one output. i.e. it accepts several data inputs and allows only one of them at a time. The routing of desired data input to output is controlled by select lines.

Diagram: **(Allotted 2 Marks)**



Q.5 Attempt any Four of the following **16 Marks**

a) State and explain Faradays law of Electromagnetic Induction.

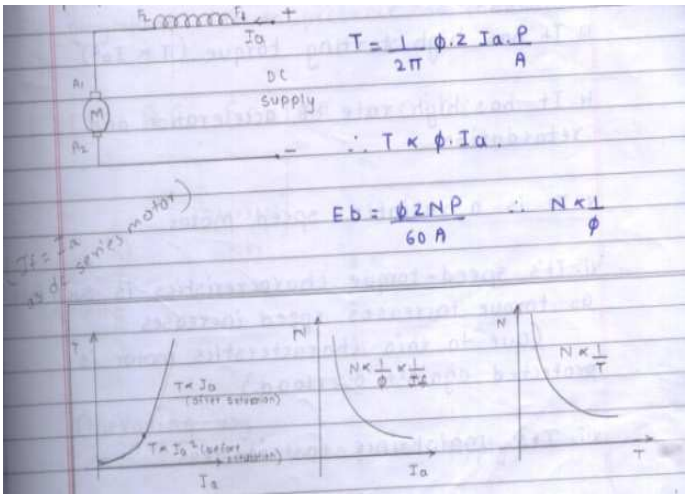
First Law: - Whenever change in the magnetic flux linked with a coil or conductor, an EMF is induced in it. **OR** Whenever a conductor cuts magnetic flux, an EMF is induced in conductor. **(Marks Allotted -2)**

Second Law: - The Magnitude of induced EMF is directly proportional to (equal to) the rate of change of flux linkages. **(Marks Allotted -2)**

$$e = \frac{-Ndt}{dt} d\phi$$

b) Draw the characteristics of D.C Series Motor and write any 2 applications of DC Shunt and DC Series Motor

Characteristics of D.C Series Motor: - **(Marks Allotted -2)**



Application of D.C Series Motor: - **(Marks Allotted -1)**

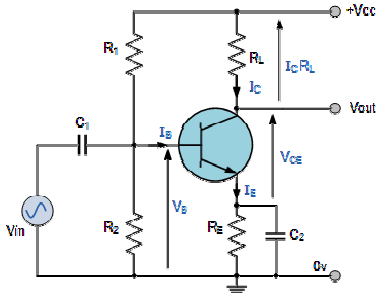
Electric Railways, Rolling mills, Metal-lurgical Works, Mine hoists, continuous conveyors, crane, valve operation etc

Application of D.C Shunt Motor:- **(Marks Allotted -1)**

Line shafts, Lathes machine, Vacuum cleaners, pressure blowers, constant head centrifugal pumps, compressor, reciprocating pumps, fans, wood working machine, Laundry washing machines, milling machines, passenger elevators, continuous conveyors, grinders, polishers, small printing presses, paper making machine.

c) With a neat sketch, explain common emitter amplifier.

Common emitter amplifier- (Allotted 2 Mark for diagram, 2 Mark for explanation)



The single stage common emitter amplifier circuit shown above uses what is commonly called "Voltage Divider Biasing". This type of biasing arrangement uses two resistors as a potential divider network across the supply with their center point supplying the required Base bias voltage to the transistor. Voltage divider biasing is commonly used in the design of bipolar transistor amplifier circuits. Resistors R1 and R2 holds the Base voltage (Vb) constant at a value below the supply voltage. Then the potential divider network used in the common emitter amplifier circuit divides the input signal in proportion to the resistance. This bias reference voltage can be easily calculated using the simple voltage divider formula below:

$$V_B = \frac{V_{CC} R_2}{R_1 + R_2}$$

The same supply voltage, (Vcc) also determines the maximum Collector current, Ic when the transistor is switched fully "ON" (saturation), Vce = 0. The Base

current Ib for the transistor is found from the Collector current, Ic and the DC current gain Beta, β of the transistor.

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

d) State the transducers used to temperature and explain working principle of any one

Transducers used for temperature measurement are- **(Allotted 2 Mark)**

RTD, Thermocouple, Thermistor, etc.

