Important suggestions 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 a)	**Attempt any THREE of the following:** **12 Marks**
a)	**State the factors on which severity of shock depends.**
Ans:	(Any Four Points from following or equivalent answer are expected)--1 Mark each point Total 4 Marks The effect of electrical shock on human bodies depends on following factors. 1. Magnitude voltage of the system. 2. The period or duration for which the area of contact with lives part. 3. It is also depends on supply system i.e. A.C or D.C. 4. Body resistance (If wet resistance of body reduces) 5. Shock may occur even when voltage (50V rms AC low or 75V DC sometimes OR Low voltage does not mean low hazard.) 6. Path of current through body. 7. The presence of moisture in the environment. 8. The general health of the person prior to the shock. 9. The phase of the heart cycle when the shock occurs.

10. The magnitude of current passing through the body :-

S.No	The current strength	Effect on human system
1	A.C current of low frequency between 1m amp to 8 mA	Are just bearable does not cause any pains
2	8mA-15mA	Give painful shock without loss of muscular control.
3	20mA-50mA	If passes through chest, it may stop breathing
4	50mA-100mA	May result in ventricular cavity in body fibrillation.
5	100mA-200mA	May cause fibration of heart
6	Above -200mA	Causes death, severe burns

b) State the importance of Electrical maintenance.

Ans: (Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks

Following points indicate importance of maintenance:-

1. It increases life of machine/equipment.
2. It prevents premature failure.
3. It keeps the machine in good working condition by reducing wear and tear.
4. It prevents developing major breakdown or fault.
5. It provides greater safety & protection to the workers.
6. It reduces breakdown to a minimum and increases the efficiency of equipments and machinery.
7. It reduces breakdown period.
8. It avoids unnecessary production loss
9. It avoids inconvenience.
10. It uses less standby equipments.

	11. It determines the need for major & minor repairs. 12. There will be energy saving if equipment or machine is well maintained. 13. For smooth running of production line 14. Due to PM , it reduces or eliminates repetitive failure . 15. It avoids multi damages due to proper maintenance.
c)	**State the factors on which life of insulation depends.**
Ans:	(Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks **Factors on which life of insulation depends are as below :-** 1. **High voltage stress:** If insulation is used for higher voltage than its designed value then there will be high voltage stresses it may reduce life of insulation. 2. **High Temperature:** Due to over loading insulation gets heated than its life reduces. 3. **Water:** If insulation is near water for the long period than its life reduces. 4. **Moisture:** If insulation contains moisture for the long period than its life reduces. 5. **Dirt & Dust Particles:** If dirt & dust particles accumulated on insulation than it will absorb moisture in the air which will reduces the insulation resistance s its may cause the failure of insulation. 6. **Mechanical Stress:** Any mechanical stress on insulation for the long period than its life reduces 7. **Improper Handling:** If it is handle roughly than it may damage. 8. **Ageing:** Due to ageing effect, it's dielectric strength reduces. 9. **Effect of oxygen & humidity:-** Life of insulation reduces due to decomposition. 10. **Chemical action:-** Life of insulation reduces due to chemical action. 11. **Presence of arc:-** If insulation is exposed near arc than it may damage. **OR** **Life of insulations depends on following factor:-** 1. Water 2. Moisture 3. High Temperature 4. Mechanical Stress

5. High voltage stress
6. Dirt & Dust Particles
7. Improper Handling
8. Ageing
9. Effect of oxygen & humidity
10. Chemical action

d) State the use of filler gauge, spirit level, bearing Puller, Growler.

Ans: ---------- **(1 Mark each Total 4 Marks)**

i) Filler Gauge :-

- It is used to check the air gap.

ii) Spirit Level:-

- It is used to check the level.
- It is a common instrument to test or adjust horizontal surface.

iii) Bearing Puller:-

- Bearing puller is used for holding and removing the item.

iv) Growler:-

- It is a equipment used for finding shorted turns of armature coil or stator/rotor winding. It is essentially a single winding transformer.
- It is available in two forms called as external growler and internal growler and can be used to find out shorted turn faults in armature winding or rotor and stator winding of induction motor.

Q.1 B) Attempt any ONE of the following: 06 Marks

a) Draw the modified equivalent circuit of induction motor referred to stator side. Explain each components. (Equivalent circuit—4 Marks & Explain each components—2 Marks)

Ans Equivalent circuit of induction motor referred to stator side:

Equivalent circuit of machine w.r.t stator:

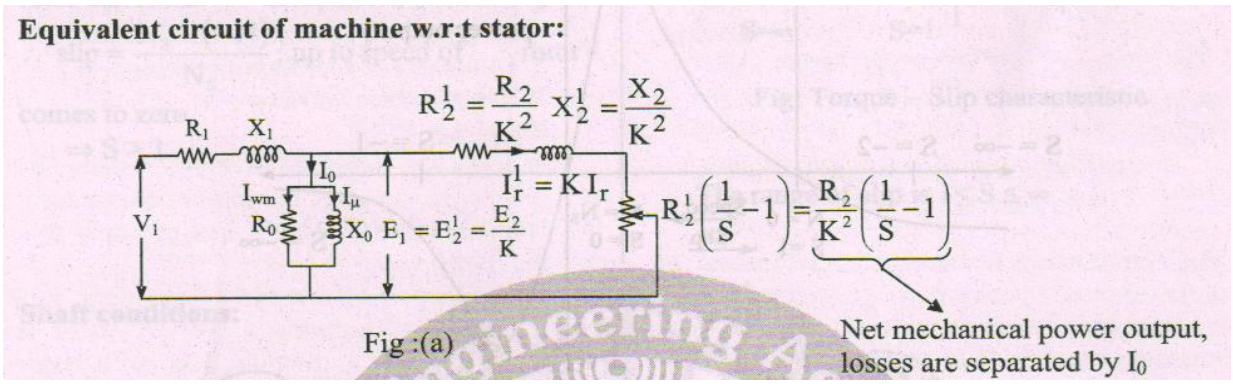
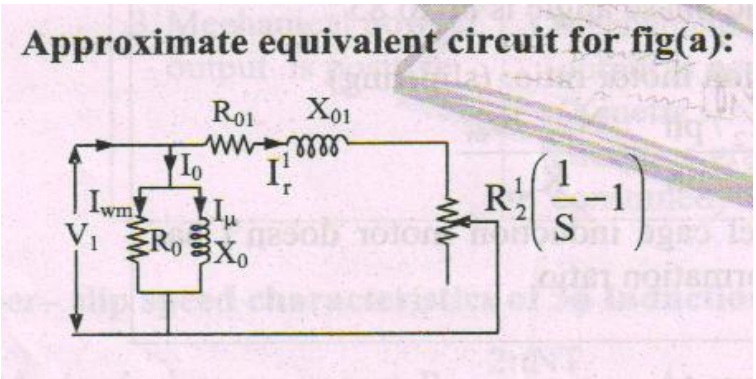


Fig :(a)

OR



Where,

R_1 is the stator resistance per phase ,

X_1 is the stator reactance per phase ,

R_2' is the equivalent rotor resistance referred to stator per phase ,

X_2' is the equivalent rotor reactance referred to stator per phase

R_c is the resistance representing core loss ,

X_m is the magnetizing reactance per phase

V_1 is the per phase supply voltage to the stator ,

s is the slip of the motor

b) What do you mean by phasing out test ? When is it required '? Explain with neat sketch the method of carrying out this test.

