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 should 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 judgment 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.

1 Attempt any ten 20 mark

1 a) Define reproducibility and accuracy.

Ans:

Reproducibility- It is the degree of closeness with which a given value may be repeatedly measured.

Accuracy: It is the closeness with an instrument reading approaches the true value of the quantity under measurement.

OR

It is defined as the ability of a device or a system to respond to a true value of a measured variable under reference conditions.

1 mark each = 2 marks

1 b) Define error and drift.

Ans:

Drift: Drift is gradual variation in output over period of time that is independent to change in output operating conditions etc.

Error: Error in the instrument is defined as the deviation of the true value from the desired value.

1 mark each = 2 marks

1 c) Explain why ammeter is low resistive and voltmeter is high resistive instrument.

Ans:

Ammeter: Ammeter is connected series in the circuit. To keep voltage drop low and power loss minimum in the ammeter ($P = I^2R_a$) the resistance of ammeter (R_a) is low.

Voltmeter: Voltmeter is connected in parallel in the circuit**.** To keep power loss minimum by drawing negligible current in the voltmeter ($P = V^2 / R_V$) the resistance(R_V) of voltmeter is high**.**

1 mark each = 2 marks

1 d) Explain why extension of range of meters is needed.

Ans: In high voltage, high current circuits e. g. in substations, there is need of high range meters. By extending the range of normal low voltage/current meters such high voltages & currents can be measured. & it also provides safety in operations.

2 marks

1 e) Define multiplying factor of wattmeter

Multiplying Factor for selected (connected) voltage and current ranges

= [(Current Range) x (Voltage Range)] / (Full Scale Reading)

2 marks

1 f) Write any two differences between current coil and pressure coil of wattmeter.

Soln:

Sr no	Current coil	Pressure coil
1	Connected in series with load	Connected in parallel with load
2	Very low resistance.	Resistance is more
3	It is fixed coil in wattmeter	It is moving coil in wattmeter.

Any two points 1 mark each

4	It is having less number of turns	It is having more number of turns

1 g) Define energy and one kilowatt hour.

Energy: Electrical energy is defined as the work done in moving electric charges in electrical fields over specific time duration. 1 mark

Electric Energy = Power x Time (watt-sec)

One Kilowatt hour: One kilowatt hour is defined as energy consumption when power of one kilowatt is drawn by a circuit over a time interval of one hour (1 kWh = 1000 W x 3600 sec = 3.6×10^6 J). 1 mark

1 h) Energy meter is integrating type measuring instrument. Explain.

Soln:

Energy meter is used for measurement of energy, which is obtained by the integration(summation) of power supplied over a particular time duration $= \int VIdt$. 2 mark

1 i) Explain maximum demand in energy meter.

Soln:

Energy meter is used for measurement of energy in industrial, commercial, residential installation. The maximum consumption of energy (demand) in such installation over 24 hours of day is called as maximum demand on energy meter. 2 mark

1 j) Explain how megger can be used for checking whether insulation of a wire.

Soln:

Megger has three terminals Line(L), Earth(E) & Guard(G). While measuring insulation resistance of wire the L terminal is connected to bare conductor (removing insulation and enamel) & E terminal is connected to insulation. The megger is then cranked with constant speed for about one minute to read the insulation resistance of wire. 2 mark

1 k) State any two applications multi-meter.

Soln:

1. Measurement of DC voltage.
2. Measurement of DC current. Any two =
3. Measurement of AC voltage. 2 marks
4. Measurement of AC current.
5. Measurement of resistance.
6. Continuity testing.
7. Testing of transistors.
8. Measurement of frequency.

1 l) Explain what is function generator.

Soln:

It is an electronic device used to generate waveforms of different specified frequencies & amplitudes. Shapes as square, saw tooth, sinusoidal, triangular, rectangular etc. are generated. These are used for testing, trouble shooting etc. Popular range of frequencies available are from 0.01 Hz to 100 kHz and the amplitudes up to 5 V or 10 V or as needed. 2 marks

1 m) What is the necessity of synchro-scope in power system?

Soln:

2 mark

The synchroscope is used to determine the exact instant of switching required to connect the alternators in parallel or put an alternator across the infinite bus.

Its pointer gives the idea of the faster and slower machine to make adjustments of speed of alternators for synchronising.

2 Attempt any two 16 mark

a) Write the difference between each of the following.

Soln:

i) .

Sr no	Absolute instruments	Secondary instruments
1	Gives magnitude of quantity in terms of physical constants of instrument	Gives reading directly of the quantity measured.
2	Need no calibration	Calibrated with respect to absolute instruments
3	Measurement is tedious and time consuming (as indirect) due to calculations needed to be done	Quick method as direct method of reading.
4	Very rarely used.	Very widely used.
5	e.g. tangent galvanometer and current balance galvanometer.	e.g. magnetic meter, induction meter, hotwire meter and electrostatic meter

½ mark for each point any four= 2 marks.

ii) .

Sr no	Deflection instrument	Null type instrument
1	This instrument gives reading by direct deflection.	In this instrument reading is obtained when pointer is at zero.
2	Balance condition in the circuit is not necessary.	Balance condition in the circuit is necessary.
3	e. g. laboratory ammeter & voltmeter	e. g. galvanometer.

01 mark for each point any two= 2 marks.

iii) .

Sr no	Analog instrument	Digital instrument
1	Signals that vary in a continuous function and take on an infinite no. of values in any given range are called analog signals. The devices which produce these signals are called analog devices.	The signals which vary in discrete steps and thus take up only finite different values in a given range are called digital signals. The devices which produce these signals are called digital devices.
2	Low Accuracy over wide range.	Higher Accuracy with wide range.
3	There are moving parts exist in analog instruments.	No moving parts exist.
4	Less sensitive to Temperature Aging effect is more	Temperature sensitive. Moderate aging effect
5	Observational error is possible.	Observational error is not possible.

½ mark for each point any four = 2 marks.

iv) .

Sr no	Indicating instrument	Recording instrument
1	These instruments give an instantaneous values of quantity under measurement	These instruments gives continuous record of quantity under measurement over a period of time
2	These instruments give reading with a help of a pointer and a calibrated scale.	These instruments give graphical representation of a quantity with the help of a pen & paper.
3	e.g. indicating ammeter, voltmeter, wattmeter	e. g. Recording ammeter & voltmeter used in generating station & substation.