Thermocouple working principle- **(Allotted 2 Marks for any one temperature transducer)**

Thermocouple principle is based on the see beck effect which states that if the two dissimilar metals having different work functions are joined together to form a junction (hot junction)and if the junction is subjected to change in temperature then the voltage is generated at the another junction (cold junction). The E.M.F. generated is proportional to the temperature difference.

OR

Working principle of Thermistor:- **(Allotted 2 Marks)**

Thermistors are one of the most commonly used devices for the measurement of temperature. The thermistors are resistors whose resistance changes with the temperature. The thermistors are made up of ceramic like semiconducting materials. They are mostly composed of oxides of manganese, nickel and cobalt having the resistivities if about 100 to 450,000 ohm-cm. Since the resistivity of the thermistors is very high the resistance of the circuit in which they are connected for measurement of temperature can be measured easily. As mentioned earlier the resistance of the thermistors decreases with the increase its temperature. The resistance of thermistor is given by:

$R = R_o e^k$

$K = \beta(1/T - 1/T_o)$

Where R is the resistance of the thermistor at any temperature T in ^oK (degree Kelvin)

R_o is the resistance of the thermistors at particular reference temperature $T_o$in ^oK

e is the base of the Naperian logarithms

β is a constant whose value ranges from 3400 to 3900 depending on the material used for the thermistors and its composition.

The thermistor acts as the temperature sensor and it is placed on the body whose temperature is to be measured. It is also connected in the electric circuit. When the temperature of the body changes, the resistance of the thermistor also changes, which is indicated by the circuit directly as the temperature since resistance is calibrated against the temperature. The thermistor can also be used for some control which is dependent on the temperature.

OR

Working principle of RTD:- **(Allotted 2 Marks)**

The resistance of the material used to manufacture RTD depends upon temperature. As temperature changes resistance of RTD gets changed, the main principle of operation of an RTD is that when the temperature of an object increases or decreases, the resistance also increases or decreases proportionally (RTDs are normally PTC type).

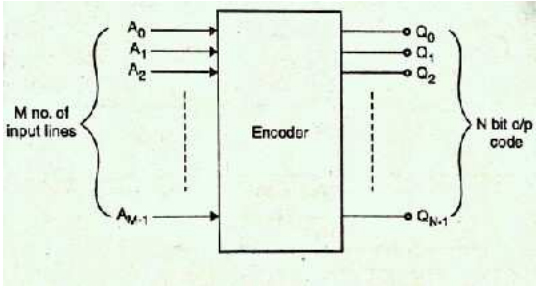
$$R = Ro\ (1+\alpha\ t\ )$$

The main difference between a RTD and a **Thermistor** is that the sensing element used in a RTD is a metal and a thermistor uses ceramic or polymer material. As platinum is the most commonly used metal for making RTD's, the device can also be called Platinum Resistance Thermometers (PRT's).

e) i) Define encoder and decoder ii) Distinguisher between positive & Negative system any 2 points

i)

Encoder- **(Allotted 2 Marks)**



or equivalent dia.

Working -

The encoder performs, the operation called as encoding. An encoder has M input lines and N output lines. Out of M input lines only one is activated at a time and it produces equivalent code on output N lines.

Decoder- **(Allotted 2 Marks)**

A decoder is a device which does the reverse operation of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode. It is a combinational circuit that converts binary information from n input lines to a maximum of 2^n unique output lines.

e) ii) Distinguisher between positive & Negative system any 2 points

Distinguish between positive and negative systems (Allotted 2 Marks for any two points)

Negative feedback system:

1. Tends to opposite excessive change (large amplitude) and wants to hold a system within a limited operating range.
2. In the case of an amplifier, it tends to reduce circuit gain and increase device operating bandwidth.
3. Tends to create system stability by ensuring linear operation.

