WINTER – 2022 EXAMINATION

Model Answer

Subject Name: Maintenance of Electrical Equipment

22625: MEE

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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any FIVE of the following:**	**10 Marks**
	a)	List out factors influencing severity of shock. (Any four). **Ans:** **Factors Influencing Severity of Shock:** The severity of shock depends on following factors: 1. Mainly the magnitude of the voltage of the system. 2. Supply system whether D.C. or A.C. The direct current shock is more dangerous. 3. Path of current through human body (through heart or brain or not?). 4. Voltage and current strength of the system. 5. Area of contact of body to the faulty machine / equipment / device. (More contact area, higher is the risk). 6. The period or duration of current flow through the body. (More the duration, higher is the risk / danger). 7. Frequency of current / supply passing through the body. (Lesser is the frequency, more is the danger). 8. Rate of rise of current flow through the body. (mA/mS). 9. The phase of the heart cycle at the instant of the shock and phase of voltage wave. 10. The presence of moisture in the environment. (Wet conditions are more dangerous than Dry conditions). 11. Human tolerance to electric current. (It varies person to person to some extent). 12. Body resistance. (For wet body / low resistance body more severe is the shock). 13. The way in which muscle contracts in relation to current passing through body. 14. Whether the body is thrown off by muscle reaction or gets attached by muscle contraction / paralysis. 15. Magnitude of current passing through the body. **OR Equivalent Answer/Points**	1 Mark for each of any two points = 2 Marks
	b)	State the maintenance to be carried out on breather used in transformer. **Ans:**	

		Maintenance to be Carried out on Breather used in Transformer: 1. The oil level in oil cap under silica gel breather must be checked in a one-month interval. If it is found the transformer oil inside the cup comes below the specified level, oil to be top up as per specified level. 2. Breathing holes in silica gel breather should also be checked monthly and properly cleaned if required, for proper breathing action. 3. Check whether the air passage of breather is clear and check / clean the dirt, dust accumulated in the air passage. 4. Daily dehydrate the breather. 5. Daily check the color of silica gel crystal it should be dark blue (dry / healthy condition) but when it absorbs moisture it becomes pink then replace it.	1 Mark for each of any two points = 2 Marks
	c)	State the classification of maintenance. **Ans:** **Classification of Maintenance of Electrical Equipment:** Broadly maintenance can be classified as 1. Routine maintenance 2. Preventive maintenance 3. Break down / Corrective maintenance and 4. Predictive maintenance 5. Productive maintenance 6. Periodic maintenance 7. Time based maintenance 8. Total productive maintenance **OR** Maintenance can also be classified as 1. Daily maintenance 2. Weekly maintenance 3. Fortnightly maintenance 4. Monthly maintenance 5. Half yearly maintenance 6. Yearly maintenance	½ Mark for each of any four types = 2 Marks
	d)	State any two advantages of direct testing method. **Ans:** **Advantages of Direct Testing Method:** 1. The efficiency can be determined at any load because constant losses are known. 2. Power required for this test is small. 3. This method is quite economical and convenient. 4. Results are actual / Gives most accurate results. 5. Very simple method. 6. Very useful for small capacity machines. 7. Very simple and easy calculations. 8. Generally, no assumptions are required. 9. As the machine is directly loaded and performance is determined hence its temperature rise at full load, commutation problems, real time problems, actual ground results are accurately known. **OR Equivalent Answer/Points**	1 Mark for each of any two points = 2 Marks

	e)	List out factors affecting life of insulation. (Any four). **Ans:** **Factors Affecting Life of Insulation:** 1. Dielectric strength / Electrical stress / High voltage stress. 2. Temperature / Thermal stress / High temperature. 3. Mechanical stress. 4. Moisture. 5. Water. 6. Dirt and dust particles on the surface of insulation. 7. Surface tracking and arcing. 8. Ageing. 9. Improper handling. 10. Oxidation. 11. Atmosphere. 12. Impurities. 13. Light. 14. Chemical reaction. 15. Effect of oxygen & humidity. **OR Equivalent Answer/Points**	½ Mark for each of any four factors = 2 Marks
	f)	List out basic requirements of foundation. (Any four). **Ans:** **Basic Requirements for the Foundation:** 1. The foundation should be strong / rigid preferably of concrete which should be able to carry the superimposed loads without causing shear or crushing failure. 2. The foundation should be able to withstand against the Weight of machine, Erection weight, Operating weight, Super imposed load weight and Accessories weight. 3. The foundation should be made of concrete with concrete ratio of 1:2:4. 4. The foundation should be of well cure before installing the machine on it. 5. Depth of foundation should be proportional to the bearing capacity of soil. 6. The surface of foundation must be well protected from the machine etc.by means of suitable chemical coating or suitable chemical treatment. 7. Level of plinth of foundation should be above the maximum flood level of the site. 8. The location of foundation is such that there should be sufficient space all around the machine. 9. The combined centre of gravity of machine and foundation should be as far as possible in the same vertical line as the centre of gravity of the base plane. 10. All amplitudes / settlements / limits should be within permissible limits which are prescribed by the machine manufacturers. 11. The dimension of foundation should be somewhat more than actual requirements and proportional to safe bearing capacity of soil. 12. The foundation should be sufficiently rigid to withstand possible horizontal thrust caused by machine while in operation. 13. The surface of foundation should be perfectly plane to avoid misalignments. 14. The depth of the foundation should be as given in the following table for better operation of machine. **OR Equivalent Answer/Points**	½ Mark for each of any four factors = 2 Marks