Ans: **(Meaning of phasing out test & When is it required---2 Marks, Sketch—2 Marks, Procedure—2 Marks, Total—6 Marks)**

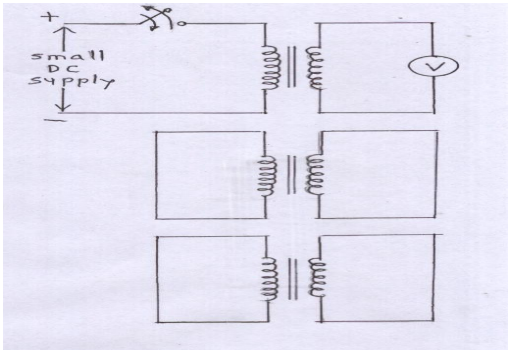
What do you mean by phasing out test:-

To identify primary & secondary windings belonging to same phase is known as phasing out test

When is it required: -

This test is carried out to identify primary & secondary windings belonging to same phase.

Sketch:-



Procedure:-

- Short primary & secondary winding of other phases expect the one under test.
- Connect voltmeter to secondary winding.
- A small DC current is circulated through the primary winding through switch.
- Now with the help of switch interrupt the DC supply instantly & repeatedly.
- Repeat the procedure by connecting voltmeter to secondary side to next secondary winding till voltmeter gives deflection.

Conclusion:

- If voltmeter indicator deflects than it indicates the two windings concerned, belong to the same phase.
- If not deflect then two windings are not belong to same phase.

Q.2	**Attempt any TWO of the following: 16 Marks**
a)	**What are the causes of fire due to electrical faults ? What precautions should be taken to avoid fire due to electrical reasons '?**
Ans:	**(Any Four Points from causes & precautions from following or equivalent answer are expected)--1 Mark each point Total 8 Marks**

Following are the causes of fire due to electrical faults :-

1. Electrical faults inside appliances are a common cause of electric fire.
2. Overloading on cables/wires/machine
3. Use of too many device plugged into a circuit, causing heated wire & possible a fire.
4. Majority of fires cause due to not using correct rating of fuse/MCB/switch gear etc. should be used in the circuit
5. Poor joints in wiring may cause overheating & lead of fires.
6. Due to loose connection in the electrical installation

7. If insulation deteriorates due to ageing, a short circuit may occur causing fire.
8. If a ground fault takes place between live wire & frame or body.
9. Not testing electrical safety devices
10. Safety devices made inoperative.
11. Electrical installation & equipments used in hazards area are not satisfied the specification/type of protection
12. Wiring that becomes defective with the passage of time.
13. If proper maintenance are not taken of the electrical installations, equipments, machines etc. it will result into electric fires.
14. Faulty electrical installation and use of outdated appliances may cause fire.
15. Old electrical sockets and unsafe appliances
16. Not maintained clearance as per voltage level

Precautions should be taken to avoid fire due to electrical reasons:-

1. Frequently checking of electrical cables, wires appliances, and closely inspect cords and plugs
2. Overloading on cables/wires/machine should be avoided
3. Do not use of too many device plugged into a circuit.
4. Correct rating of fuse/MCB/switch gear etc. should be used in the circuit.
5. Joints in wiring must be sound.
6. There should not be any loose connection in the electrical installation.
7. Replace deteriorated cables, wires, etc. by new one.
8. Use ground fault protection. like ELCB/earth fault relay.
9. Test electrical safety devices
10. Do not make safety devices inoperative.
11. Electrical installation & equipments used in hazards area should be satisfied the specification/ type of protection.
12. Replace Wiring that becomes defective with the passage of time
13. Maintenance should be done strictly as per schedule.
14. Use of superior quality of material ISI mark.

15. Replace faulty electrical installation and outdated appliances.
16. Replace Old electrical sockets and unsafe appliances
17. Maintain clearance as per voltage level

b) Explain four factors affecting preventive maintenance schedule.

Ans: (Any Four Points from following or equivalent answer are expected)---2Mark each point Total 8 Marks

Following factors affecting preventive maintenance schedule:

1. Operating cycle of equipment or machine affect the maintenance schedule.
2. Type of machine & it's working condition.
3. Aging of machine
4. Cost of the maintenance.
5. Availability of spares & raw material.
6. Availability of trained & skilled technician.
7. It depends on production requirement.
8. Working environment of industry.(Presence of dust, dirt, chemical fumes, moisture in the air)

c) Prepare the troubleshooting chart of three phase induction motor. (any 4 faults)

Ans (Any Four Points from following or equivalent answer are expected)---1Mark each point Total 8 Marks

Sr.No	Type of fault/abnormal conditions/Troubles	Causes	Remedies
1.	Motor fails to start **or** not accelerate (Faults in starting supply circuit)	➢ Terminal voltage too low ➢ Blowing of fuse/single phasing. ➢ Defective starting mechanism ➢ protection devices has been tripped ➢ The motor controller will not operate ➢ Short circuit in supply cable. ➢ Open circuit in supply cable. ➢ Loose contact. ➢ Motor rotor, bearings or driven	Rectify The Cause

			load is locked. ➢ Overloaded ➢ Bearing is seized (Frozon). **If ask Squirrel cage I.M. add this point** Inspect the rotor bars endings. **If ask Slip ring I.M. add this point** In case of SR motors, check the rotor resistance circuit and control.	
	2.	Motor has been running, then fails to start	➢ Fuse or circuit breaker tripped. ➢ Motor overloaded. ➢ Stator is shorted	Rectify the Cause
	3.	Motor stalls	➢ One phase may be open ➢ Wrong application ➢ Over load ➢ Low voltage	Rectify the Cause
	4.	Motor runs but dies down/ Motor does not pick up rated speed/ Motor does not come up to speed	➢ Starting load is high ➢ Low Voltage ➢ Broken rotor bars or loose rotor	Rectify the Cause
	5.	Motor takes too long to accelerate	➢ Voltage too low ➢ Defective Capacitor. ➢ Starting switch has failed ➢ Bad bearings	Rectify the Cause
	6.	Motor runs in the wrong direction	➢ Incorrect wiring. ➢ Phase sequence of supply changed ➢ Improper connection of motor leads to supply line	Rectify the Cause
	7.	Motor overload protector continually trips.	➢ Load too high. ➢ Ambient temperature too high. ➢ Protector may be defective. ➢ Winding shorted or grounded.	Rectify the Cause
	8.	Motor runs high speed	➢ Voltage available is more than rated voltage ➢ Load is too less.	Rectify the Cause

	9.	Run Slow (Motor starts Sluggishly)	➢ Low voltage. ➢ Low frequency. ➢ Single phasing. ➢ Overload ➢ Stator connected in star instead of delta. ➢ One motor terminal was by mistake connected to neutral instead of phase ➢ Improper connection of motor leads to supply line ➢ Shorted stator coils ➢ Broken rotor bars	Rectify the Cause
	10.	Bearings continuously fail	➢ High ambient temperature. ➢ Unbalanced load. ➢ Misalignment of shaft and bearing.	Rectify the Cause
	11.	Brush Heating	➢ line current is more ➢ Brushes are bedding or sticking in holders-not properly ➢ Dirt is accumulated on brushes ➢ Improper pressure and spring tension. ➢ Grads of brush material is of bad quality. ➢ Due to sparking.	Rectify the Cause
	12.	Run Hot/ Thermal overload/ Motor overheating/ Motor frame Hot to touch (Winding Overheating)	➢ Single phasing. ➢ Overload ➢ Over/Under voltage. ➢ Unbalance voltage ➢ Over/Under frequency ➢ Poor motor ventilation/ Air flow obstructed or inadequate ventilation. ➢ Ventilating Fan is not working ➢ Rotor rubbing on stator ➢ Worn bearings ➢ High ambient temperature at the motor controller. (above 40^0C) ➢ Excessive core loss. ➢ Stator winding is in correct connected (Wrong connection) ➢ It may be due to internal faults inside the winding or for winding to earth. ➢ Check the correct starting time and duty cycle.	Rectify the Cause