Positive feedback system:

1. Tends to generate excessive system gain, noise, narrows bandwidth, and can cause oscillation.
2. Creates instability and tends to drive a system into its nonlinear region of operation.
3. Whereas negative feedback reduces system gain and increases bandwidth. Positive feedback increases system gain, narrows bandwidth, and becomes unstable. However, a system operating with positive feedback that hasn't gone into complete instability (oscillation), can be a very sensitive device with very high-gain amplifiers and sharp selectivity--super-regenerative radio receiver is a good example.

f) i) On which principle thermistor works? ii) Define power factor in 2 ways.

i) Working principle of thermistor: **(Allotted 2 Marks)**

Thermistors are one of the most commonly used devices for the measurement of temperature. The thermistors are resistors whose resistance changes with the temperature. The thermistors are made up of ceramic like semiconducting materials. They are mostly composed of oxides of manganese, nickel and cobalt having the resistivity if about 100 to 450,000 ohm-cm. Since the resistivity of the thermistors is very high the resistance of the circuit in which they are connected for measurement of temperature can be measured easily. As mentioned earlier the resistance of the thermistors decreases with the increase its temperature. The resistance of thermistor is given by:

$$R = R_o\, e^{k}$$

$$K = \beta(1/T - 1/T_o)$$

Where R is the resistance of the thermistor at any temperature T in ^oK (degree Kelvin) R_o is the resistance of the thermistors at particular reference temperature $T_o$in ^oK e is the base of the Naperian logarithms β is a constant whose value ranges from 3400 to 3900 depending on the material used for the thermistors and its composition.

The thermistor acts as the temperature sensor and it is placed on the body whose temperature is to be measured. It is also connected in the electric circuit. When the temperature of the body changes, the resistance of the thermistor also changes, which is indicated by the circuit directly as the temperature since resistance is calibrated against the temperature. The thermistor can also be used for some control which is dependent on the temperature.

ii) Define power factor in 2 ways.

Power factor: **(Marks Allotted -2)**

i) It is ratio of true power (active power) 'P' to the apparent power 'S'

$$P.F = \frac{Active\ \ Power(P)}{Apparant\ Power(s)}$$ **OR**

ii) It is defined as cosine angle between voltage and current. **OR**

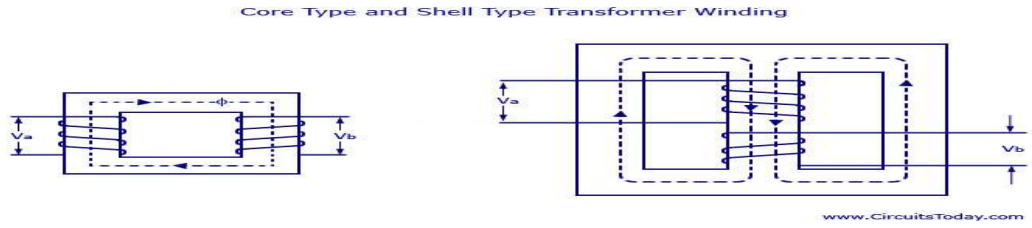
iii) It is the ratio of resistance 'R' to the impedance 'Z.

$$Cos\phi = \frac{\text{Re}\,sis\,\text{tan}\,ce\,(R)}{\text{Im}\,pedance\,(Z)}$$ **OR**

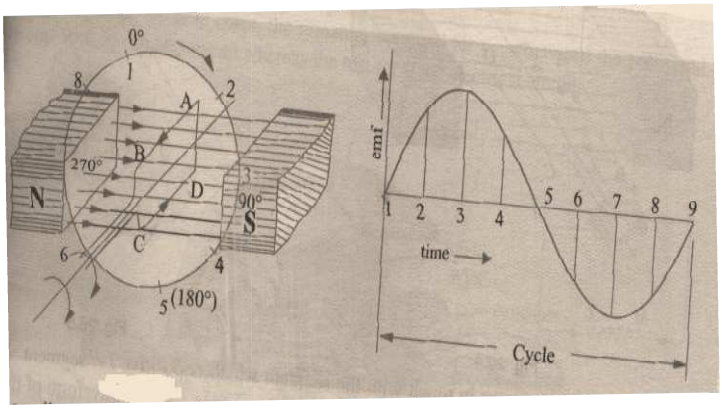
iv) Power factor is defined as how much current is utilized out of total current

Q.6 Attempt any Four of the following **16 Marks**

a) Distinguish between core and shell type transformer any 4 points. (Each point -1 Mark)