01 mark for each point any two= 2 marks.

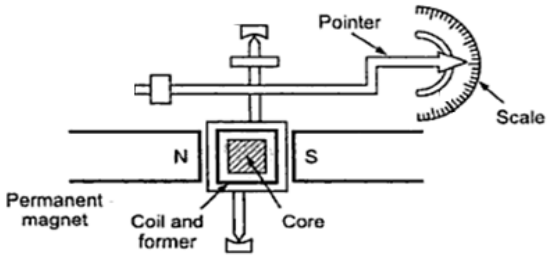
2 b) Describe three types of torques required in analog type measuring instruments.

Soln:

List of torques in analog instruments: 2 torques 4 marks,

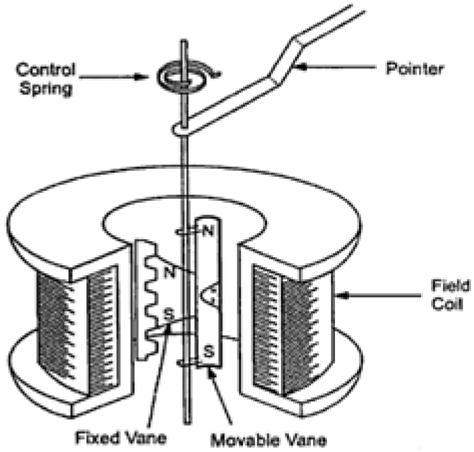
1. Deflecting torque
2. Controlling / restraining torque.
3. Damping torque.

1. Deflecting torque: to create deflection proportional to the quantity to be measured; this is normally current. 3 torques 6 marks.
   - In PMMC instruments it is produced due to interaction of magnetic fields due to permanent magnet and current coil placed in it. Deflecting force is proportional to the permanent magnetic field and the current in the coil.

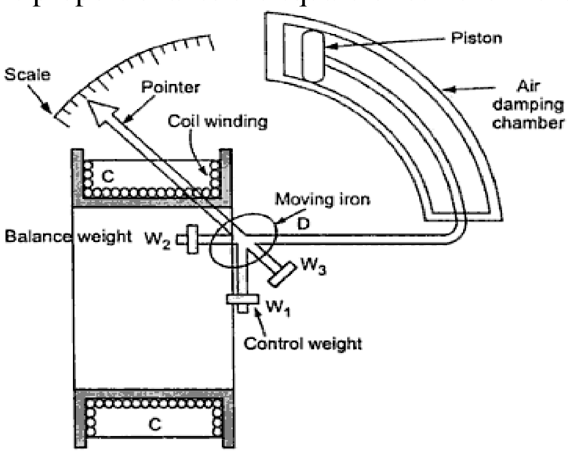


For figures 2 marks

- Moving iron instruments: current in field coil induces similar fields in the two iron vanes that repel each other to give the deflecting torque proportional to square of current in coil.



- Moving iron instruments with one coil producing magnetic field while the iron piece is attracted towards the coil where the force of attraction is proportional to the square of current in the coil



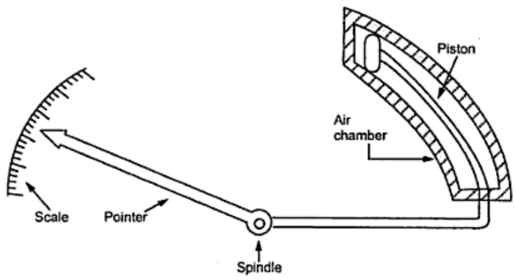
2. Controlling / restraining torque:
   - To restrict the motion of pointer/spindle and stop the pointer at the relevant position to get correct reading.
   - To bring back pointer to zero position when the quantity under measurement is removed.

   This is provided by springs normally made of phosphor bronze that are used to hold the moving member along with spindle in the magnetic field producing the deflecting torque/force.

- This is also provided by control weights shown in figure above.

3. Damping torque:
   - To stop pointer/spindle at the final deflected position.
   - Bring the pointer to stand still quickly.
   - To minimize oscillations about final position.

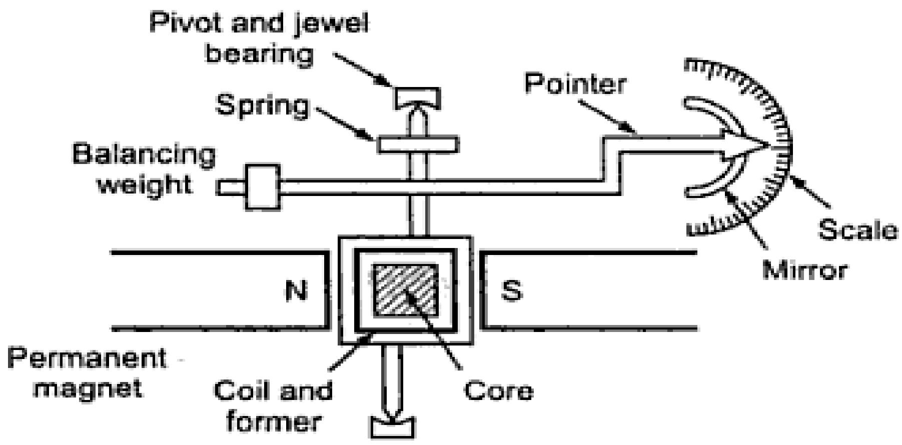
For air damping: air trapped in the chamber works as damping medium for the piston movement connected to the spindle. The piston moves in the air chamber. The clearance between piston and air chamber wall is very small. When the pointer system moves in either direction the piston arm experiences an opposing force due to either compression action on one side and opposition to expansion on the other side. Thus the oscillations of the pointer system are damped by the opposition by the damping system. The damping torque is directly proportional to the speed at which the piston (pointer/spindle) moves. Hence greater the speed higher will be the damping torque bringing the pointer to the equilibrium position quickly.



Air friction damping

2 c) With neat diagram describe construction and working of PMMC type measuring instrument.

Soln:



Any one diagram unlabeled 2 marks, labeled 3 marks.