		➢ Broken rotor bars ➢ Shorted stator coils ➢ Dirt in motor	
13.	Bearing overheating	➢ Misalignment ➢ Bearing may wear out. ➢ Too much grease/ No grease/ Foreign matter in grease. ➢ Oil level too high/ low. ➢ The bearing is not correctly assembled ➢ Bent or spring shaft. ➢ Excessive belt pull. ➢ Pulleys too far away. ➢ Pulley diameter too small. ➢ Overloaded bearing. ➢ Broken ball or rough races ➢ Excessive end thrust. ➢ No oil ➢ Poor grade of oil or dirty oil. ➢ Failure of the oil rings to revolve with the shaft. ➢ Rough bearing surface. ➢ Incorrect fitting of the bearing. ➢ Loose bolts in the bearing cap. ➢ Excessive end thrust due to incorrect leveling. ➢ Excessive end thrust due to magnetic pull ➢ Excessive side pulls because the rotating part is out of balance.	Rectify the Cause
14.	Vibration	**1. Electrical Causes:-** ➢ Un-even air gap ➢ Shorted stator ➢ Shorted rotor coil or open rotor bars ➢ Loose iron core/rotor spider **2. Mechanical Causes:-** ➢ Reflected vibration from the driven load. ➢ Reflected vibration from adjoining machines ➢ Dynamic unbalance of the rotor ➢ Mis-alignment to the coupled load	Rectify the Cause

			➢ Incorrect balancing of job when mounted on face plate ➢ Incorrect Leveling ➢ Due to bent shaft ➢ Defective bearings ➢ Loose foundation bolts	
	15.	Noise	➢ Cooling fan is touching on stationary part. ➢ Bearing properly not fit. ➢ Motor mounting is loose. ➢ No uniform air gap or rotor rubbing on stator. ➢ Rotor unbalanced ➢ Foreign matter in air gap. ➢ Dirt in motor ➢ Loose on bed plate ➢ Coupling out of balance. ➢ Normal motor noise amplified by resonant mounting. ➢ Voltage boost may too high. ➢ Current loop is unstable. ➢ Single phasing. ➢ Unbalanced voltage. ➢ Gears and gear trains are among the principal sources of noise and vibration.	Rectify the Cause
	16.	Regular clicking (Short sound)	➢ Foreign matter in air gap. ➢ Dirt in motor.	Rectify the Cause
	17.	Scraping Noise	➢ Fan rubbing ➢ Fan striking insulation ➢ Loose bed plate nut bolt	
	18.	Motor hums a) During Start up b) When running	➢ Unequal phase resistance ➢ Open circuit ➢ Inter turn short circuit on motor. ➢ Short circuit between turn to turn or parts of stator winding. ➢ Earth fault (Winding to frame short circuit)	Rectify the Cause Rectify the Cause

19.	Abnormal Supply conditions	➢ Loss of supply voltage. ➢ Unbalanced supply voltage. ➢ Phase sequence reversal of supply voltage. ➢ Over /Under frequency ➢ Over /Under Voltage ➢ Single Phasing	Rectify The Cause
20.	High input current in all 3 phases	➢ Line voltage 10% or above /below the motor nameplate voltage. ➢ Motor overloaded.	Rectify The Cause
21.	Unbalanced line current on poly phase motors during normal operation.	➢ Unequal terminal voltage. ➢ Single phase operation ➢ Unbalanced voltage	Rectify the Cause

Q. 3 **Attempt any FOUR of the following:** **16 Marks**

a) **State any four troubles in case of 3 phase transformer.**

Ans: (Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks

Sr.no	Troubles	Causes	Remedial Measures
1.	Transformer becomes overheating	➢ It may be due to overloading. ➢ Failure of cooling System. ➢ High ambient temperature. ➢ Low liquid level.	Rectify the Cause
2.	Over temperature	➢ Over current, ➢ Over voltage, ➢ Insufficient cooling, ➢ Low liquid level, ➢ Sludge in the transformer liquid, ➢ High ambient temperature ➢ Short-circuited core.	Rectify the Cause
3.	Excessive core heating	➢ Due to high magnetizing current ➢ High inrush current	Rectify the Cause
4.	Transformer does not show output voltage	➢ Primary side fuses blown out or circuit breaker may trip. ➢ Failure of primary winding. ➢ Tap changer, loose connection. ➢ Wire connection may be open in	Rectify the Cause

		bushing.	
5.	Incorrect secondary voltage	➢ Improper turns ratio ➢ Abnormal primary voltage ➢ Shorted turns in the transformer.	Rectify the Cause
6.	Phase voltage unequal (Non-Symmetrical voltage on secondary side)	➢ Unequal Loading. ➢ Single phasing.	Rectify the Cause
7.	High exciting current	➢ Usually, high exciting currents are due to short circuited core ➢ open core joints	Rectify the Cause
8.	Transformer body gives shock	➢ Insulation resistance reduced. ➢ Any live wire touches the transformer tank (Earth fault).	Rectify the Cause
9.	Low insulation resistance	➢ Moisture in the oil.	Rectify the Cause
10.	Winding insulation failure	➢ Failure may be due to a short-circuit Fault, ➢ Lightning, ➢ Overload ➢ Over current condition, ➢ Transformer liquid containing moisture and contaminants.	Rectify the Cause
11.	Unexpected voltage to earth measurement	➢ Earth failure on one phase.	Rectify the Cause
12.	External Short circuit	➢ It may be due to insufficient clearance on overhead line. ➢ Accumulation of dust on insulator (Transformer bushing).	Rectify the Cause
13.	Internal Short circuit	➢ Continuous overloaded transformer, due to this temperature increases so, possibility of insulation failure. ➢ Fault in tap changer. ➢ Loose connections, causing local overheating. ➢ Vibration on Insulation resulting internal short circuit	Rectify the cause.
14.	Short circuit between adjacent turns (Turn to turn fault)	➢ Reason of external short circuit. ➢ Fluctuating load. ➢ Transient overvoltage. ➢ Moisture in oil	Rectify the cause.

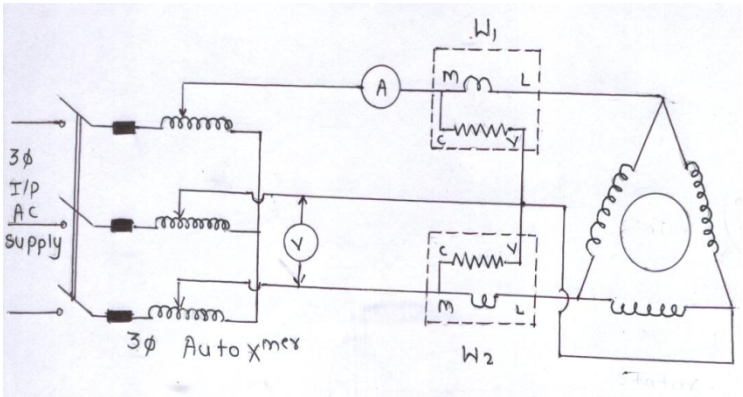
15.	Rapid deformation of oil	➢ Poor Quality of transformer oil. ➢ Presence of water. ➢ Presence of dissolved moisture. ➢ Presence of carbon deposits. ➢ Presence of dirt & dust. ➢ Presence of sulpher. ➢ Presence of dissolved gases. ➢ Presence of acids. ➢ Breakdown voltage of oil reduces. ➢ It may be due to excessive overheating.	Rectify the causes.
16.	Moisture in oil /Low dielectric strength	➢ Moisture in the oil while filling. ➢ Breather gets saturated. (Colour of silica gel becomes pink). ➢ It may be due to defective seals (gasket). ➢ Penetration of moisture due to improper ventilation ➢ Broken relief diaphragm ➢ Leaks around transformer Accessories ➢ Cooling coil leakage.	Rectify the Cause
17.	Pressure-relief diaphragm broken	➢ Due to an internal fault causing excessive internal pressures ➢ The transformer liquid level being too high ➢ Excessive internal pressure due to over loading of transformer.	
18.	Carbon & other conducting particles in oil	➢ Sparking. ➢ Excessive temperature of oil	Rectify the Cause
19.	Oxidation of oil	➢ Mainly due to exposure to air ➢ High operating temperatures.	Rectify the Cause
20.	Discoloration of transformer liquid	➢ Mainly caused by carbonization of the liquid due to switching ➢ Contaminations	Rectify the Cause
21.	Incorrect oil level (oil level to low)	➢ Due to leakages through gasket or tank or drain valve. ➢ Leaks around transformer Accessories ➢ Leakage can occur through screw joints, welds, casting, pressure-relief device, and so on. ➢ The main causes are improper assembly of mechanical parts	Rectify the Cause

