Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

1 Attempt any TEN of the following. 2 x 10 = 20

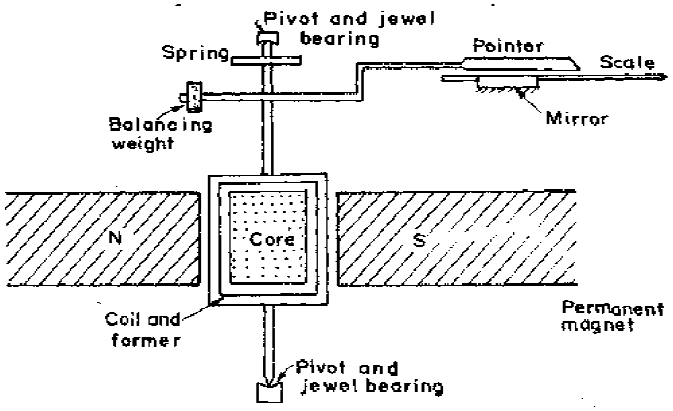
1 a) Define RMS value of an alternating quantity.

Ans- RMS Value: The RMS value or effective value of an alternating current is measured in terms of the direct current that produces the same heating effect in the same resistance when same time is provided. 02 mark

Or

The RMS value or effective value of an alternating current is defined as that value of direct current which will does the same amount of work in the same time or would produce the same real effect as when the alternating quantity is applied.

1 b) Draw the neat labeled diagram of PMMC instrument.



Neat diagram 01 mark

Correct labeling carries 01 mark

Or equivalent diagram.

1 c) State any two applications of digital multimeter.

Ans

1) To measure direct & alternating voltages.
2) To measure direct & alternating currents.
3) To measure unknown resistance.
4) To measure capacitances
5) To check continuity of electrical circuits / elements as resistances, coils etc.
6) To test Diodes.
7) To test the transistor

01 mark each point any 02 points = 2 marks

1 d) State the function of commutator in D.C. motor.

Ans-

The ends of the armature coils are connected to the commutator, which with the help of brushes supplies the DC power to the armature windings of motor for its operation. It reverses the direction of current in the armature conductors as the poles under which they travel alternate. This results in unidirectional torque production in the motor armature. 1 mark 1 mark

1 e) Define transformer.

Ans-

Transformer is a static (or stationary) device by means of which electrical power in one circuit is transferred to another circuit with frequency unchanged. It can raise or lower the voltage in a circuit with corresponding increase or decrease in current. 02 marks

1 f) What is transformation ratio of transformer?

Ans: Transformation ratio or turns ratio is equal to the ratio of primary to secondary induced emfs (voltage transformation).

At substantial values of load currents near full load values the ratio of currents is inverse of 1 mark

the turns ratio.
Mathematically,

$$K = \frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}$$ 01 mark

1 g) What is slip of an induction motor? What is its value at standstill condition?

Ans-

The difference between synchronous speed (Ns) and actual speed (N) of the rotor expressed as fraction or percentage of the synchronous speed is known as slip (s). 01 marks

i.e. slip, $s = [(Ns- N)/N_S]$ p.u

OR percentage slip = $[(Ns- N)/N_S] \times 100$.

At standstill (N = 0) hence slip is equal to one p.u. or 100 per cent.

i.e. s=1 or s= 100 % 01 marks

1 h) Name any four safety tools used in industry.

Ans:

1) Hand gloves
2) Goggles
3) Rubber mats
4) Fire extinguishers
5) Danger plates (Danger notice plates)
6) Search lights
7) Safety shoes or Gumboots
8) Ear plugs
9) Fall arresters
10) Life line rope
11) Safety helmets
12) Safety belts
13) Safety mask
14) Fire buckets
15) First aid box
16) Insulating stick or discharge rod

½ mark each point student can write any 04 points = 02 marks

1 i) What is energy audit?

Ans:

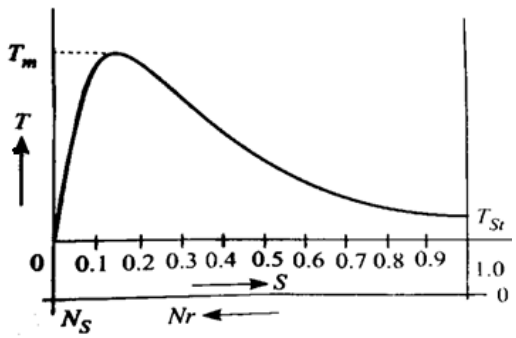
Energy audit is inspection, survey and analysis of energy flows in an energy consumption occupancy, process or system to identify, suggest means to conserve energy and increase the energy efficiency without negatively impacting the output(s). 02 mark

1 j) Draw the speed torque characteristics of 3-phase induction motor.

Ans:

N_S, N_r & S are synchronous speed, rotor speed & slip respectively; 02 mark

T_m & T_{St} are maximum & starting torques respectively.



1 k) State the method to reverse the direction of rotation of 3-phase induction motor.

Ans-

Direction of rotation of three phase induction motor can be reversed by changing the phase sequence of the three phase supply. — 1 mark

i.e. R-Y-B ---- clockwise direction

R-B-Y or Y-R-B --- anticlockwise direction — 1 mark

1 l) State any two applications of electrical machines in electro agro system. — 01 mark each, any 02 points = 2 marks

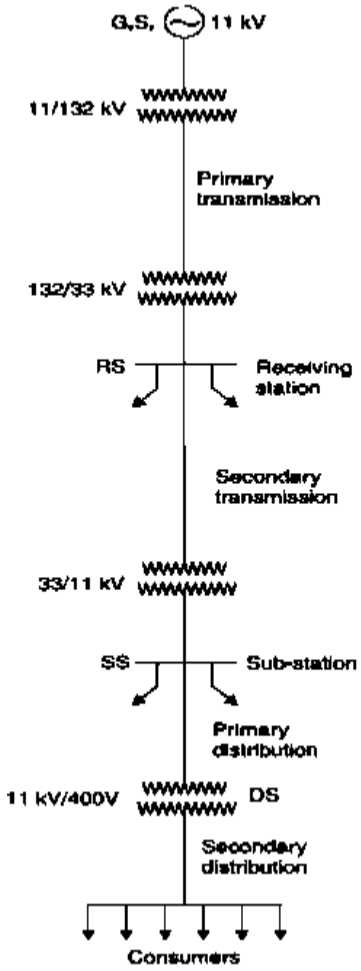
Ans:

1) Submersible Water pump
2) Water pumps on the borewells.
3) Crop Cutting machines
4) Diesel generator
5) Electrical oven and space heaters.