S.No	Core Type Transformer	Shell Type Transformer
1.		
2.	The Winding surround the core	The core surround the windings
3.	Average length of the core is more	Average length of the core is less
4.	Magnetic Flux has only one continuous path	Magnetic Flux is distributed into 2 paths
5.	Suitable for high voltage & less output	Suitable for less voltage & high output
6.	Easy for repairs	Difficult for repairs
7.	Less in Weight	More in Weight
8.	Leakage flux are more	Leakage flux are less

b) How A.C voltage is generated: **(Figure -2 Marks & Explanations- 2 Marks)**



Imagine the coil ABCD to be rotating in clockwise direction, as the coil assumes successive positions in the field the flux leakage with it changes. Hence an EMF induced in it which is proportional to the rate of change of flux leakage.

When the plane of the coil is at right angle to line of fluxes i.e when its position 1 then flux linked with the coil is maximum but rate of change of flux leakage is minimum.

The coil plane is horizontal i.e parallel to lines of flux i.e at $\theta = 90^0$C at position 3, at this stage the flux linked with the coil is minimum but rate of change of flux leakage is maximum. Hence maximum emf is induced in the coil at this position shown in figure.

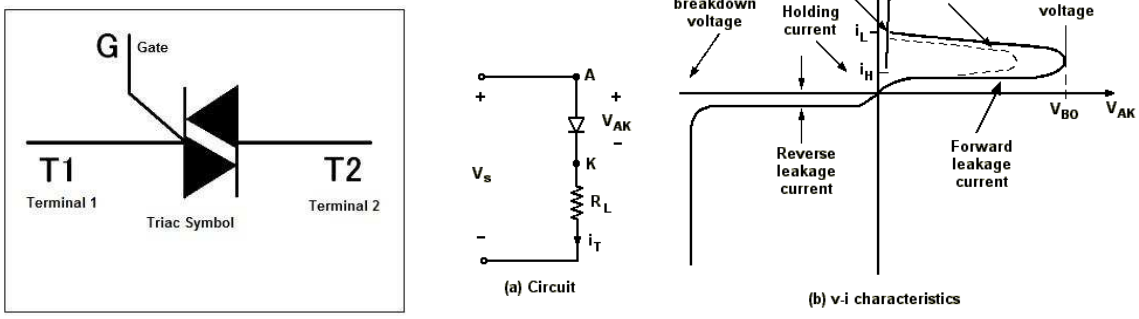
From 90^0C to 180^0C the flux linked with the coil gradually increases but the rate of change of flux linkage decreases. Hence the induced emf decreases gradually till in position 5 of the coil it is reduce to zero value

The direction of induced emf can be found by Fleming's right hand rule.

In the next half revolution i.e from 180^0C to 360^0C the variation in the magnitude of emf is similar to those in the first half revolution but in opposite direction.

c) Draw symbol and V-I characteristics of triac and give any 2 applications of it.

V-I characteristics of Triac **(Allotted 2 Marks)**

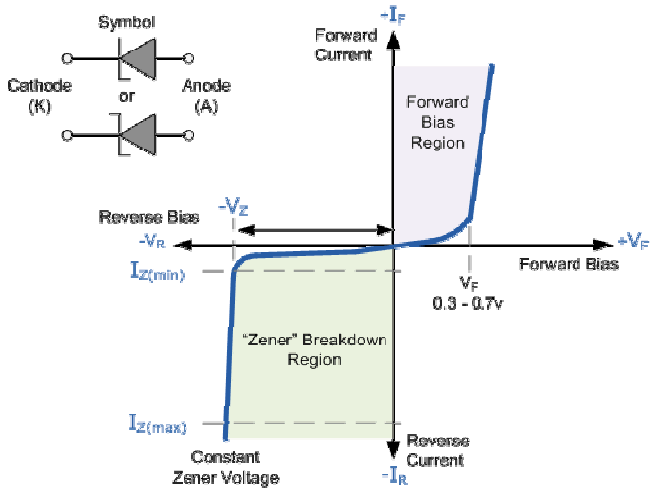


Applications of Triac :- **(Allotted 2 Marks)**

Low power TRIACs are used in many applications such as light dimmers, speed controls for electric fans and other electric motors, and in the modern computerized control circuits of many household small and major appliances.

d) Draw V-I Characteristics of Zener diode. Show breakdown voltage on it and explain it.