		➢ Poor joints ➢ Defects in the material used ➢ Insufficient tightness of mechanical parts.	
22.	Leakage of transformer liquid:	➢ Leakage can occur through screw joints, around gaskets, welds, casting, pressure-relief device, and so on. ➢ The main causes are improper assembly of mechanical parts ➢ Poor joints ➢ Defects in the material used ➢ Insufficient tightness of mechanical parts.	Rectify the Cause
23.	Internal arcing	➢ Low liquid level ➢ Loose connections, ➢ Failure of the transformer dielectric.	Rectify the Cause
24.	Noise/vibration	➢ Magnetostriction. ➢ Loose clamping of core. ➢ Mechanical vibrations of tank valves. ➢ Damping	Rectify the Cause
25.	Bushing failure	➢ Caused by flash over due to Dirt accumulation ➢ Lightning strikes.	Rectify the Cause
26.	Transformer switching equipment troubles	➢ May be excessive wearing of contacts, ➢ Mechanism Over travel, ➢ Moisture condensation in mechanism liquid.	

b) Draw and explain the circuit diagram to perform no load and S.C. tests on 3-Ph induction motor.

Ans: **(Circuit diagram---2Marks Explanation of N.L. & S.C.—2Marks ,Total—4Marks)**

Diagram:-



Explanation of No Load test:-

i) The stator windings are connected through auto transformer to a supply of rated frequency.

ii) Increase the voltage gradually up to its rated voltage given on the rating plate.

iii) Machine will run close to the synchronous speed due to no-load.

iv) Take the corresponding readings of input voltage (V_O), input current (I_0) and input power (W_0)

S.C. test :-

During this test rotor is blocked

Explanation:-

i) Hold the rotor stationary with the help of jaw/clamps/ hand for small motors. (That is short circuit test)

ii) Keep the auto transformer at zero volt position initially.

iii) Increase the applied voltage to the stator gradually with the help of auto transformer in steps till it circulates full load current.

iv) Take the corresponding readings of input current (full load current) (I_{SC}), input voltage (V_{SC}), and input power (W_{SC}).

c) State and explain the properties of transformer oil. (any four)

Ans: (Any Four Points from following or equivalent answer are expected)1 Mark each point Total 4 Marks

Following are the properties of transformer oil :-

1. Dielectric strength :- It should be have a high dielectric strength
2. Specific resistance :- It should be have a high Specific resistance.
3. DDF (Dielectric dissipation factor):- It should be as low as possible.
4. tanδ :- The value of tanδ as small as possible. High value of this tanδ is an indication of presence of contaminants in transformer oil.
5. Relative permittivity (Dielectric constant) :- It should be 2.2
6. Oil should be chemically stable.
7. Oil should be free from moisture and dissolved gas.
8. Oil should have low viscosity.
9. Oil should have low density.
10. The oil should be clear & plane in colour, transparent & free from suspended matter.

11. It should be not contain impurities such as sulpher & its compounds to avoid rusting & sludge formation.
12. Flash Point: - Oil should have very high flash point.

d) State the classification of insulating materials as per IS 1271-1985 with two example each.

Ans: (Any Four classes from following or equivalent answer are expected)---1Mark each point Total 4 Marks

Classification of insulating materials as per IS 1271-1985 :-

Sr.No.	Insulation Classes	Maximum permissible temperature (^{0}C)	Insulating Material
1	Class-Y or O	90^0	Cotton, silk, paper, press board, wood ,cellulose-,PVC,VIR .
2	Class- A	105^0	Cotton, silk or paper impregnated paper & cellulose Easter.
3	Class- E	120^0	Laminated Cotton, Synthetic resin enamels and paper laminations .
4	Class- B	130^0	Glass fiber, asbestos, mica, asbestos laminates.
5	Class- F	155^0	Laminated asbestos, Glass fiber, and asbestos, Mica, built up mica.
6	Class- H	180^0	Made of inorganic material glued with silicon resin or adhesive coated on mica, glass fiber.
7	Class- C	Over 180^0	Made of 100% inorganic material E.g. mica, porcelain, ceramics, glass quartz, asbestos.

e) What are the permissible limits for safe working of electrical machines ?

Ans: (Any Four permissible limits from following or equivalent answer are expected)---1Mark each point Total 4 Marks

1. **Voltage:** The terminal voltage is ± 10% of rated voltage. For a period of 10 sec. (T.V. differing from rated value by not more than 6 %.)
2. **Unbalanced voltage:** The permissible unbalance in supply voltage should not exceed 1%. For a

period of 15 sec

3. **Frequency:** Supply of frequency is ± 5% of rated frequency. For a period of 10 sec. (Frequency differing from its rated value by not more than 3 %.)
4. **Voltage and frequency:** Any combination of a) & b) ± 10% For a period of 10 sec
5. **Unbalanced Current :-** The permissible unbalance 8% For a period of 15 sec
6. **Starting Current:** Less than 4.5 times the rated current.
7. **Over load (Momentary excess torque**): Capable of withstanding for 15 sec. without stalling or abrupt change in speed 1.6 times their rated torque.
8. **Slip:** ± 20% of the slip for machine output 1 KW or more. For machines having output less than 1KW ± 30% of the slip.
9. **Over Speed:-** Squirrel cage general purpose I.M. shall be designed to withstand 1.2 times the maximum rated speed.& Crane duty I.M. shall be designed to withstand 2.5 times the maximum rated speed. The duration of any over speed test shall be 2 Minutes
10. **Variation of speed:** - On highest side: 3% of synchronous speed. On lowest speed: + 3% of synchronous speed.
11. **Temperature rise:** Shall not exceed by more than 10^0C for motors of output up to and including 1000 KW and 5^0C for motors of output exceeding 1000KW

OR

No	Test Item	Permissible limits
1	Efficiency	- 10 to -15 % of (1-η)
2	Total Losses applicable to machine above 50 KW	+ 10 % total Losses
3	Power factor of induction Machines	-1/6 (1- cosϕ) & Min -0.02, Max. -0.07
4	Slip of Induction Motors	± 20% of generated slip
5	Speed of AC Motors	Highest speed: - 3% and Lowest speed + 3 %
6	Breakaway Torque	-15 % to +25 % of the guaranteed torque (+25 % may be exceeded by agreement)
7	Pullout Torque	-10 % of the guaranteed torque except that after allowing for this tolerance, the torque shall be not

		less than 1.6 or 1.5 times the rated torque.
8	Moment of inertia or stored energy constant applicable to motors of frame sizes above 315	± 10% of guaranteed value
9	Rotor Voltage	± 10%
10	Frequency	± 3%
11	Temperature rise	Shall not exceed by more than 10^0C for motors of output up to and including 1000 KW
12	Temperature rise	5^0C for motors of output exceeding 1000KW

Q.4 A) Attempt any THREE of the following: 12 Marks

a) A brake test for a de motor the effective load on the brake pulley is 265 N. The effective diameter of the pulley is 650 mm. The speed is 750 rpm. The motor takes 37 Amps at 215 volts. Calculate the output power and the efficiency at this load.