2 Attempt any FOUR of the following. — 4 X 4 = 16

2 a) Draw the single line diagram of electrical power system and mark the voltages.

Ans:



Correct diagram 02 marks and Correct Voltage levels 02 marks — Total = 4 marks

Or equivalent diagram

2 b) Define the following terms as referred to an alternating quantity:
(i) Cycle
(ii) Frequency
(iii) Maximum value
(iv) Average value

Ans-

(i) Cycle: A complete set of positive and negative values of an alternating quantity. 01 mark

(ii) Frequency: Number of repetitions of one cycle in one second is called as frequency. Unit Hertz or cycles/second. 01 mark

(iii) Maximum value: The maximum instantaneous value of alternating quantity is its maximum value or its peak value. 01 mark

(iv) Average value: Average value of an alternating quantity is defined as average of all instantaneous values over a period of half cycle. 01 mark

2 c) State any four advantages of three phase system over single phase system.

Ans:

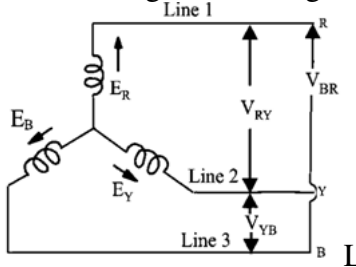
(i) In a three phase system with balanced loads the supply systems can hold on to their stable balanced conditions which increases the life of the system and leads to less maintenance problems & unwarranted conditions. 01 mark each point
(ii) Three phase transformers are more economical (power capacity/weight ratio is more) any 04
(iii) Three phase induction motors are self-starting, whereas single phase induction motors are not self-starting machines unless provided with an extra starting winding. points = 04 marks
(iv) Three phase motors have higher efficiency as compared to single phase motors.
(v) Three phase motors have better power factor.
(vi) Single phase motors commonly designed for fractional horse power rating so these motors are useless for industrial applications, where the power requirement is quite high.
(vii) The size of three phase motors is small as compared to single phase motors of same rating.
(viii) Three phase system is much cheaper with regards to generation of power and its transmission and distribution compared to a single phase system.

2 d) What is line voltage and phase voltage? Draw star connected 3- phase supply system and mark line voltage and phase voltage.

Ans-

Line voltage- The voltage available between any pair of terminals (or outers) is called line voltage (V_L). 01 mark

Phase voltage- the voltage induced in each winding is called Phase voltage (V_{ph}). 01 mark



Neat labellled diagram 02 mark

Line Voltages = V_{RY}, V_{YB}, V_{BR}, Phase Voltages = E_R, E_Y, E_B

2 e) The current flowing through a circuit is i = 14.14 sin (314t – π/6) . find :

(i) Frequency
(ii) Phase difference
(iii) RMS value of current
(iv) Amplitude

Ans:

(i) Frequency –

ϙt = 314t

ϙ = 2πf = 314

$\therefore f = \frac{314}{2\pi} = 49.97\ Hz \approx 50\ Hz$ 01 mark

(ii) Phases difference

Since, $\emptyset = \frac{\pi}{6}$

$\therefore \emptyset = 30°$ or (π/6) radians 01 mark

(iii) RMS value of current

Maximum value = $Im = 14.14\ units$

$Irms = \frac{Im}{\sqrt{2}} = \frac{14.14}{\sqrt{2}} = 9.99\ A \approx 10\ units$ 01 mark

(iv) Amplitude 01 mark

$Im = 14.14\ units$

2 f) Explain the principle of working of clip-on ammeter. Where it is used?

Ans-

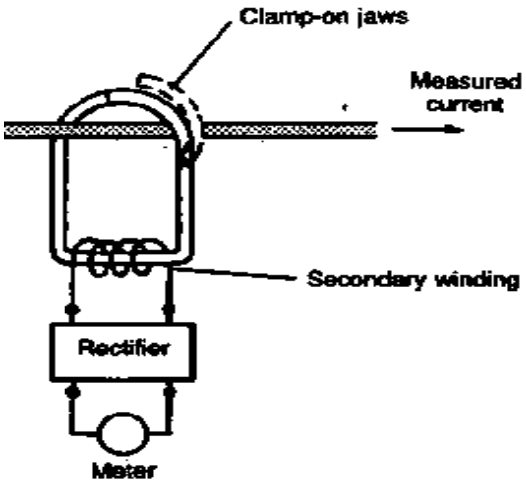


Diagram 01 mark

Working of clip on ammeter-

The principle of operation is shown in above figure, where it can be seen that the clamp-on jaws of the instrument act as a transformer core and the current-carrying conductor acts as a primary winding. The resulting secondary current is then measured by the instrument (taking the turns-ratio of the current transformer into account).Current

Working principle 02 mark

induced in the secondary winding is rectified and applied to a moving-coil meter.

Use:
Clip-on ammeter is used to measure the AC current without breaking the circuit or without opening the circuit. 01 mark

3 Attempt any FOUR of the following. 4 X 4 = 16

3 a) Explain the working principle of DC motor and explain the significance of back e.m.f.
Ans:

Working Principle of D.C. Motor

A machine that converts d.c. power into mechanical power is known as a d.c. motor. Its operation is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force. The direction of this force is given by Fleming's left hand rule and magnitude is given by; 02 mark

F = BIL newtons

Where,
B= Flux density
I = Current through the conductor
L = length of the conductor

Significance of back EMF -

The presence of back e.m.f. makes the d.c. motor a self-regulating machine i.e., it makes the motor to draw as much armature current as is just sufficient to develop the torque required by the load.

Armature current $Ia = \frac{V-Eb}{Ra}$

(i) When the motor is running on no load, small torque is required to overcome the friction and windage losses. Therefore, the armature current Ia is small and the back e.m.f. is nearly equal to the applied voltage.