Construction of PMMC Instrument

Consists of the parts shown in the diagram. The coil is suspended as shown to rotate in the air gap between the permanent poles. The pointer attached to the spindle of the coil moves over the scale whenever the coil rotates. The spring attached to the spindle provides the restraining/ opposing torque and brings the system to standstill when the operating and restraining torques are equal. The pivot and jewel bearing has the minimum frictional resistance when the spindle is rotating. The balancing weight makes sure that the CG of the system coincides with the axis of spindle for positions of the spindle and thus ensures uniform wear for all positions of the spindle. Construction 2 marks

Working-

The measuring DC current flows from one end of moving coil to another end. The current carrying coil experiences the force by the magnetic field and so deflecting torque is produced. This torque rotates the coil through certain angle and the coil rest at the position where magnetic effect becomes cancelled. The angular deflection of the moving coil is directly proportional to current flowing through it ($\Theta \propto I$) as the current increases the deflection of moving coil also increases. The deflecting torque is given by Working 3 marks

$$T_d = NBIL$$

Where, N= no. of turns of coil,
B=Flux density,
I=current through conductor, L= length of conductor.

3 Attempt any two 16 mark

3 a) Explain with neat diagram construction and working of attraction type moving iron intrument.

Soln:

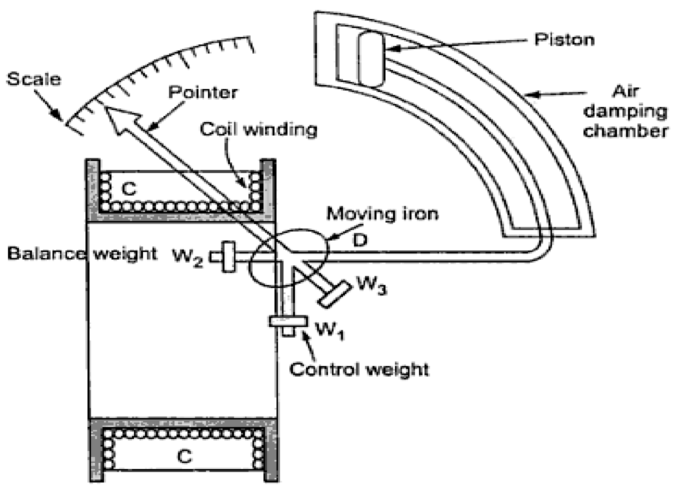


Diagram: labeled 4 marks, unlabeled 1 mark, partially labeled 2 marks.

Above fig. shows constructional details of an attraction type moving iron instrument. The coil is flat and has a narrow slot like opening. The moving 1 mark iron is a flat disc or a sector eccentrically mounted.

Working- When the current flowing through the coil, a magnetic field is produced and moving iron moves from the weaker field outside the coil to the stronger field inside it or in other words the moving iron is attracted in. The controlling torque provided by spring but gravity control can be used for panel type of instrument which is vertically mounted. The damping is provided by air friction damping with the help of light aluminium piston (attached to the moving system) which moves in a fixed chamber closed at one end as shown in above figure. 3 marks

3 b) A moving instrument gives a full scale deflaction of 5 milliamp when the potential diffrence across its terminal is 50 millivolt. Calculate

i) The shunt resistance for a Full Scale Deflection corresponding to 50A.
ii) The series resistance for Full Scale reading with 500 V.
iii) Calculate power dissipated in i) & ii) above.

Soln:

Current in coil for full scale deflection $i = 5\text{ mA} = 0.005\text{ A}$

P D acroos coil = $50\text{ mV} = 50 \times 10^{-3}\text{ V}$

Internal resistance $= R_C = 50/5 = 10$ ohm 2 mark

a) Max. Current to be measured $I = 50$ A.

Shunt resistance $S = i R_C/(I - i)$

$= 0.005 \times 10/(50 - 0.005)$

$= 1 \times 10^{-3}$ ohms. 2 mark

b) $V = 500$ V, $R_M = ?$

$R_M = (V / i) - R_C = (500 / 5 \times 10^{-3)} - 10 = 99990$ ohm 2 mark

c) Power loss in ammeter

$I_S = I - i = 50 - .005 = 49.995$ A

$P_s = I_S^2 \times S = 2.5$ watt

Power loss in voltmeter

$PR_M = i^2 R_M = 2.449$ watt. 2 mark

3 c) i) Explain with neat diagram how voltmeters are calibrated.

Soln:

Procedure of calibration of voltmeter:

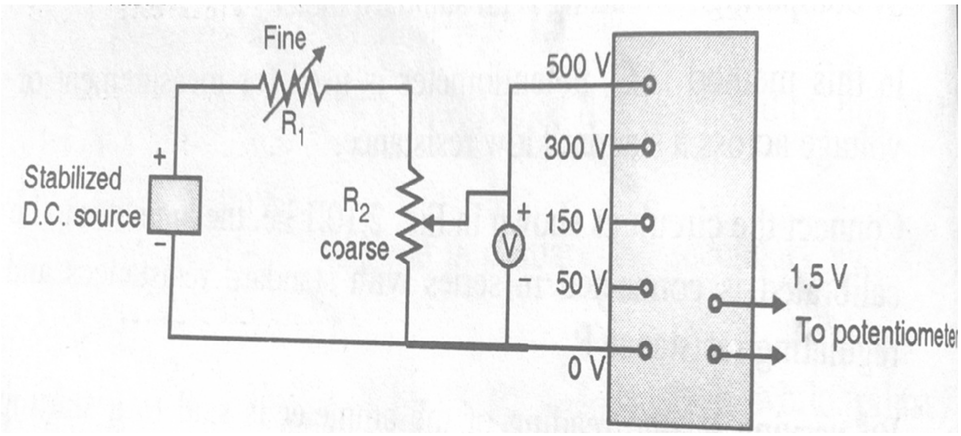


Diagram 02 mark

For calibration of voltmeter using DC potentiomter a voltage ratio box is required which consist 50Ω to 100KΩ variable resistors.

Explanation 02 mark.

- The circuit is connected as shown in above fig. with the help of resistance R_1 and R_2. The reading of voltmeter is set to the certain value.
- Let the reading of votlmeter is 'V' and the voltage measured by DC potentiometer is Vp.
- The true value of the voltage is found out by multiplying the reading of potentiometer Vp by corresponding ratio of the voltage ratio box. Potentiometer is standardized before measurement.