Ans:

Given Data:

Effective load =265N effective diameter = 650mm Speed N= 750 RPM, I= 37A & Volt V= 215V

$The\ effective\ \ diameter\ of\ \ pully = 650\ mm$

$$r\ = effective\ redius = \frac{d}{2} = \frac{650\times10^{-3}}{2} = 325\times10^{-3} meter$$

----------**(1/2 Marks)**

$$\text{Torque } = (F1-F2)\times r \text{ N}-\text{m}$$

----------**(1/2 Marks)**

$$\text{Torque } = (\text{Effective Load})\times r \text{ N}-\text{m}$$

$$Torque\ = (265)\times(325\times10^{-3})\ N-m$$

$$Torque\ = 86.125\ N-m$$

----------**(1/2 Marks)**

$$\text{Output of Motor in watt } = \frac{2\pi N T}{60}$$

----------**(1/2 Marks)**

$$\therefore output\ = \frac{2\times3.142\times750\times86.125}{60}$$

$$\therefore output\ = 6764\ .241\ \ watts$$

----------**(1/2 Marks)**

$$\text{Output of Motor in HP } = \frac{\text{Output of Motor in watt}}{735.5}$$

$$Output\ of\ \ Motor\ in\ HP\ = \frac{6764\ .241}{735.5}$$

$Output\ of\ Motor\ in\ HP = 9.1967\ HP$

----------**(1/2 Marks)**

$\therefore Input = VI = 215 \times 37 = 7955 watts$

$$\% \eta = \frac{o/p}{Input} \times 100$$

----------**(1/2 Marks)**

$$\% \eta = \frac{6764\ .241}{7955} \times 100$$

$$\% \eta = 85.031\ \%$$

----------**(1/2 Marks)**

b) List out the effect for mis-alignment of electrical machines.

Ans: **(Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks**

Followings are the effect for mis-alignment of electrical machines :-

1. Excessive vibrations.
2. Increase noise level.
3. Premature bearing and coupling failure
4. Premature failure of belt in case of indirect drive.
5. High bearings temperature.
6. High lubricating oil temperature.
7. Loose or broken foundation bolts and coupling bolts
8. The shaft is breaking (or cracking)
9. Increases friction
10. Increases stresses on coupling & shaft.
11. Increases maintenance cost.
12. Increases energy consumption
13. It reduces motor efficiency
14. Overall performance of machine reduces.
15. Early wear & tear of both driving & driven machine.

c) Distinguish between installation earthing and system earthing.

Ans: (Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks

Sr.No.	Installation earthing	System earthing
1	It means connecting the live part to the earth for example neutral of transformer.	It means connecting the dead part to the earth for example electrical equipment's frames, enclosures, supports etc.

2	It is source or system earthing.	It is equipment earthing.
3	It is a source for unwanted currents and also as a return path for main current for protection of delicate equipments.	It is an alternate low resistance path for leakage current.
4	It is done for the protections of power system equipment and to provide an effective return path.	Purpose of it is to minimize risk of receiving an electric shock if touching metal parts when a leakage current is present.
5	It is provided for eliminating arcing ground and over voltage surge.	Purpose of it is to minimize risk of receiving an electric shock to human.
6	Generally Black wire is used for this as a nomenclature.	Generally Green wire is used for this as a nomenclature.
7	It increases stability of the system.	It is nothing to do with the system stability.
8	This earthing provides suitable means for earth fault protecting system.	It does not provide any means for protection system against earth fault.

d) What safety precautions are necessary when working with electrical installations ?

Ans: (Any Four Points from following or equivalent answer are expected)---1Mark each point Total 4 Marks

Following safety precautions are necessary when working with electrical installations:-

1. Only qualified men do the work, untrained person should not allow handling electrical equipment.
2. Do not allotted work to untrained person (worker) to handle electrical equipment.
3. Do not allow visitors & unauthorized persons to touch or handle electrical equipment.
4. Wear appropriate clothing (loose clothing is avoided)
5. Use shoes with rubber soles to avoid shock.
6. Use approved discharge earth rod for before working.

7. Do not wear suspended Necklace, arm bands, finger ring, key chain, watch with metal parts while working.
8. Do not work on live circuits without express order of the person in charge.
9. For major work take permit to shut down the supply from authority.
10. Always obey the safety instructions given by the person in charge.
11. Do not work without authority & operating switches without knowledge.
12. Do not work under unfavorable condition such as rainfall, Fog, high wind.
13. Do not work if there is improper illumination such as insufficient light, or producing glare or shadows.
14. Do not Do the work if you are not sure or knowledge of the condition of equipment/ machine.
15. Do not use aluminum ladders but use wooden ladders. (Use insulated ladder)
16. Use proper insulated tools & safety devices.
17. Do not guess, whether electric current is flowing through a circuit by touching.
18. Never touch a wire till you are sure that no currents are flowing.
19. Switch off the supply before starting the work.
20. Do not make safety devices inoperative.
21. Insulate yourself on the insulating material like wood, plastic etc. before starting the work on live main.
22. Never speak to any person working upon live mains.
23. Do not sacrificing safety for speed.
24. Use proper instrument to test the circuit.
25. Always use proper insulated tools, rubber gloves, safety devices while working.
26. Well insulated & proper size of wires with ISI mark should be used.

27. Make habit to look out for danger notice, caution board, flags, and tags.
28. Do not touch or operate switches when your hands are wet.
29. Your hand & feet must be dry (not wet) while working on live main.
30. Place yourself at safe distance from working equipment.
31. Remove the cords by pulling the plug, not the cords.
32. Correct rating of fuse/MCB etc. should be used in the circuit.
33. Inspect all electrical equipment & devices to ensure there is no damage or exposed wires that may causes a fire or shock.
34. Avoid using electrical equipment near wet, damp areas.
35. The joints in the electrical system should mechanically & electrically sound.
36. The earth connection should be perfectly sound & proper.
37. Over loading of equipments / circuit should be avoided.
38. Do not go carelessly near running belts on machines.
39. Do not expose your eyes to an electric arc.
40. Rubber mats must be placed in front of electrical switch board/ panel.
41. Ground all machine tools, body, and structure of equipments.
42. Earthing should be checked frequently.
43. When working on live equipment obey proper instruction.
44. Do not work on defective equipment.
45. Do not use defective material.
46. Inspect all electrical equipment & devices to ensure there is no damage or exposed wires that may causes a fire or shock.
47. By the use of proper rating protective devices with the electrical circuits.

48. Electrical installation & equipments used in hazards area should be satisfied the specification/type of protection.

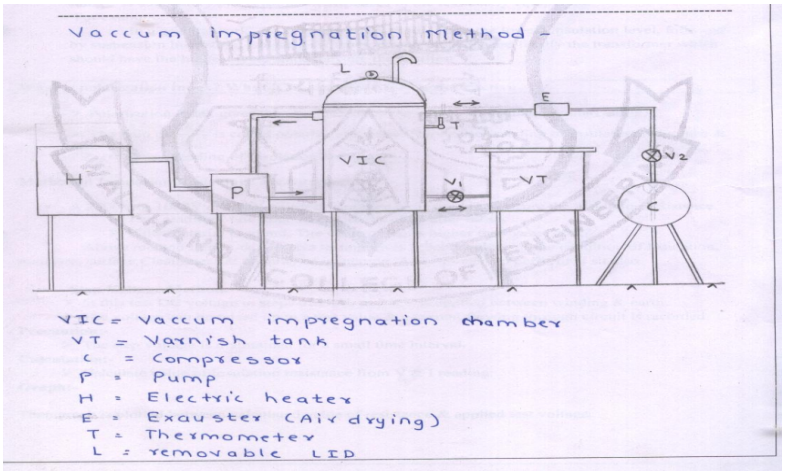
49. Frequently checking of electrical cables, wires appliances, and closely inspect cords and plugs

50. Overloading on cables/wires/machine should be avoided
51. Do not use of too many device plugged into a circuit.
52. Correct rating of fuse/MCB/switch gear etc. should be used in the circuit.
53. Joints in wiring must be sound.
54. Replace deteriorated cables, wires, etc. by new one.
55. Use ground fault protection. like ELCB/earth fault relay.
56. Test electrical safety devices
57. Replace Wiring that becomes defective with the passage of time
58. Replace faulty electrical installation and outdated appliances.
59. Replace Old electrical sockets and unsafe appliances
60. Maintain clearance as per voltage level
61. Do not store highly flammable liquids near (close to) electrical oven/furnace to avoid fire.