02 mark

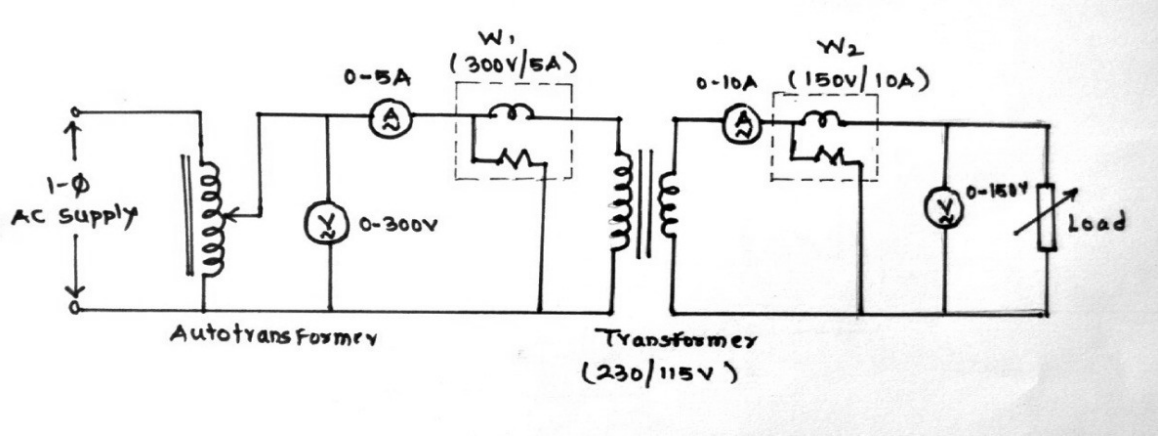
(ii) If the motor is suddenly loaded, the first effect is to cause the armature to slow down. Therefore, the speed at which the armature conductors move through the field is reduced and hence the back e.m.f. Eb falls. The decreased back e.m.f. allows a larger current to flow through the armature and larger current means increased driving torque. Thus, the driving torque increases as the motor slows down. The motor will stop slowing down when the armature current is just sufficient to produce the increased torque required by the load.

(iii) If the load on the motor is decreased, the driving torque is momentarily in excess of the requirement so that armature is accelerated. As the armature speed increases, the back e.m.f. Eb also increases and causes the armature current Ia to decrease. The motor will stop accelerating when the armature current is just sufficient to produce the reduced torque required by the load.

It follows, therefore, that back e.m.f. in a d.c. motor regulates the flow of armature current i.e., it automatically changes the armature current to meet the Load requirement.

3 b) Draw experimental setup to determine regulation and efficiency of the given 1 KVA, 230/115 V, 50 Hz, single phase transformer. Also give the meter ranges.

Ans :



02 marks for circuit diagram

02 marks for correct meter ranges

3 c) Explain the working of autotransformer with diagram.

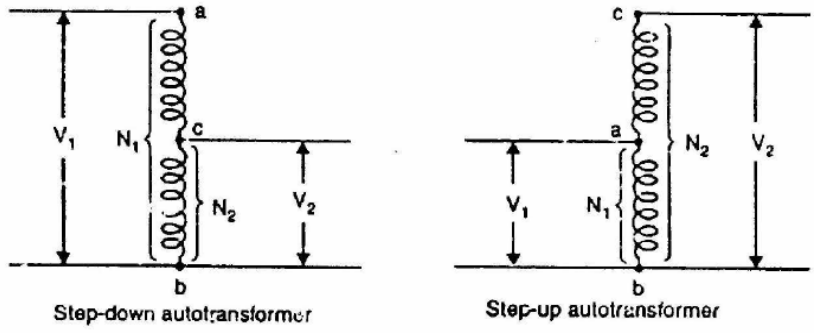


Fig.(i) fig(ii)

02 mark diagram

An autotransformer has a single winding on an iron core and a part of winding is common to both the primary and secondary circuits. Fig. (i) shows the connections of a step-down autotransformer whereas Fig. (ii) shows the connections of a step-up autotransformer. In either case, the winding 'ab' having N_1 turns is the primary winding and winding be having N_2 turns is the secondary winding. The primary and secondary windings are connected electrically as well as magnetically. Therefore, power from the primary is transferred to the secondary conductively as well as inductively (transformer action). The voltage transformation ratio K of an ideal autotransformer is

02 mark for explanation

$$K = \frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}$$

3 d) A capacitor having capacitance of 10 microfarad is connected in series with a non-inductive resistance of 120 ohm across 100 V, 50 Hz supply. Calculate:

(i) Current
(ii) Impedance
(iii) Phase difference between current and supply
(iv) Power

Ans: Given data: C= 10 μF , R= 120Ω, V = 100V, f= 50 Hz

Impedance-

$$Xc = \frac{1}{2\pi fC} = \frac{1}{2\pi * 50 * 10 * 10^{-6}} = 318.31\ \Omega$$ ½ mark

$$Z = \sqrt{R^2 + Xc^2} = \sqrt{120^2 + 318.30^2} = 340.17\ \Omega$$ ½ mark

(i) Current:

$$I = \frac{V}{Z} = \frac{100}{340.17} = 0.2939\ A$$ 1 mark

(ii) Impedance: 340.17 Ω

(iii) Phase difference between current and supply voltage-

Since, given circuit is series RC circuit,

$$\emptyset = \tan^{-1}\left(\frac{Xc}{R}\right) = \tan^{-1}\left(\frac{318.30}{120}\right) = 69.34°$$ 01 mark

(iv) Power – $P = VI\cos\emptyset = 100 * 0.2939 * cos\ 69.34° = 10.36\ watts$ 01 mark

3 e) A balanced three-phase delta connected load consists of three resistances each of four ohms connected to a 400V, 3-phase 50 Hz supply. Find:-

(i) Phase voltage
(ii) Phase current
(iii) Line current
(iv) Power Consumed

Ans:

Given data- R= 4 Ω/phase, V_L = 400 Volts, delta connected load

(i) Phase voltage -

$V_L = Vph$:

For delta connection; $V_L = Vph$

$\therefore\ Vph = 400\ Volts$ 01 mark

(ii) Phase current-

$\therefore\ Iph = \frac{Vph}{Zph} = \frac{400}{4} = 100\ A$ .....$(Since,\ Zph = Rph)$ 01 mark

(iii) Line current -

$I_L = \sqrt{3} *\ Iph = \sqrt{3} *\ 100 = 173.20\ A$ 01 mark

(iv) Power consumed: (if V & I are line values)

$P = \sqrt{3}\ V\ I\ \cos\emptyset = \sqrt{3} * 400 * 173.20 * 1 = 120000\ W = 120\ kW$ 01 mark

3 f) Derive e.m.f. equation of transformer.

Ans: EMF equation of transformer-

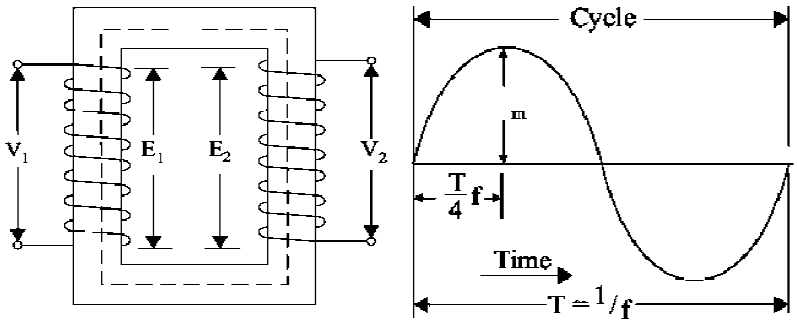


Fig.(i) Fig. (ii)

Let,

N_1 = No. of primary turns, N_2 = No. of secondary turns, f = Frequency of A.C. supply in Hz

$Ø_m$ = Max. flux in core = B_m x A (webers).