g) List out contaminating agents of transformer oil. — ½ Mark for each of any four agents = 2 Marks

Ans:

Agents Which Contaminate the Insulating Oil:

1. Water.
2. Moisture.
3. Dirt / dust.
4. Carbon deposits.
5. Sulphur.
6. Acids.
7. Gases.
8. Alcohols.
9. Grease.
10. Acetones and aldehydes.
11. Presence of sludge which is mainly an oxidation product, whose formation is accelerated by temperature and contact with air.
12. Presence of solid particles.

OR Equivalent Answer/Points

2. Attempt any THREE of the following: — 12 Marks

a) Prepare trouble shooting chart for 1Φ Induction motor (Any four troubles). — 1 Mark for each of any four trouble with cause and remedy = 4 Marks

Ans:

Trouble shooting Chart for 1Φ Induction Motor:

Sr. No.	Type of fault / trouble abnormal conditions	Causes	Remedies
1	Motor fails to start or not accelerate / Faults in starting supply circuit / Motor switch ON but does not start	1. Blowing of fuse / tripping of MCB. 2. Terminal voltage is too low. 3. Defective starting mechanism. 4. Tripping of protection device. 5. The motor controller is not operating. 6. Open circuit in supply cable. 7. Overloaded. 8. Loose connections of motor leads. 9. Motor rotor or driven load is locked. 10. Bearing is seized. 11. Open circuit in auxiliary winding. 12. Open circuit in main winding. 13. Opening of capacitor. 14. Shorting of capacitor.	Rectify & repair the cause
2	Motor stalls	1. Terminal voltage is too low. 2. Over load 3. Wrong application.	Rectify & repair the cause
3	Motor does not pick up rated speed	1. Starting load is high 2. Low supply voltage. 3. Low supply frequency. 4. Broken rotor bars or loose rotor.	Rectify & repair the cause
4	Runs slow	1. Low supply voltage.	Rectify &

	(Motor starts sluggishly)	2. Low supply frequency. 3. Overload. 4. Shorted stator coils.	repair the cause
5	Motor runs hot / Motor overheats / Winding overheating	1. Over / Under voltage. 2. Unbalance voltage 3. Over / Under frequency 4. High ambient temperature 5. Ventilating fan is not working 6. Poor motor ventilation / Air flow obstructed or inadequate ventilation. 7. Overload. 8. Worn bearings.	Rectify & repair the cause
6	Motor vibrates	1. Loose fitting of iron core. 2. Dynamic unbalance of the rotor. 3. Misalignment of rotor. 4. Bent shaft. 5. Run out of shaft. 6. Warn out bearings. 7. Incorrect leveling. 8. Loose foundation bolts.	Rectify & repair the cause
7	Noisy operation of motor	1. Misalignment of rotor 2. Bent shaft. 3. Run out of shaft. 4. Improper fitting of bearing. 5. Warn out bearings. 6. Incorrect leveling. 7. Loose foundation bolts. 8. Cooling fan is touching with stationary part. 9. Non uniform air gap or rotor rubbing on stator. 10. Unbalancing of rotor. 11. Faulty gears and gear trains.	Rectify & repair the cause
8	Bearing failure	1. Misalignment of rotor. 2. Due to bent shaft / Run out shaft 3. Bearings not properly fitted. 4. Warn out bearings. 5. Overloaded bearing. 6. Use of poor quality of grease / lubricating oil 7. No greasing / lubricating oiling.	Rectify & repair the cause
9	Bearing overheating	1. Misalignment of rotor. 2. Due to bent shaft / Run out shaft. 3. Bearings not properly fitted. 4. Warn out bearings. 5. Overloading. 6. Use of poor quality of grease / lubricating oil 8. No greasing / lubricating oiling.	Rectify & repair the cause

		9. Excessive belt pull.	
10	Motor runs in the wrong direction	1. Improper connection of motor windings (Main & auxiliary winding)	Rectify & repair the cause
11	Motor has been running, then suddenly fails to start	1. Fuse or circuit breaker tripped. 2. Motor overloaded. 3. Stator is shorted. 4. Starting switch has failed.	Rectify & repair the cause

OR Equivalent Answer/Points

b) List out internal and external causes of failure of transformer.