OR

- The sub-standard or calibrated meter and meter under test are connected inparallel across voltage source and readings are noted.

3 c) ii) Explain with neat diagram how ammeters are calibrated.

Soln:

Procedure of calibration of ammeter:

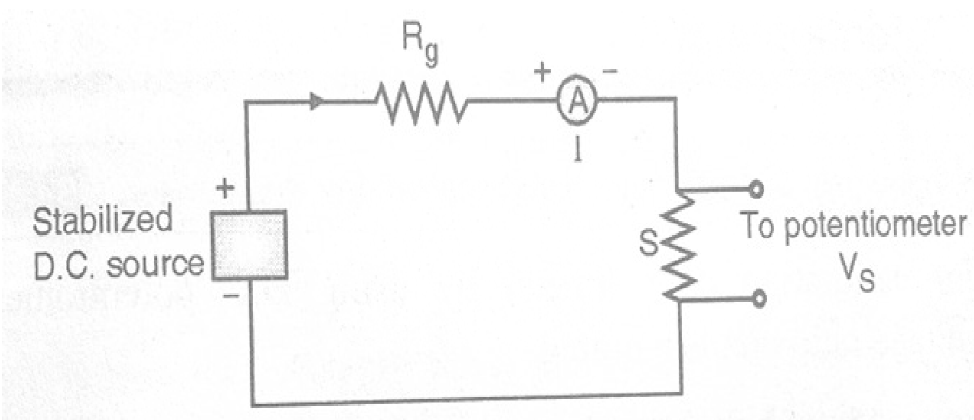


Diagram 02 mark

In this methos DC potentiometer used for measurement of voltage across a standard low resistance.

• Connect the circuit as shown in above fig. the ammeter to be calibrated is connected in series with standard resistance and regulating resistace Rg.
• By varying Rg, voltage across potentiometer (S) is measured. Before measurement potentiometer is required to be standardized. At the same time current through ammeter is also measured (I). i.e. reading of ammeter under calibration.

Explanation 02 mark

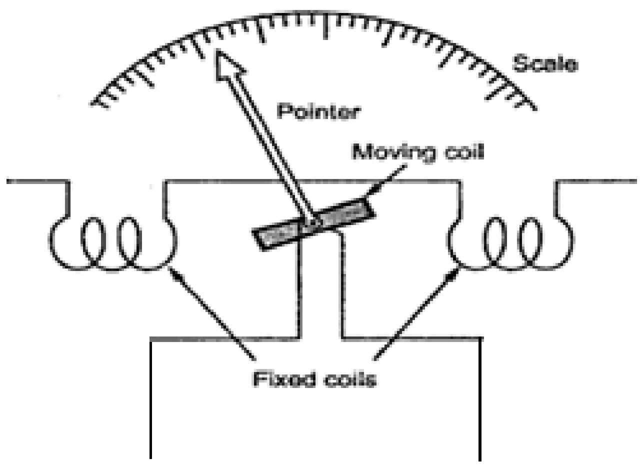
OR

The sub-standard or calibrated meter and meter under test are connected in series and readings are noted for corresponding currents.
• At each step, true value of ammeter is calculated as,
Where, Vs= Voltage across potentiometer
S= resistance of potentiometer.
and I are compared for finding out error in ammeter.

4 Attempt any two 16 marks

4 a) Explain with neat diagram construction and working of electrodynamometer type wattmeter.

Soln:



Electrodynamometer type instrument

Diagram: labeled 4 marks, unlabeled 1 mark, partially labeled 2 marks.

Construction &Principle of dynamometer instruments:

The electrodynamometer instruments consist of two sets of coils whose fluxes are made to interact to produce the required torque. Of the two coils one of them is the moving coil(C) while the other is the fixed coil (divided in to two sectional coils F_1 & F_2). The torque produced on the moving coil is directly proportional to the product of the currents in the two coils. Here the two coils are connected in to carry the current proportional to the quantities whose product is to be measured.

Construction & Principle 4 mark

Torque T α $|I_1|$ x $|I_2|$ x cosØ,

I_1 α V & I_2 α I ,

Therfore Torque T α |V| x |I| x cosØ

α Power(P)

where Ø = angle between the two currents.

The dynamometer instruments consist of two sets of coils whose fluxes are made to interact to produce the required torque. Of the two coils one of them is the moving coil while the other is the fixed coil (divided in to two sectional coils). The torque produced on the moving coil is directly proportional to the product of the currents in the two coils. Here the two coils if connected in series to carry the current proportional to the quantity to be measured. Hence even in ac applications the torque is directly proportional to the square (product) of the current I.

Hence as Torque T α I2, the torque is always positive and hence can be used for DC and AC applications.

Further if the two coils are made current coil and voltage coil (wattmeter) then we can measure power as the deflection is proportional to products of the voltage, current and cosine of phase angle between them.

4 b) i) Draw circuit diagrams for measurment of 3 phase active power and 3 phase reactive power using one wattmter.
Soln:

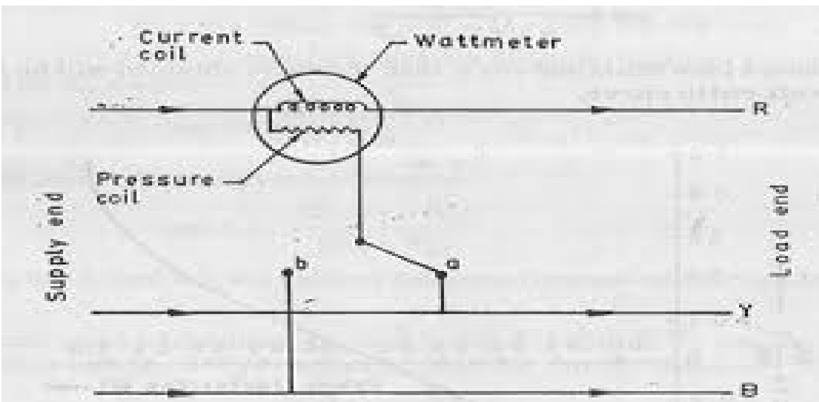
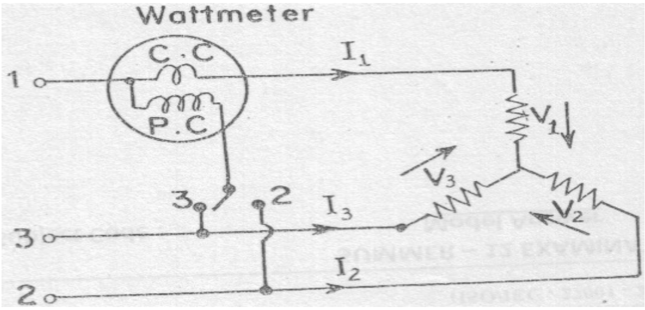


Diagram: labeled 4 marks, unlabeled 2 mark

OR



4 b) ii) Explain effect of power factor on reading of wattmeter.