As shown in above fig (ii), flux increases from its zero value to maximum value of $Ø_m$ in one quarter of cycle i.e in (¼)f second.

Therefore Average rate of change of flux $= \frac{Øm}{(1/4)f}$

$$= 4f\,Øm\ \text{Wb/s} \quad or \text{ volt}$$ 1 mark

Now, rate of change of flux per turn means induced emf in volts.

Therefore Average e.m.f/turn = $4f\,Øm$ volt

If flux Ø varies sinusoidally, then r.rm.s. value of induced e.m.f is obtained by multiplying the average value with the form factor.

$$\text{Form factor} = \frac{\text{r.m.s value}}{\text{average value}} = 1.11$$

Therefore value of e.m.f/turn = 1.11 X $4f\,Øm = 4.44f\,Øm$ volt 1 mark

Now, r.m.s. value of the induced e.m.f. in the whole of primary winding

= (induced e.m.f./turn) X (No. of primary tuns)

$E_1 = 4.44\ f\ N_1 N B_m A$……(i) 1 mark

Similarly r.m.s. value of the induced e.m.f. in the whole of secondary winding

$E_2 = 4.44\ f\ N_2 N B_m A$……(ii) 1 mark

Equation (i) & (ii) are e.m.f. equation of transformer.

4 Attempt any FOUR of the following. 4 x 4 = 16

4 a) Classify the transformers according to

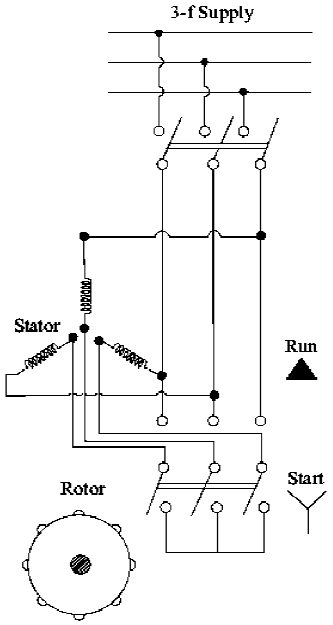
i) No. of phase
ii) Construction
iii) Voltage
iv) Application

Ans –

(i) By number of phases: a) Single phase, and b) Three phase 01 mark

(ii) By Construction: a) Core type, b) Shell type, c) Berry type. 01 mark
(iii) By Voltage: a) Step up, b) Step down. 01 mark
(iv) By Application: a) Instrument transformer for measurement, b) Instrument transformer for relaying, c) Power transformer, d) Distribution transformer e)Auto-transformers. Any two = 01 mark

4 b) Draw a neat labeled diagram of star-delta starter and write any one advantage of this starter.
Ans-



(schematic connection changing arrangement from star to delta expected)

Neat labeled diagram 03 mark, unlabeled or partially labeled 1 to 2 marks.

Advantage –

(i) This method is cheap and effective.
(ii) Power loss in the starter can be reduced considerably by limiting the starting current as per relation $I_{L(star)} = 1/3\ I_{L\ (delta)}$.
(iii) No external resistances required to achieve the reduced voltage starting.

Any one Advantage 01 mark

4 c) How speed control of induction motor is done by VFD.
Ans-

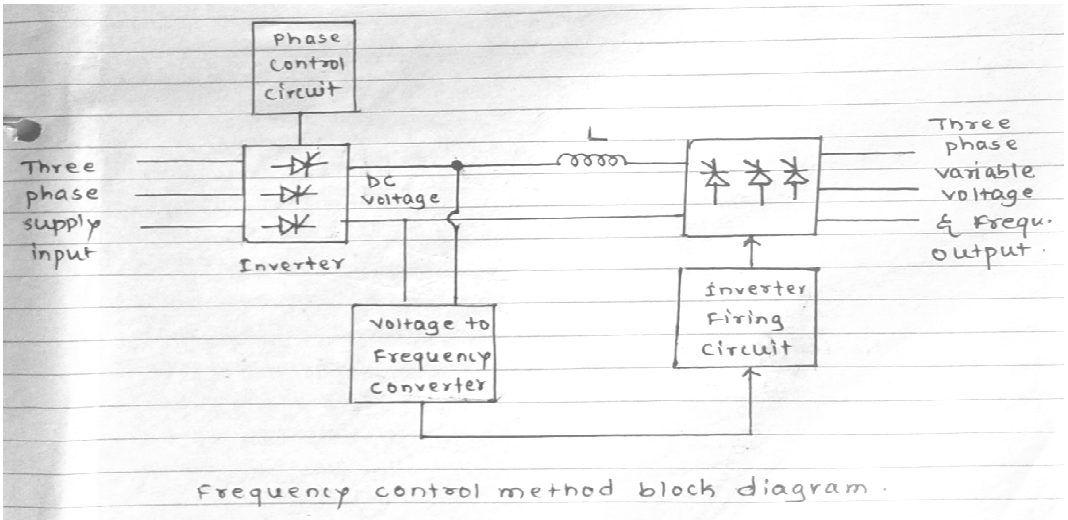
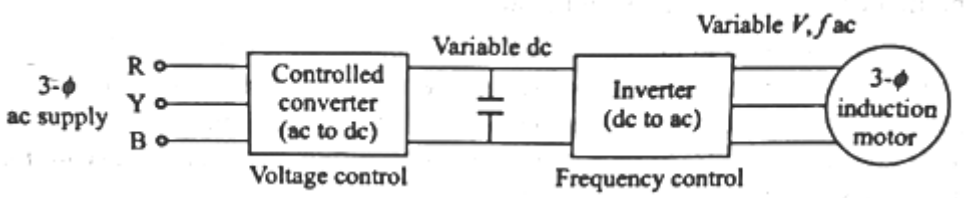


Diagram 02 mark

Or



Explanation-

The synchronous speed of the induction motor is given by, Ns=120f/P. The synchronous speed of an induction motor can be changed by changing the supply frequency (f). Variable frequency can be obtained from solid state equipment or (i.e. VFD drives).