Q. 4B) **Attempt any ONE of the following:** **06 Mark**

a) **Describe procedure of vaccum impregnation method with diagram.**

Ans: **(Diagram---3 Marks & procedure---3 Marks)--Total---6 Marks**



Steps /procedure for Vacuum Pressure Impregnation of the winding:-

- The surfaces of all coils windings are perfectly clean and it should be free from dirt & dust, oily matters etc.
- Coil / winding should be free from moisture. For the moisture removal heat the winding with the

help of lamp (carbon filament) or in an oven till all moisture get evaporated.

- A pre dried winding is placed into a processing chamber (tank).
- A vacuum is created in the process tank to remove all air, including air within the pores (Air gaps) of the job.
- Then Varnish is transferred from storage tank to the processing tank till the entire job is submerged.
- After that vacuum is released and desired pressure is applied into the processing tank above the varnish level using compressed air/nitrogen.
- The varnish is now forced into porous spaces inside the coil due to high pressure.
- After desired amount of time, the pressure is released and the varnish is drained back into the varnish storage tank.
- Then coil is removed and apply finishing gel (varnishes) by brushing or spraying to job for additional protection against moisture, chemical fumes and dust.
- It is then kept in a baking oven till it gets set properly and become dry .

b) A short circuit test was carried out to find impedance and load losses on a 1 kVA, 230/115 volts single phase transformer and following are the observating in primary side :
Consider eq. resist as 1.8 ohm, Calculate : (i) Impedance at 75 °C (ii) Impedance voltage at 75 °C (iii) Copper losses at 75 °C

Ans:

Given Data:

1-ph: 1 KVA Transformer 230/115 Volts Vsc = 9 V Isc = 4.35 A W_{SC} = 35 W Room Temperature= 30^0C

Solution:

1. Resistance at 30^0C : ---------- **(1 Mark)**

$$W_{SC} = I_{SC}^2 R_{01}$$

$$R_{01}\ at\ (30^0C) = \frac{W_{SC}}{I_{SC}^2} = \frac{35}{(4.35)^2}$$

$$R_{01}\ at\ (30^0C) = 1.8496\,\Omega$$

2. $Z_{01} = \frac{V_{SC}}{I_{SC}} = \frac{9}{4.35} = 2.689\,\Omega$ ---------- **(1 Mark)**

$$\therefore X_{01} = \sqrt{(Z_{01})^2 - (R_{01})^2}$$

$$\therefore X_{01} = \sqrt{(2.0689)^2 - (1.8496)^2}$$

$$\therefore X_{01} = 0.9269\,\Omega$$

3. Resistance at 75^0C : ---------- **(1 Mark)**

$$\frac{R_2}{R_1} = \frac{t_2 + 234.5}{t_1 + 234.5}$$

$$\therefore R_{01}\ at\ (75^0 C) = R\ at\ (30^0 C) \times \frac{234.5 + 75}{234.5 + 30}$$

$$\therefore R_{01}\ at\ (75^0 C) = 1.8496 \times \frac{234.5 + 75}{234.5 + 30}$$

$$\therefore R\ at\ 75^0 C = 2.1642\ \Omega$$

There will be no effect on inductive reactance, The value of inductive reactance will be remain the same

$$\therefore X_{01}\ at\ (75^0 C) = X_{01}(30^0 C) = 0.9269\ \Omega$$

4. Impedance at 75^0C : ---------- **(1 Mark)**

$$\therefore Z_{01}\ at\ (75^0 C) = \sqrt{R_{01}(75^0 C)^2 + X_{01}(75^0 C)^2}$$

$$\therefore Z_{01}\ at\ (75^0 C) = \sqrt{(2.1642)^2 + (0.9269)^2}$$

$$\therefore Z_{01}\ at\ (75^0 C) = 2.3543\ \Omega$$

5. Cu Losses at 75^0C : ---------- **(1 Mark)**

$W_{SC} = I_{SC}^2\ R_{75}^{oc}$

$= (4.35)^2$ x (2.1642)

= 40.9520 W

6. Impedance Voltage at 75^0C : ---------- **(1 Mark)**

$= I_{SC}\ Z_{75}^{oc}$

$= (4.35)^2$ x (2.3543)

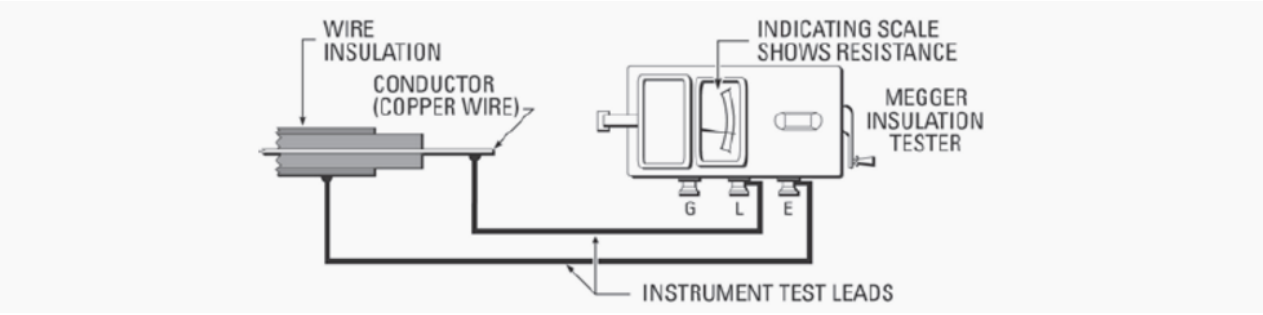
= 10.2412 V

Q.5	**Attempt any TWO of the following: 16 Marks**
a)	**Why is it necessary to check insulation resistance regularly and keep records? State the method of measurement of insulation resistance by megger.**
Ans:	**(Necessity and keep records---3 Marks, Diagram—1 Mark, Method of measurement—4 Marks)---Total 8 Marks** **Why is it necessary to check insulation resistance regularly and keep records :-** Insulation resistance is one of the critical readings of electrical equipment systems and serves as the best guide to indicate the health of the electrical machinery.

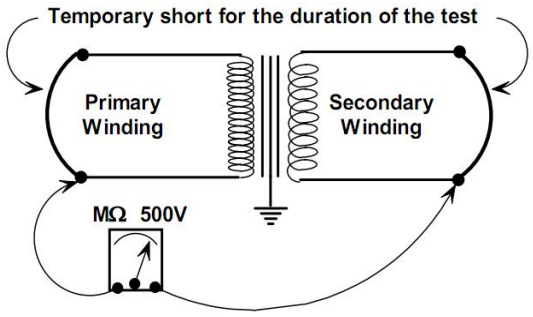
- Due to ageing insulation causes deterioration in the performance.
- Also due to Harsh operating environments, extreme operating temperatures, moisture, and chemical contamination, will accelerate the deterioration process of insulation.

Hence It's necessary to measure and keep record of insulation resistance of the insulation of electrical equipment, installation at all times **to avoid any accident such as electrical shock, fire, short circuit, etc.**

Method of measurement of insulation resistance by megger:-



OR



Measurement of insulation resistance:-

Rating of Megger: are available for 500, 1000, 2500 & 5000 or even 10000 Volt D.C.