Soln:

In two wattmeter method the readings of two wattmeters are given by equations:

W_1=V I cos(30+ø) and W_2=V I cos (30-ø)

We will consider different cases of power factors

four cases with effect 2 marks each = 8 marks

1. If power factor is unity i.e. p.f.=1 ($ø=0^0$)

   W_1=V I cos (30+0) and W_2=V I cos (30-0)

   W_1=V I cos 30 and also W_2=V I cos 30

   Thus both the watt meters read equal readings.

2. If power factor is 0.5 lagging i.e. $ø=60^0$

   W_1=V I cos (30+60) and W_2=V I cos (30-60)

   W_1=V I cos 90 and W_2=V I cos (-30)

   W_1=V I (0) and W_2=V I cos (-30)

   W_1=0 and W_2=V I cos (-30)

   Thus it is observed that one of the wattmeter reads zero and all the power is measured by second wattmeter.

3. If power factor is between 0.5 and 0. i.e. is greater than 60^0 & less than 90^0. In this case one of the wattmeter gives positive reading and second wattmeter give negative reading.

   Hence for taking reading of second wattmeter its pressure coil connections or current coil connections is to be interchanged.

4. If power factor is 0 i.e. $ø=90^0$

   W_1=V I cos(30+90) and W_2=V I cos(30-90)

   W_1=V I cos120 and W_2=V I cos(-60)

   W_1=0.5* V I and W_2=V I*(-0.5)

Thus it is observed that both the wattmeter reads equal and opposite power.

For leading power factors: - The readings of two watt meters only interchange.

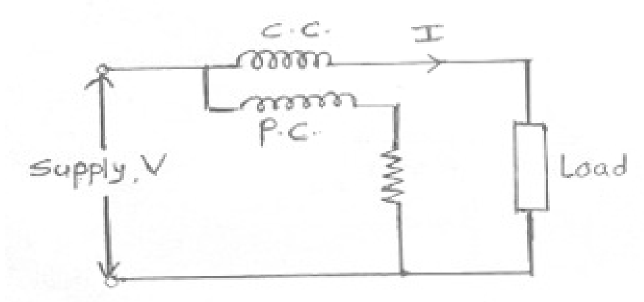
4 c) Describe any four errors in electrodynamometer type wttmeter.

Soln:

Errors in wattmeter:

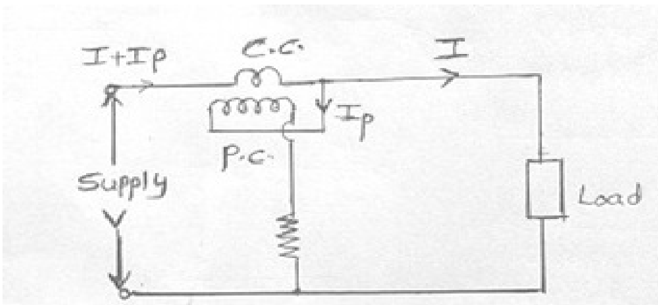
1.Errors due to method of connection.

In uncompensated wattmeter , the reading of wattmeter includes the powerloss in coils



The error in measurement can be reduced by using this connection for loads having low current values.

Any four errors expected. With diagram 2 marks each.



By using compensating coil , the error due to current coil which carris the current of PC in addition to the load current is eliminated

2.Error due to pressure coil inductance.

Pressure coil inductance causes wattmeter to read more power than actual . A capacitor connected in parallel with pressure coil.

3.Error due to Pressure Coil Capacitance.

The wattmeter reads less power.

This error can be reduced by designing pressure coil circuit such that inductive reactance of the circuit matches exactly with the capacitance reactance of the circuit i.e. $X_L=X_C$.

4.Error due to mutual inductance effect.

An emf induced in pressure coil due to current through the current coil. This emf of pressure coil opposes applied voltage.

Instrument is developed such that their coil systems are so arranged that they are always in zero position of mutual inductance.

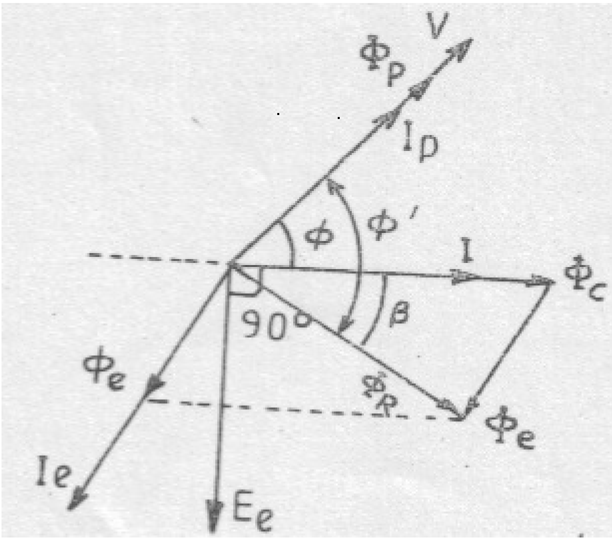
5.Error due to stray magnetic fields.

Main magnetic field gets disturbed by external magnetic fields known as stray magnetic fields

To avoid this error, magnetic shield is placed over CC & PC.

6.Error due to eddy currents

Phasor diagram of effect of eddy current on watt meter reading:



E_e = eddy emf, I_e = eddy current, I_P = current in pressure coil, Φ_e = flux due to eddy current, Φ_c = flux due to current coil, Φ_p = flux due to pressure coil,, Φ_R = resultant flux.