A basic block diagram of speed control of induction motor using variable frequency source is shown in above fig. Three phase supply at input is first converted into controlled DC. This DC voltage is applied to inverter circuit whose frequency is controlled by pulses from voltage to frequency controller unit. A smoothing reactor, L is connected in the circuit to filter the controlled DC. Explanation 02 mark

4 d) State any four advantages of electric drive over any other type of drives.

Ans-

Advantages of electric drive over any other type of drives

1. These drives are available in wide range torque, speed and power.
2. The control characteristics of these drives are flexible. According to load requirements these can be shaped to steady state and dynamic characteristics. As well as speed control, electric braking, gearing, starting many things can be accomplished.
3. They are adaptable to any type of operating conditions, no matter how much vigorous or rough it is.
4. They can operate in all the four quadrants of speed torque plane, which is not applicable for other prime movers.
5. They do not pollute the environment.
6. They do not need refueling or preheating, they can be started instantly and can be loaded immediately.
7. They are powered by electrical energy which is atmosphere friendly and cheap source of power

01 mark to each point 04 correct points = 04 marks

4 e) What is universal motor? Where is it used? State its types.

Ans:

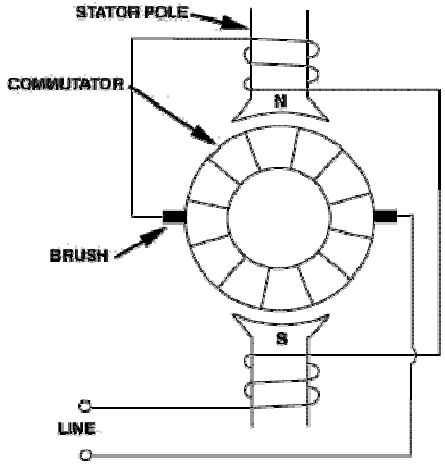


Diagram 01 mark

Or equivalent diagram

Universal motor is one that can be used with a single phase AC source as well as DC. The stator and rotor windings of the motor are connected in series through the rotor commutator. The universal motor is also known as AC series motor or AC commutator motor. — 1 mark explanation

Universal motor applications
(i) Vacuum cleaners, (ii) Drink and food mixers, (iii) Domestic sewing machine etc. (iv) Portable drills, (v) Blenders etc. — Any two ½ mark each = 1 mark

Types of universal motor-
1. Non-compensated type universal motor.
2. Compensated type universal motor. — 01 mark

4 f) Explain the working principle and operation of self-excited alternator.

Working Principle:

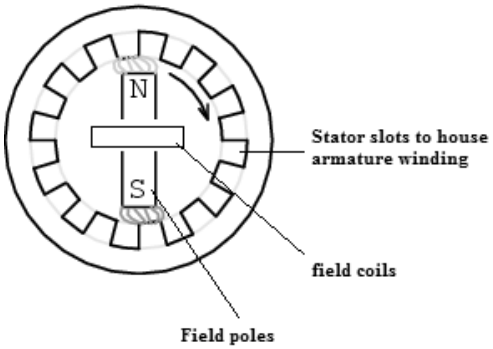


Fig 1

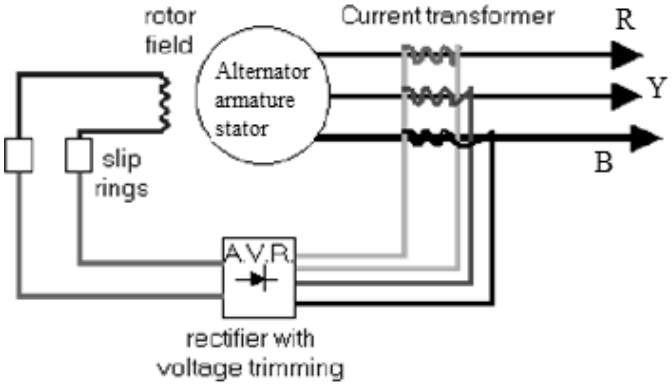


Fig 2

Any simple diagram 1 mark

OR

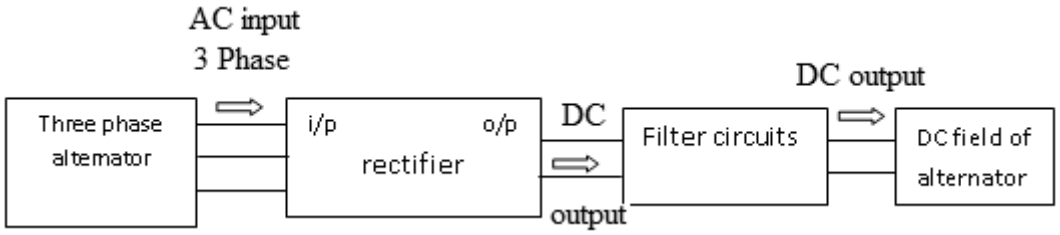


Fig3

Explanation 03 marks

Or equivalent diagram

Figures show the stationary armature, two pole rotating field type three phase alternator. Operates on the principle of electromagnetic induction. Consists of armature winding and a magnetic field. When the rotor rotates, the stator conductors (being stationary) are cut by magnetic flux, hence they have induced emf produced in them. Because the magnetic poles are alternately N and S, they induce an emf and hence current in armature conductors, which first flows in one direction and then in other. Hence, an alternating emf is produced in the stator conductors (i) whose frequency depends upon number of N and S poles and (ii) whose direction is given by Flemings Right Hand rule.

A schematic diagram of one type of self excited alternator working is shown

in Fig 2. The three phase generator output is fed to the rectifier whose output (DC) is given to the field winding. This DC output is regulated such that the induced emf in the alternator is maintained at the required value. As the field is fed from alternator's own generated emf it is called self excited alternator.

Students may draw a simple diagram as below or its equivalent which also must be assessed.

5 Attempt any four of the following. 04 x 4= 16

5 a) Explain the construction of three phase induction motor with diagram.