V-I characteristics of zener diode: (Allotted 2 Marks for characteristics and 2 Marks for explanation)



Zener Diodes are used in the "REVERSE" bias mode, i.e. the anode connects to the negative supply and from its I-V characteristics curve above, we can see that the Zener diode has a region in its reverse bias characteristics of almost a constant voltage regardless of the current flowing through the diode. This voltage across the diode (it's Zener Voltage, Vz) remains nearly constant even with large changes in current through the diode caused by variations in the supply voltage or load. This ability to control itself can be used to great effect to regulate or stabilize a voltage source against supply or load variations. The diode will continue to regulate until the diode current falls below the minimum Iz value in the reverse breakdown region.

e) State electrical Method for moisture measurement. **(Marks Allotted -4)**

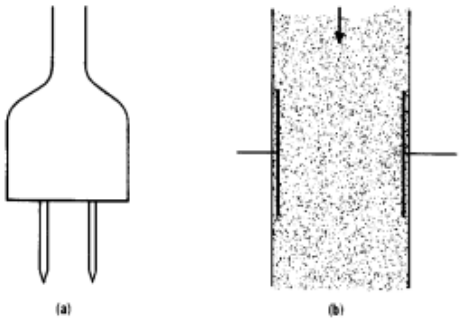
Following are the different methods for moisture measurement:

i) Resistance Moisture measurement

ii) Dielectric Moisture measurement

iii) In-line Moisture measurement

OR



Two techniques for electrical measurements of moisture in solids: (a) pointed probes for insertion in wood, plaster, etc. to measure resistance, (b) capacitance plates to measure moisture in flowing powder or granules.

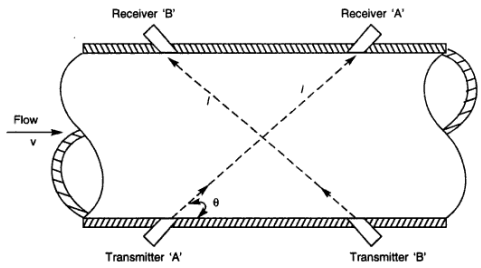
Moisture can produce a marked increase in the electrical conductivity of material, and because of waters high dielectric constant, capacitance measurement can be also valuable. Electrical resistance measurement of moisture in timber and plaster are generally made using a pair of sharp pointed probes, which are pushed in to material. The meter on the instrument being calibrated directly in percentage moisture.

f) Explain working of ultrasonic flow meter with a neat sketch.

(Allotted 2 Marks for diagram, 2 Marks for Working Principle)

Ultrasonic flow meter Schematic diagram:-

There are two types based on – 1) Doppler effect 2)Transit time.



or equivalent dia.

Working- Ultrasonic flow meter based on Doppler effect is explained here.

A and B are piezo-electric devices transmitting the short duration ultrasonic signals through the fluid that is flowing through the pipe at a velocity v. Similar type of crystals are used as receivers to respond to pressure fluctuations.

Due to the fluid velocity v aiding the transmission, the velocity of ultrasonic signal from the transmitter-A to receiver-A is increased to a value c + v cos θ, where c is the velocity of sound through the fluid in the pipe and θ is the angle between the path of sound and the pipe valve. The repetition frequency of the received pulse f_A will be

$$f_A = \frac{c + v\cos\phi}{l}$$

Where l= the distance between the transmitter and receiver. On the other hand, the velocity of the ultrasonic signal transmitted by transmitter B and received by received B will be reduced by the fluid velocity causing a retardation of v cos θ and its pulse repetition frequency f_B will be

$$f_B = \frac{c - v\cos\phi}{l}$$

The difference between frequencies is given by

$$\Delta f = f_A - f_B = \frac{2v\cos\phi}{l}$$

By measuring the difference in the repetition frequency Δf and knowing the values of θ and l, the velocity of the fluid can be computed alternatively, the flow velocity can be computed by measuring the transit time difference between the two pulse trains in either direction.

----------END----------