As seen from the diagram the resultant flux lags the current coil flux, due to which the phase angle between Φ_p and Φ_R increases. As the torque is a function of the magnitudes of Φ_p and Φ_R and angle between them the resultant torque decreases.

Is very small and is neglected.

7.Temperature error.

Change in room temp. changes the value of resistance of pressure coil and the stiffness of the springs.

Using low temp. coeff. materials for coils and components this can be minimised.

8.Error due to vibration of moving system.

Avoided by designing the moving system such that its natural freq is greater than 2 times the freq of deflecting torque of the wattmeter

5 Attempt any two 16 mark

5 a) Two wattmetrs connected to measure 3 phase power gives reading of 3000 W and 1000 W respectively. Find power factor of circuit.

i) When both readings positive

ii) When reading of 1000 W is obtained after reversing CC of second wattmeter

Soln:

i)Here W_1 = 3000 W, W_2 = 1000 W.

Total power of load P = $W_1 + W_2$,

= 3000 + 1000 = 4000 W. 2mark

p.f = cos $\{\tan^{-1} [\sqrt{3}(W_1 - W_2)/(W_1 + W_2)]\}$

= cos $\{\tan^{-1} [\sqrt{3}(3000 - 1000)/(3000 + 1000)]\}$ 2mark

= cos $40.89^o = 0.755$ lag.

ii) **Here** $W_1 = 3000$ W, $W_2 = - 1000$ W.

Total power of load = $W_1 + W_2$,

= 3000 + (-1000) = 2000 W. 2mark

p.f = cos $\{\tan^{-1} [\sqrt{3}(W_1 - W_2)/(W_1 + W_2)]\}$

= cos $\{\tan^{-1} [\sqrt{3}(3000 + 1000)/(3000 - 1000)]\}$ 2mark

= cos $73.89^o = 0.277$ lag.

5 b) Explain with diagram construction and working of induction type energy meter.

Driving system:-It consists of two electro-magnets namely shunt magnet (upper) & current magnet (lower). In between these two magnet light weight aluminum Disc is mounted on spindle. The registering system connected to spindle. The copper shading band gives compensation in driving torque.

Construction 2 marks

Cotrolling system:- It cosist of C shsped permanent magnet known as braking magnet.It provides T_C and value of this torque is adusted by shifting the position of brake magnet

Registring system:- it consists ofa pinion which egages a gear train which drives the number of plates on the dial.

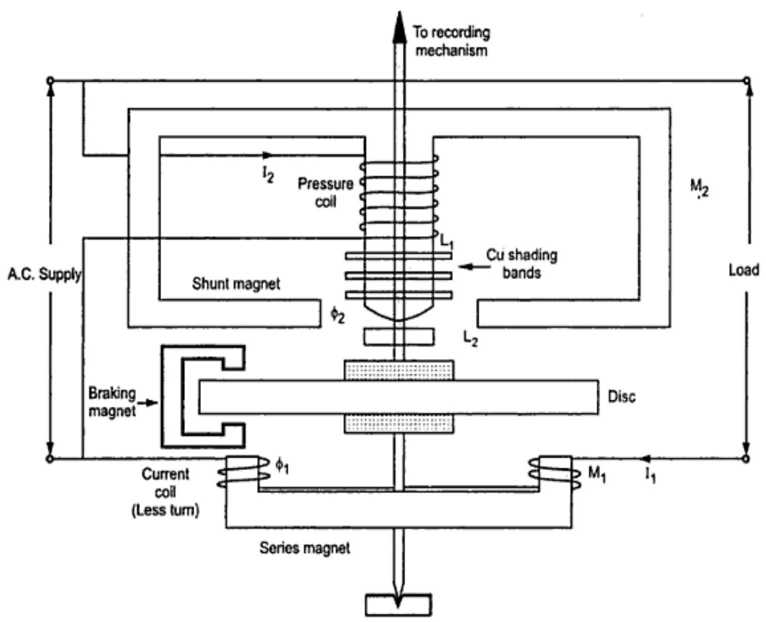


Diagram: labeled 3 marks, unlabeled 2 mark

Working:- As shown in the diagram the disc is placed between the two electromagnets ,eddy currents will be induced on the disc by two fluxes i.e. flux due to pressure coil and flux due to current coil, which will set up torque on the disc which is proportional to power causing the disc to rotate.

$T_d \alpha P \alpha V I \cos\phi$

&

$T_b \alpha N$ (speed of disc)

For steady speed of disc, $T_d = T_b$

Multiplying both sides by time t

Therefore, P x t = N x t

Therefore, Energy α Number of revolutions of the disc in time t.

Working 3 Marks

5 c) i) Compare analog and digital multi-meter. (any four points)

	Analog meter	Digital meter
1	Power supply is not required	Power supply is required
2	Construction is simple	Construction is complicated
3	Bigger in size & less expensive	Smaller in size & more expensive
4	Accuracy is less	High accuracy is obtained
5	Less suffered from electric noise	More suffered from electric noise
6	Better visual indication of changes in the reading is obtained	Visual indication of changes in the reading is not that much better.
7	Less isolation problem	More isolation problem

Any four pts 1 mark each = 4 marks

5 c) ii) Explain how earth resistance can be measured using earth tester.