Ans:

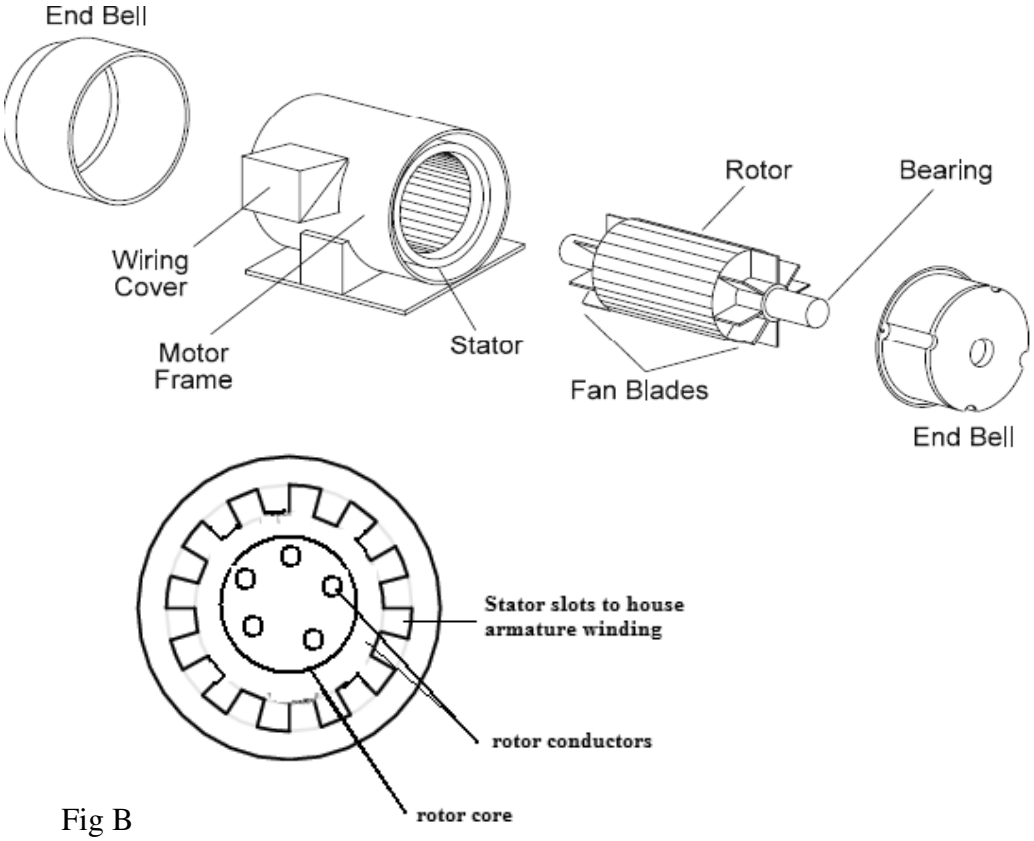


Diagram 02 marks

OR Fig B

Main parts:

Stator: laminated electromagnetic core with slots to accommodate 3 phase insulated windings spaced 120^o apart in space. Stator core housed in standard sized frames. The frame has terminal box for the windings. Windings may be star or delta connected.

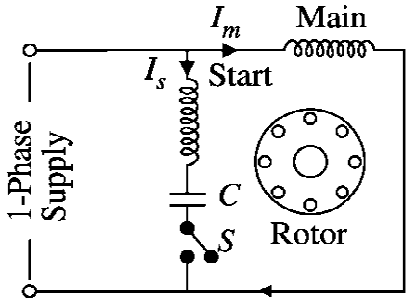
1 mark

Rotor: laminated construction with slots to house conductor bars in squirrel cage rotors and windings in slip ring rotors. Mounted on steel shaft supported by bearings housed in the end covers. Slip rings provided to connect to the rotor windings in wound rotor (slip ring type). Fan for cooling mounted on shaft.

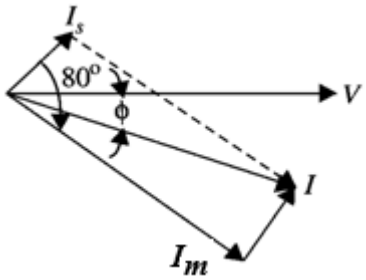
1 mark

5 b) Explain the working of single phase capacitor start induction motor.

Ans:



Fig(i)



Fig(ii)

Diagram 02 mark

The capacitor-start motor is identical to a split-phase motor except that the starting winding has as many turns as the main winding. Moreover, a capacitor C is connected in series with the starting winding as shown in Fig. (i). The value of capacitor is so chosen that Is leads Im by about 80° (i.e., α ~80°) which is considerably greater than 25° found in split-phase motor. Consequently, starting torque (Ts = k Im Is sin α) is much more than that of a split-phase motor Again, the starting winding is opened by the centrifugal switch when the motor attains about 75% of synchronous speed. The motor then operates as a single-phase induction motor and continues to accelerate till it reaches the normal speed.

Working 02 marks

5 c) What is (i) Resistance heating (ii) Induction heating (iii) Dielectric heating ?

Ans:

(i) Resistance heating :

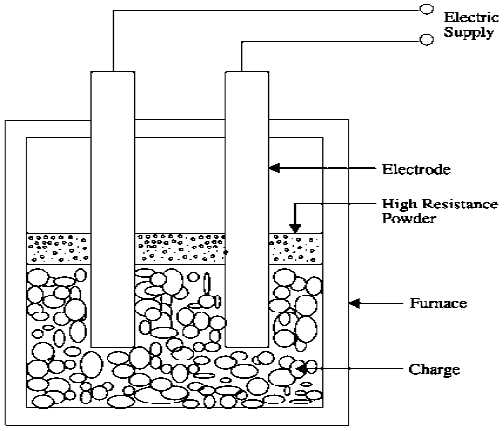


Diagram or equivalent ½ mark

It is based on the I^2 R effect. When current is passed through the resistive element I^2 R loss takes place which produce heat.

In this method the material to heated is treated as a resistance and current is passed through it. The charge may be in the form of powder, small solid pieces or liquid. The two electrodes are inserted in the charge and connected to either AC or DC supply. When the charge in the form of small pieces, a powder of high resistivity material is sprinkled over the surface of the charge to avoid direct short circuit. Heat is produced when current passes through it. This method of heating has high efficiency because the heat is produced in the charge itself.

½ mark

(ii) Induction heating :

Induction heating: high frequency supply passing through a coil (work coil) generates

strong magnetic field that induces emf and hence current in the metallic job/charge to be heated. As the path of induced currents (eddy currents) is short circuit these are very high leading to large amount of heat production. Also skin effect causes high resistance in eddy current paths leading to larger amount of heat produced. Used for surface hardening, melting metal charge etc. 1 mark

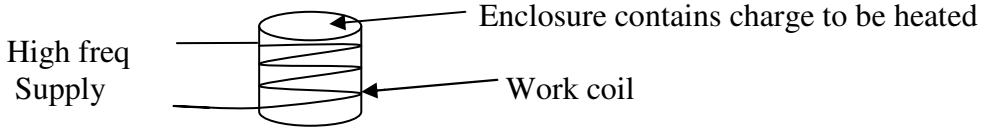


Diagram or equivalent ½ mark

(iii) Dielectric heating :

Dielectric heating: heating of insulators (or non-metallic material with extremely poor conductivity) due to the leakage current (and hence heat losses) in them when subjected to high freq. ac supply. The freq is normally between 12 kHz to 30 kHz and voltage is about 20 kV. Material to be heated is placed between two metal electrodes and the supply is applied. 1 mark

Applications: 1) drying of industrial products as textiles, agricultural produce as tobacco etc. 2) rubber vulcanizing, 3) curing of rubber and plastics, 4) sterilization.