Procedure:-

- First disconnect all the line & neutral terminals of the equipment.
- To check the IR, megger should be cranked (rotate) at a speed indicated in its certificate (usually 120 rpm).

OR

The generator can be hand-cranked or line-operated to develop a high DC voltage which causes a small current through and over surfaces of the insulation being tested This current (usually at an applied voltage of 500 volts or more) is measured by the ohmmeter, which has an indicating scale.

b) What are the basic requirements of foundation for (i) Static equipments (ii) Rotating machines

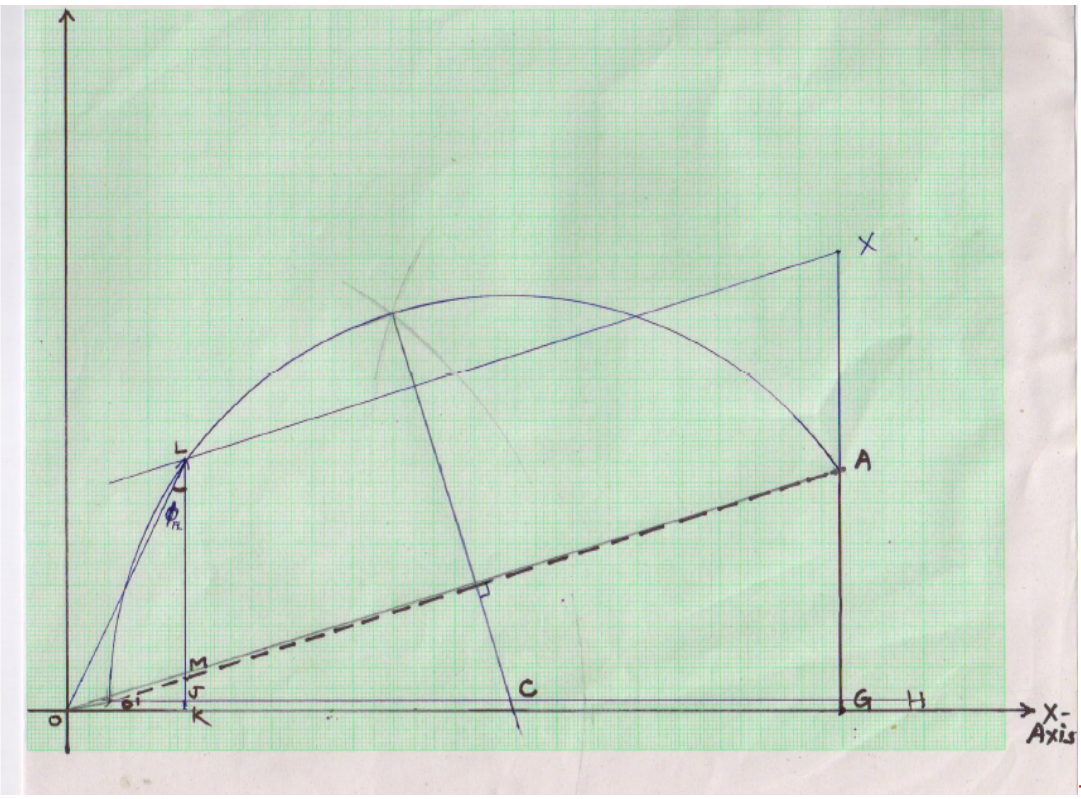
Ans: (Any Eight Points from following or equivalent answer are expected)---1 Mark each point Total 8 Marks

Following are the basic requirements of foundation for (i) Static equipments (ii) Rotating machines:-

1. Consider Static weight of the machine and accessories.
2. Also consider the operating weight.
3. The foundation should be able to carry the superimposed loads.
4. The foundation should be able to absorb the vibration while operating at its full capacity.
5. The foundation should be sufficiently rigid to maintain proper alignment between the motor and the driven machine.
6. The foundation should be sufficiently rigid to withstand the possible horizontal thrust caused by machine while in operation.
7. The dimension of foundation should be proportional to safe bearing capacity of soil.
8. The dimension of foundation block should be sufficient that the resultant of all the forces should pass within the foundation block.
9. The combined center of gravity of machine and foundation should be as far as possible, be in the same vertical line.
10. For concrete foundations use concrete ratio of 1:2:4.
11. The foundation should be well cure before machine put on it.
12. Depth of foundation should be proportional to the bearing capacity of soil.
13. Level of plinth should be above the maximum flood level of the site.
14. The surface of foundation must be protected from machine oil by means of suitable chemical coating or suitable chemical treatment.
15. The following size of depth of foundation:
16.

Sr. No.	Rating of Motor	Size of depth of foundation
1	Upto 10 H.P	7.5 to 10 cms deep
2	10 to 25 H.P	15 to 20 cms deep
3	25 to 50 H.P	20 to 25 cms deep
4	50 to 75 H.P	25 to 37.5 cms deep
5	75 to 100 H.P	37.5 to 60 cms deep

c)	**A 3 phase 500 V, squirrel cage IM gave the following test results :** **No load test : 500 V, 4 A, 750 W Blocked rotor test : 100 V, 16 A, 800 W** **Draw the circle diagram and determine : (i) efficiency (ii) p.f. when motor is supplying 25 HP.**
Ans:	**No load test: 500, 4A, 750W,** **Blocked-rotor test: 100V, 16A, 800W Draw a circle diagram and determine:** **i) Line current and power factor at rated output ii) Maximum O torque** **Solution:-**