Soln:

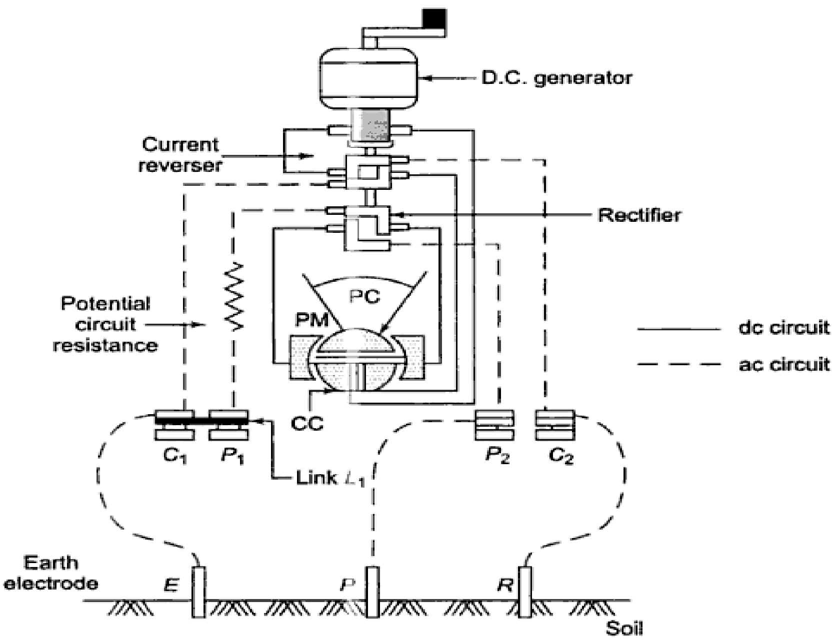


Diagram 2 marks

For measuring earth resistance the current electrodes R must be driven in to the soil at a sufficient distance from the earth plate E. Also the potential electrode P must be driven in at a point which is outside the resistance areas of both E and .As a rough guide the current electrode should be 25 to 30 meter away and potential electrode about half the distance from E .Take three readings of earth resistance with the potential electrode at different positions in turn (a) Mid way between E & R (b) 3 meter nearer to E and (c) 3 meter nearer to R. If the three readings agree substantially take the mean of these three readings as a correct value of earth resistance. Procedure 2 marks

6 Attempt any two 16 marks

6 a) Explain with diagram construction and working of single phase dynamometer type power factor meter.

Soln:

Single phase dynamometer type power factor meter.

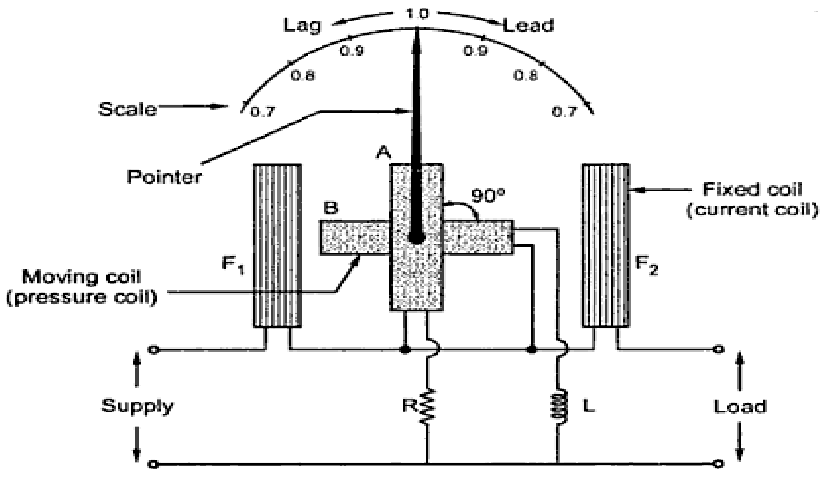


Diagram: labeled 4 marks, unlabeled 2 mark

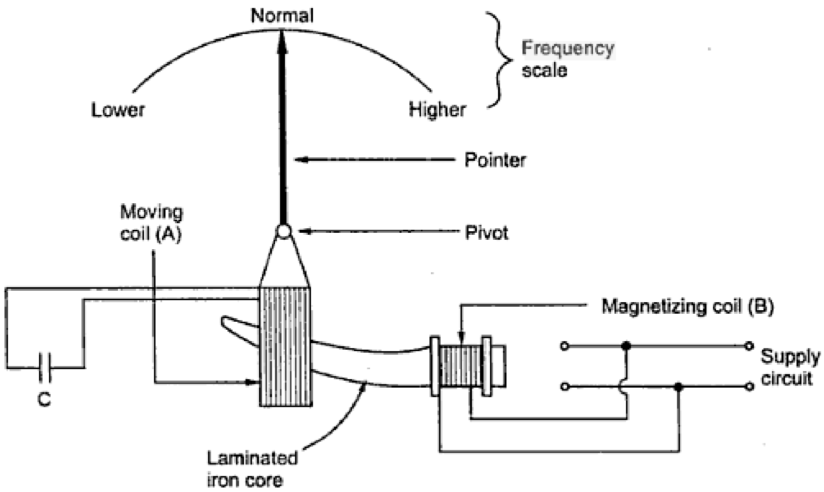
Single phase electrodynamometer type power factor meter

No controlling torque is required in this meter. Current flows in the pressure coil through ligaments of silver. The coil A is connected in series with a non inductive resistance R. So that current flowing through it is in phase with the applied voltage. 1 mark The coil B is connected in series with a highly inductive reactance L, so that current flowing through it lags the voltage by 90^0. 1 mark The coil system of A and B takes up position of equilibrium where their torques are equal. At this the angular position θ of A with respect to horizontal line is the power factor angle Φ. 2 marks

6 b) Explain with diagram construction and working of each of following:

i) Ferro dynamic type frequency meter:

Soln: Constructional details of ferro-dynamic type frequency meter.
(Electrical resonance type frequency meter)
It consists of a fixed coil. The supply whose frequency is to be measured is connected across it. This coil is also known as magnetizing coil. It is mounted on a laminated iron core. The core has a typical varying cross section. It varies along the length and is maximum at the end of core. The moving coil of it is pivoted over this iron core. The pointer is fixed to the spindle and the terminals of moving coil are connected to a suitable capacitor C .No controlling torque is required.



Ferrodynamic frequency meter

Diagram: labeled 2 marks, unlabeled 1 mark
.

Working: - Current flowing through magnetizing coil produces flux in the iron core which will set up an emf in the moving coil .This emf lags the flux ø by almost 90^0. This will cause current I to flow through capacitor C. If current is inductive it will lag induced emf and a torque will act on the coil. If current is capacitive then also the torque will act, but if the inductive reactance is equal to capacitive reactance two torques will act on the moving coil. The capacitive reactance is constant for given frequency but the inductive reactance depends upon the position of pivoted coil on the core. The nearer the coil approaches the magnetizing coil, the greater is it's inductance .The moving coil is pulled towards the magnetizing coil until both the reactances are exactly equal. i.e. when torque is zero. The value of

Description 2 marks

capacitor is so selected that the moving coil takes up a convenient position when frequency is of normal value.