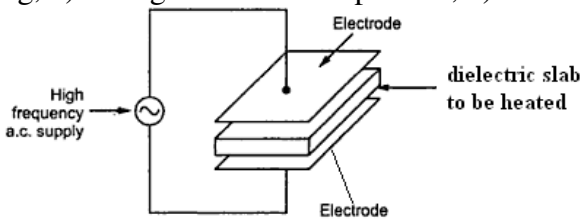


Diagram or equivalent ½ mark

5 d) A six pole 50 Hz induction motor has a slip of 2.5%. Find its actual speed and slip speed.

Ans:

Given f =50 Hz, s=2.5 % = 0.025

$$Ns = \frac{120f}{P} = \frac{120 * 50}{6} = 1000\ RPM$$ 01 mark

$$Actual\ speed\ ;\ N = Ns\ (1 - s)$$ 01 mark

$$= 1000\ (1 - 0.025)$$

$$= 975\ RPM$$ 01 mark

$$Slip\ speed\ = Ns - N = 1000 - 975 = 25\ RPM$$ 01 mark

5 e) Classify electric drive. Explain each type in brief.

Ans:

Classification of electric drives-

(i) Group drive
(ii) Individual Drive
(iii) Multi-motor Drive

List 1 mark

(i) Group drive

- If several group of mechanisms or machines are organized on one shaft and driven or actuated by one motor, the system is called a group drive or shaft drive.

- Single motor drives a no of machines through belt from common shaft.

Advantage : This is most economical type of drive.
Disadvantage: 01 mark
1. Any Fault that occurs in the driving motor renders all the driving equipment idle.
2. Efficiency low because of losses occurring in the energy transmitting mechanisms (Power loss).
3. Not safe to operate.
4. Noise level at the working spot is high.
5. Low Flexibility.

(ii) Individual Drive

- A single motor drives or actuates a given mechanism.
- Each machine load operating system is driven by its own separate motor. 01 mark

Advantage: specialized for given application hence increases productivity & quality
Disadvantage: Costly, investment wasted if drive remains idle for longer time.

(iii) Multi Motor Drive:

- Each operation of the mechanism is taken care of by a separate motor.
- The System contains several individual drives (motors) each of which is used to operate its own mechanism.
- Separate motors are provided for actuating different parts of the driven mechanism. 01 mark

Advantage :
1. Each Machine is driven by a separated motor it can be run and stopped as desired.
2. Machines not required can be shut down and replaced with a minimum of dislocation.
3. There is flexibility in the installation of different machines.
4. In the case of motor fault, only its connected machine will stop where as others will continue working undisturbed.
5. Absence of belts and line shafts greatly reduces the risk of accidents to the operating personnel.

Disadvantage:
Initial high cost.

5 f) Explain the concept and principle of electroplating with neat sketch.

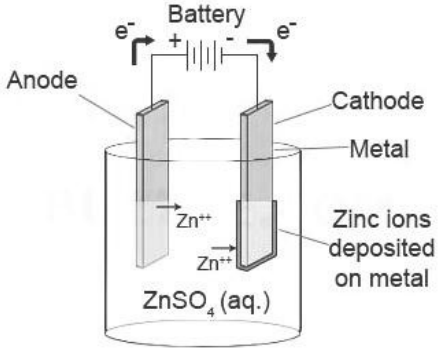


Diagram 01 mark

Electroplating is the application of a metal coating to a metallic or other conducting surface by an electrochemical process.

Working principle-

The article to be plated (the work) is made as cathode (negative electrode) and immersed into an electrolytic solution. The anode is usually a pure plate of metal whose coating is desired on the article is also suspended in electrolytic solution. 01 mark

The electrolyte is a solution of salt of metal with which article to be electroplated. On passing electric current, the metal ions from electrolyte get deposited on the article. The equivalent amount of anode get dissolved in a form of ions and passed into electrolyte. Smooth and brighter deposits are obtained. For zinc electroplating,

At cathode $Zn2^{+}(aq) + 2\ e^{-} \longrightarrow Zn\ (s)$

02 mark

At anode $Zn(s) \longrightarrow Zn2^{+}\ (aq) + 2\ e^{-}$

Faraday's laws of electrolysis govern the amount of metal deposited.

6 Attempt any FOUR of the following. 4 x 4 = 16

6 a) Explain the principle of eddy current heating in detail.

Ans –

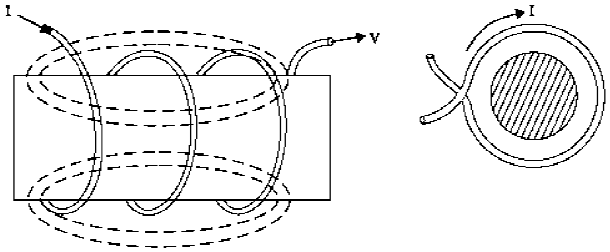


Diagram 02 mark

By heating an article by eddy currents, it is placed in-side a high frequency a.c. current-carrying coil. The alternating magnetic field produced by the coil sets up eddy-currents in the article which, consequently, gets heated up. Such a coil is known as heater coil or work coil & the material to be heated is known as charge or load. Primarily. It is the eddy current loss which is responsible for the production of heat although hysteresis loss also contributes to some extent in the case of non–magnetic material.

Explanation 02 marks

The eddy current loss $W_e\ \alpha\ B^2\ f^2$.