---2 Marks

Given data: 3-ph, 500V, 25 HP, 50Hz Squirrel Cage Induction motor

1) No load Test: $V_0 = 500V$, $I_0 = 4A$, $W_0 = 750$ watt

Vector 00' *represents* $I_0 \angle \phi_0$

$$\phi_0 = Cos^{-1}\left(\frac{W_0}{\sqrt{3}\,V_0\,I_0}\right)$$

$$\phi_0 = Cos^{-1}\left(\frac{750}{\sqrt{3}\times 500\times 4}\right)$$

$\phi_0 = 77.52^0$ *Elec.* ---------- **(1/2Mark)**

2) Blocked Rotor Test: - V_{SC} = 100V, I_{SC} = 16A & W_{SC} = 800 watt

Vector $0A'$ *represents* $I_{SN} \angle \phi_{SC}$

$$I_{SN} = I_{SC}\left(\frac{V}{V_{SC}}\right)$$

$$I_{SN} = 16\left(\frac{500}{100}\right)$$

$I_{SN} = 80\ A$ ---------- **(1/2Mark)**

$$\phi_{SC} = Cos^{-1}\left(\frac{W_{SC}}{\sqrt{3}\,V_{SC}\,I_{SC}}\right)$$

$$\phi_{SC} = Cos^{-1}\left(\frac{800}{\sqrt{3}\times 100\times 16}\right)$$

$\phi_{SC} = 73.24^0$ *Elec.* ---------- **(1/2Mark)**

3) Let, the Current scale: - 1 cm = 4A

The vector 00' represent : $I_0 \angle \phi_0$ $I_{SN} \angle \phi_{SC}$

4) Power scale:- $= \dfrac{W_{SN}}{Lenght\ at\ \ AG\ in\ cm}$

$$W_{SN} = W_{SC}\left(\frac{V}{V_{SC}}\right)^2$$

$$W_{SN} = 800\left(\frac{500}{100}\right)^2$$

$W_{SN} = 200000$ *watts* ---------- **(1/2Mark)**

Form circle diagram length of AG in cm = 5.8 cm

$$\text{Power scale:-} = \frac{W_{SN}}{Lenght\ at\ \ AG\ in\ cm}$$

$$= \frac{20000}{5.8}$$

$$= 3448.28\ \ watts/cm$$ ---------- **(1/2Mark)**

5) Length of AX in cm $= \frac{Output\ in\ watts}{power\ \ scale}$

$$= \frac{25 \times 735.5}{3448.28}$$

$$= 5.33\ \ cm$$ ---------- **(1/2Mark)**

6) Line current at rated O/p is represented by line OL:-

= 6.8 cm

Line current at rated output = 60.3 A

7) Power factor at full load $= \frac{Line\ \ LK\ \ in\ cm}{Line\ OL\ \ in\ cm}$

$$Cos\phi = \frac{6.1}{6.8}$$

Power factor at Full load = 0.897 *Lag* ---------- **(1Mark)**

8) Efficency $\eta\ \% = Full\ laod\ \%\ \eta$

$$\eta\ \% = \frac{Line\ (lM)}{Line\ (lK)} \times 100$$

$$\%\ \eta\ = \frac{5.33}{6.1} \times 100$$

$$\therefore \%\ \ \eta\ = 87.37\ \ \%$$ ---------- **(2Mark)**

Q.6	**Attempt any four of the following :** **16 Marks**
a)	**List the devices and tools required for loading, unloading, lifting and carrying heavy equipment.**
Ans:	(Any Four **devices and tools** from following or equivalent answer are expected)---1Mark each Total 4 Mark **List the devices and tools required for loading, unloading, lifting and carrying heavy equipment** :- 1) Stationary Cranes 2) Overhead or Gantry Cranes 3) Mobile Cranes 4) Truck Mounted Crane 5) Steam Crane 6) Chain pulley Block 7) Chain Hoist 8) Electric Hoist 9) Screw Jacks 10) Winches 11) Hoses & tripods (For temporary supports) 12) Ceiling ropes.
b)	**State the necessity for electrical earthing & factors affecting earth resistance.**
Ans:	**(Necessity----2 Marks, Factors affecting—2 Marks)----- Total 4 Marks** **Necessity for electrical earthing**: 1. To provide an alternative path for the leakage current to flow towards earth. 2. To save human life from danger of electrical shock due to leakage current. 3. To protect high rise buildings structure against lightening stroke. 4. To provide safe path to dissipate lightning and short circuit currents. 5. To provide stable platform for operation of sensitive electronic equipments. **Factors affecting earth resistance:-**

Following factors affect soil resistance (resistivity):-

1. Depth of electrode embedded in the earth.
2. Lengthen the earth electrode in the earth.
3. Size of earth electrodes
4. Resistance of the electrode itself and connections to it.
5. Contact resistance between the electrode and the soil adjacent to it.
6. Resistance of the surrounding earth.
7. Earth resistance can be reduced by increasing number of earth electrodes inter connected in parallel.
8. Temperature of soil
9. Soil Condition
10. Dissolved salts in soil
11. Climate Condition
12. Moisture content in soil
13. Physical Composition of soil
14. Effect of grain size and its distribution
15. Area Available
16. Location of Earth Pit
17. Obstructions in under ground
18. Size and spacing of earth plate and size of conductor.
19. Metal of earth plate and earth wire.
20. Quality of Coal / Charcoal used in the earth electrode pit.
21. Leakage Current Magnitude

OR

Following factors affect soil resistance (resistivity)

(1) Temperature of soil:

Increase in temperature reduces resistivity of soil.

(2) Soil Condition:

If soil is dry then soil resistivity value will be very high.

(3) Moisture:

Increase or decrease of moisture content determines the increase or decrease of soil resistivity.

The resistance of soil drops quickly to a more or less content in soil.

(4) Dissolved salts:

Increase in salts in water reduces soil reduces resistivity of soil.

(5) Climate Condition:

In dry whether resistivity will be very high and in monsoon months the resistivity will be low.

(6) Physical Composition**:**

Different soil composition gives different average resistivity. for rocky or gravel soils resistivity of clay is more than soft soil.

(7) Location of Earth Pit:

Choose a location of earth pit that is naturally not well drained.

(8) Effect of grain size and its distribution:

Grain size, since they control the manner in which the moisture is held in the soil.

(9) Area Available:

- Single electrode rod or strip or plate will not achieve the desired resistance alone.
- If a number of electrodes could be installed and interconnected the desired resistance could be achieved.

(10) Obstructions:

Obstructions like concrete structure near about the pits will affect resistivity.

(11) Depth of electrode embedded in the earth:-
A ground rod is driven deeper into the earth, its resistance is reduced.

(12) Size and spacing of earth plate and size of conductor.
Doubling the diameter of the ground rod reduces resistance.

(13) Metal of earth plate and earth wire:-

Use of copper material for earthing reduces resistance than use of aluminum material

(14) Quality of Coal / Charcoal used in the earth electrode pit.

(15) Leakage Current Magnitude:

- A current of significant magnitude and duration will cause significant drying condition in soil and thus increase the soil resistivity.

c)	**Describe the objectives of reduced voltage running up test on 3 phase induction motor.**
Ans:	(Any Four **objectives** from following or equivalent answer are expected)---1Mark each Total 4 Marks **Objectives:-** 1. The test is applied to squirrel cage motors. 2. To determine the ability of motor to run equal and nearly equal to rated speed of the motor even at reduced voltage. 3. To see whether there is any tendency of crawling presents in the motor. 4. This test is also conducted to check the noisy running of motor 5. To see whether ,if noise level is more than tolerance limit which may be due to damaged bearings, also the presence of loose bars and wrong connection stator winding.
d)	**List the Mechanical, Magnetic and electrical faults in the electrical machines.**
Ans:	**(Mechanical—1 Mark, Magnetic--- 1Mark and electrical faults—2Marks)---Total—4 Marks** **Mechanical fault:- (Any TWO faults are expected)** Following are the reasons of mechanical faults:- ➢ Warn out bearings ➢ Misalignment ➢ Rotor unbalance ➢ Bent shaft ➢ Excessive belt pull. ➢ Failure of lubricating system ➢ Loose foundation ➢ Overloaded bearings ➢ Out of roundness in a Commutator **Magnetic faults:- (Any TWO faults are expected)** It is internal fault caused by unbalance in magnetic condition. Following are the reasons of magnetic faults:- ➢ Non-uniformity of air gap ➢ Short circuit between armature laminations ➢ Failure of insulation between core clamping bolts and core ➢ Misalignment of poles ➢ Non-uniform distribution of magnetic flux ➢ Bad contacts of contactor

	Electrical faults:- (Any TWO faults are expected) ➢ Internal Short circuit fault (turn to turn fault) ➢ Open circuit fault ➢ Ground fault ➢ Poor contact in armature winding. ➢ Wrong setting of brushes. ➢ Overheating of Commutator due to sparking ➢ Overvoltage ➢ Over frequency ➢ Under frequency ➢ Single phasing
e)	**What are the different routine and types tests of transformer as per IS ?**
	(Routine tests---2 Marks, Type tests--- 2Marks)---Total---4 Marks **Routine tests of transformer include:- (Any Four Tests are expected)** 1. Polarity test 2. Phasing out test 3. Winding resistance measurement. 4. Measurement of voltage ratio/Turns ratio 5. Short circuit test (for measurement of impedance voltage/short circuit impedance and load loss). 6. Open circuit test (for measurement of no load loss and no load current/magnetizing current) 7. Measurement of insulation resistance. 8. Transformer vector group test. 9. Dielectric test of transformer 10. Tests on on-load tap-changer, where appropriate. 11. To check against leakages past joints and gaskets for liquid-immersed and gas-filled transformers.

	Type tests of transformer includes:- (Any TWO Tests are expected) In type test all above routine tests are again conducted in addition to that following tests are conducted 1. Temperature-rise type test. 2. Dielectric type tests. 3. Vacuum tightness tests on tank and radiators.

---------- **END**----------