6 b) **ii) Clip on meter:**

Clip on ammeters are used to measure the high current flowing through bus bar, cable or fuse holders carrying currents. They consist of split core current transformer whose secondary winding is connected to rectifier type moving coil instrument. The primary become conductor, whose current is to be measured. The split core gets aligned by the force of a spring tension. While the core is covered with insulating material. Hence higher current through conductors can be measured. A selector switch is provided to select secondary number of turns which ultimately changes the current range. For measuring current the core is opened by pressing trigger shown and then clipped over the conductor carrying current. The dial will record the current directly.

Description 2 marks

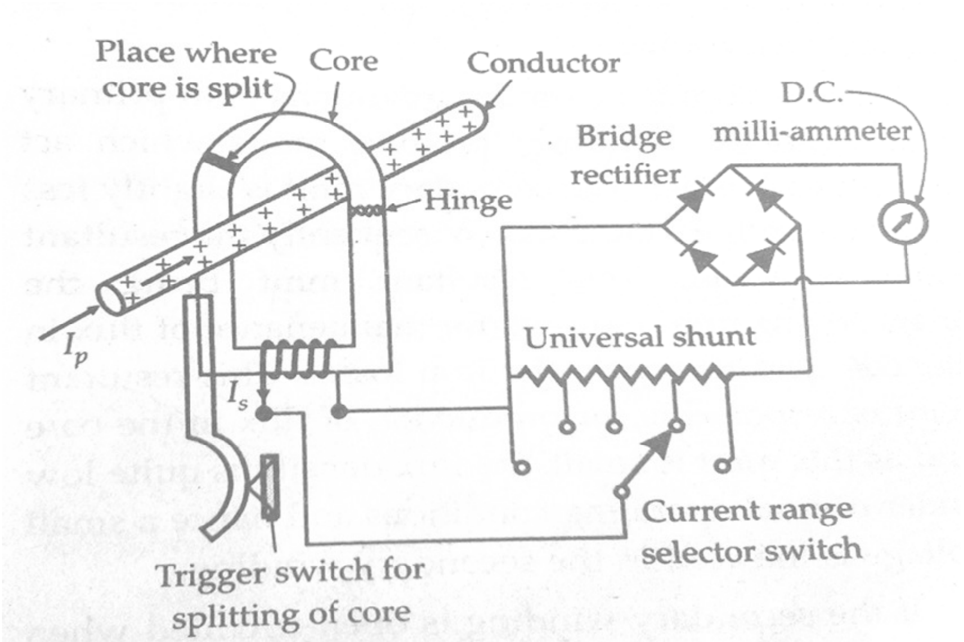
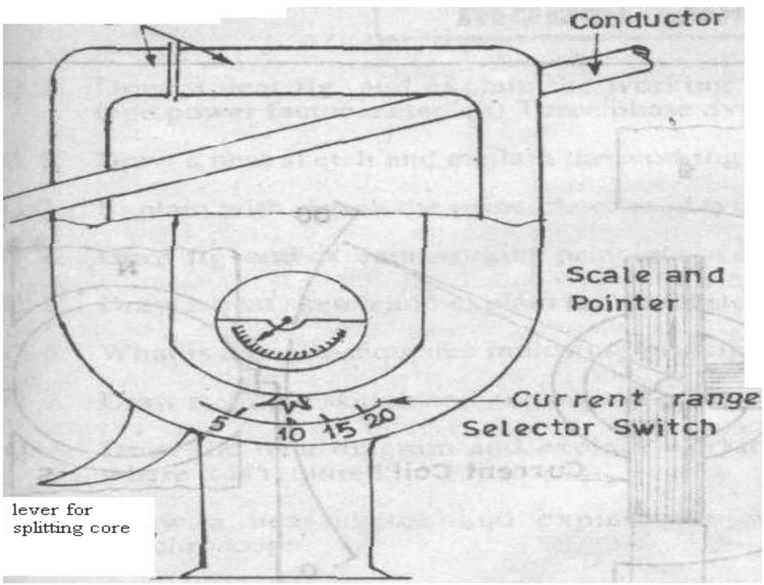


Diagram 2 marks

OR

splitting core



clip on ammeter

6 c) Draw and explain internal structure of a cathode ray rube:

Soln:

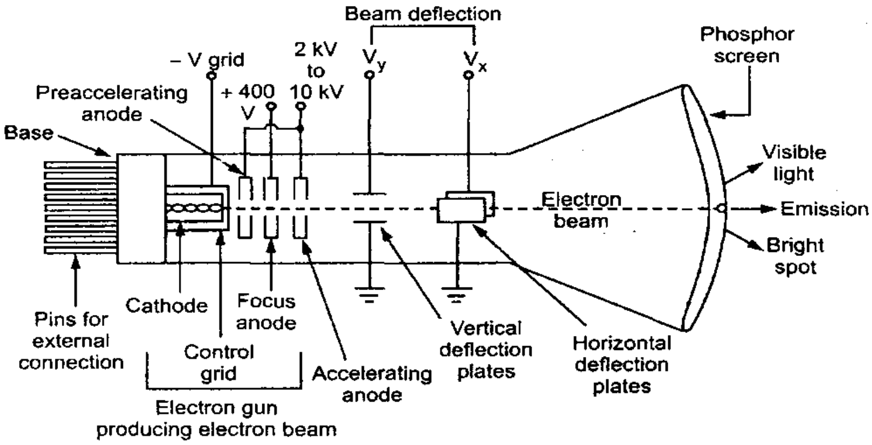


Diagram: labeled 5 marks, partially labeled 3 unlabeled 2 mark

- CRT consists of electron gun assembly which includes pins for connection, thermally heated cathode, control grid, focusing anode, accelerating anode, vertical deflecting plates, horizontal deflecting plates & internally coated screen.
- The beam of electrons is generated by heating cathode thermally.
- The number of electrons is controlled by control grid.
- The focusing anode & accelerating anode focuses & accelerate the beam of electron respectively.

-The electron beam coming out from electron gun assembly enters to deflecting plates.

-The screen of CRT internally coated with Phosphors material on which we observe waveform of the input signal.

Description 3 marks