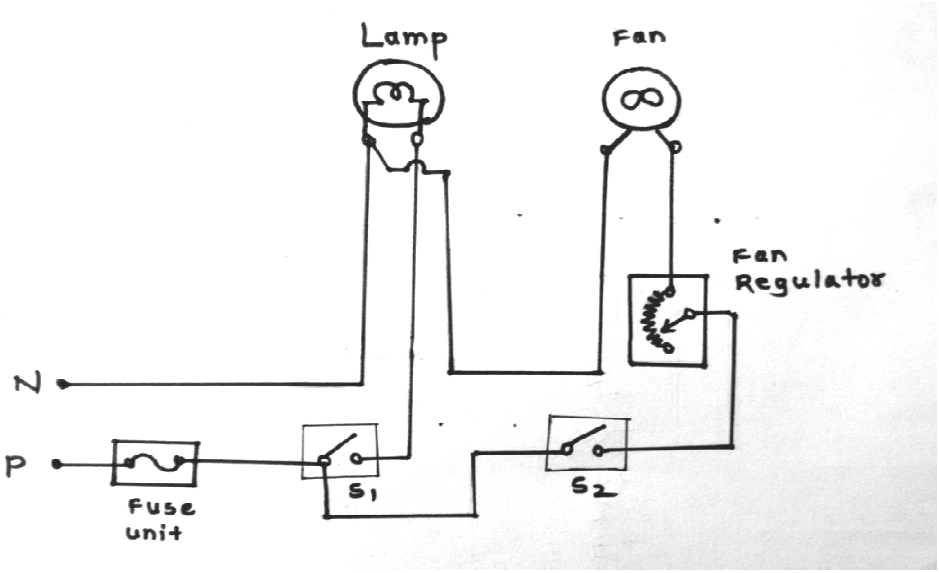
Hence, this loss can be controlled by controlling flux density B and the supply frequency *f*.

This loss is greatest on surface of the material but decreases as we go deep inside.

6 b) Draw the wiring diagram for control of one lamp one fan by two different switches.

Ans-

Correct diagram 04 marks



6 c) Write the function of (i) MCB (ii) ELCB (iii) Fuse.

Ans-

Function of MCB: Provide short circuit protection & over load protection to electric loads. 01 mark

Function of ELCB: Provides protection by detecting the unsafe magnitudes leakage currents flowing to earth and disconnecting the supply to the circuit. 02 mark

Function of Fuse: Provides short circuit & occasionally over current protection depending on its size & related circuit rating. 01 mark

6 d) State the necessity of earthing. Compare equipment earthing and neutral earthing.

Ans-

1) Earthing is grounding the body of the electrical equipment's to avoid the hazards due to leakage current. If the leakage current keeps circulating in the body of the equipment's, it might result in electrical shocks
2) Earthing is necessary for better voltage regulation and protection from surges and lightning strikes.
3) To provide safe path to dissipate lightning and short circuit currents. 01 mark
4) To provide stable platform for operation of sensitive electronic equipment's.

Equipment earthing and neutral earthing.

Sr. No.	Equipment earthing	Neutral earthing
01	Body earthing is path for fault current or leakage current through solid conductor connected to earth.	Neutral earthing is return path for current by making earth as conductor for star points of supply systems.
02	Equipment earthing is related to earthing of non-current carrying metallic parts that may get energized during earth fault. So it is done in order to prevent any shock to any person.	Star point connected to ground is known as neutral earthing. It is essential for preventing arcing ground effect during faulty conditions and maintaining zero potential at neutral

01 mark to each point any three points expected= 03 marks

		even during unbalanced condition.
03	It does not solve stability problem of the system.	It increases stability of the system.
04	There is no provision for connecting any means for earth leakage protection.	Neutral available in the system allows to use Earth fault relays/equipment's to act against ground faults.

6 e Explain metal arc welding with diagram.

Ans :

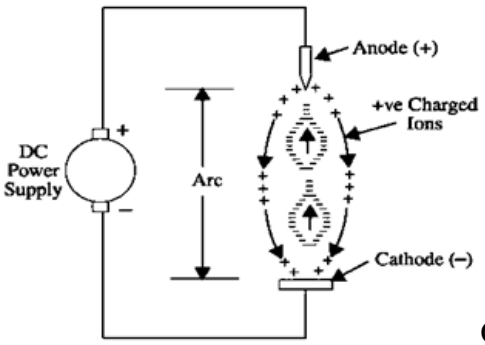
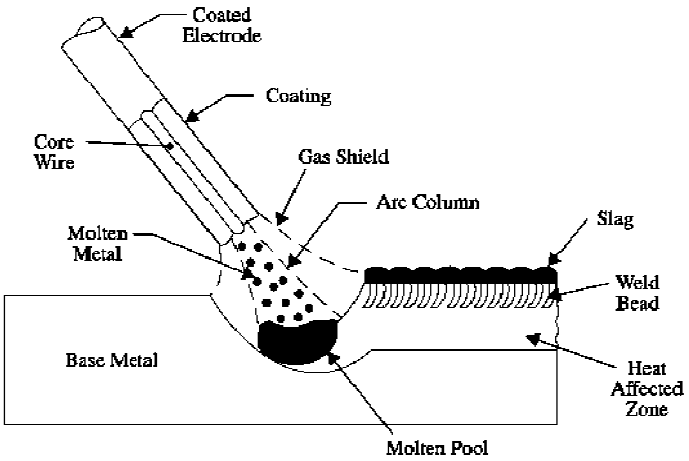


Diagram 02 mark

Or



An electric arc is formed whenever p.d is applied between two metallic electrodes which are separated by a short distance from each other. The arc is started by touching the positive electrode (anode) to the negative metal (or plate) and then withdrawing it to about 3 to 6 mm from the plate. When electrode first touches the plate, a large short circuit current flows and as it is later withdrawn from the plate, current continues to flow in the form of spark across the air gap so formed. Due to this spark (or discharge), the air in the gap becomes ionized i.e. is split into negative electrons and positive ions. Air becomes conducting and current is able to flow across the gap in the form of an arc.

02 mark

6 f) Explain in brief four different fire extinguishing methods adopted in electrical engineering.

Ans: Normally only two types are used for electrical fires CO_2 & Dry chemical powder.

(i) Carbon Dioxide Extinguishing Systems.

This type is the most suitable & widely recommended one for electrical fires. Carbon dioxide (CO_2) extinguishers are normally Class C extinguishers. To use the extinguisher, pull the pin near the handle, point the horn at the base of the fire, and hold down the handle. As the flames shrink continue spraying until the fire is fully extinguished. 2 marks

(ii) Dry chemical extinguisher -

The Dry Powder (or Dry Chemical) charged fire extinguisher is a multi-purpose fire extinguisher and can be used on wide variety of fires. They are used on electrical fires but leave a residue that may be harmful to sensitive electronics. They work by chemical reaction with the fire causing the particles to expand, chemically inhibiting combustion and expelling the oxygen thereby smothering the flames. 1 mark

(iii) Sand buckets -

A bucket filled with sand is used to prevent the spread of or extinguish fires. Typically, fire buckets are painted bright red and have the word 'FIRE' stenciled on them. preferred method for fighting small fires in certain situations. The main advantages of fire buckets are that they are cheap, reliable, easy to use and can be quickly refilled and reinstated. Normally, they are hung on dedicated fire bucket stands. 1 mark

(iv) In addition to above for fires other than in electrical reasons/areas pressurized water hose, water mist can be use.