Ans:

List of Internal causes of Failure of Transformers:

1. Insulation breakdown between winding and earth.
2. Insulation breakdown between different phases.
3. During normal working shot - circuit may occur due to some reasons (e.g. short circuit between H.V. & L.V.).
4. Some live terminal touches the metallic part hence developing phase to ground fault.
5. Fault between winding and core leads to failure of machine.
6. Failure of magnetic circuit.
7. Some turns of phase windings get shorted.
8. Insulation breaks down between adjacent turns i.e. inter-turn fault.
9. In some unavoidable situation the transformer may have to be run "over loaded" for a longer period which causes temperature rise beyond the permissible limit. Resulting abnormal operation of transformer.
10. Single phasing means one of the three phases become open circuited and the load is shared by only two phases instead of 3 - phases. Hence over loading on phases and behavior becomes abnormal.
11. Phase winding may electrically touch each other may create problem.
12. Unbalance loading causes abnormal behavior of the transformer.
13. Presence of moisture, air bubbles in the transformer oil.
14. Open circuit (either in H.V or L.V).
15. Short circuit (between in H.V and L.V).
16. Ground fault (between H.V and core).
17. Ground fault (between H.V and supporting structure).
18. Shorted turns (either in H.V or L.V).
19. Transformer core fault.

List of External causes of Failure of Transformers:

1. Sometimes in the generating station receiving station / substation there occurs over voltage or under voltage which affect the normal working of the transformer.
2. High voltage disturbances.
3. Sustained power frequency over voltage disturbances.
4. Lightning surges.
5. Switching surges (there may be always chances of system over voltages due to sudden disconnection of the large / bulk loads).
6. Travelling waves.
7. Arcing grounds.

½ Mark for each of any four points = 2 Marks

		8. Resonance conditions. 9. External short circuit – the short circuit may occur in two or three phases of feeder/ distributor lines. 10. Sometimes due to wind, rains, birds etc. short circuit occurs in the supply system which affects working of machine / equipment instantly. 11. If supply system generator working in generating station is subjected change in the speed of prime mover, then supply frequency changes which affects the working of transformer. 12. Under frequency effect in power transformers i.e. if frequency reduces in a system, flux in the core changes and causes abnormal operation for the machine / equipment which are supplied by such transformers. 13. If external load on the transformer is sustained for a length of period, the insulation may start burning due to excessive temperature rise. 14. A 3- phase machine is supplied with 3 - line wires L.L.L. These are called as lines. If fault is developed in the feeder / distributor line only two lines will supply the equipment. The two lines supply power to three phases of transformer & two phases become excessive of load & over heating take place and transformers condition becomes abnormal. 15. External damage to transformer supply cable, Fault in MCCB, Fault in MCB, damage happened by mechanical means as accidental breakage of cable etc. **OR Equivalent Answer/Points**	½ Mark for each of any four points = 2 Marks
	c)	List out dos and don'ts for electrical supervisors - (Any four each) **Ans:** **Dos for Electrical Supervisors:** 1. Work on low & medium voltage mains and apparatus should be carried only by authorized person(s) and all mains and apparatus to be worked upon shall be isolated from all sources of supply before starting the work. 2. Warning boards shall be attached to or kept adjacent to the line apparatus and the limit of the zone, in which work may be carried out, should be specifically indicated. 3. Ensure that all the safety apparatus such as rubber mats, stool, platforms or other safety devices to be used, should be in good condition. 4. When any live mains are to be earthed, the procedure prescribed should be scrupulously followed. 5. Maintenance on H.T. Breaker should be attempted only when it is fully isolated and withdrawn. 6. No work should be done on the transformers unless, it is disconnected from all external electrical circuits and all windings have been solidly earthed. 7. De - energize incoming power before removing top and side access or cover plates of any bus cover. Lock out the incoming power source. Earth the main horizontal bus before working on the bus. 8. Check voltage, if any, by multi meter / test lamp so as to be sure that circuit breaker / switches are open or that the bus is de - energized. 9. Isolate all remote-control voltage sources when working on the board. 10. Pad - lock the breakers with isolated position and test before working on a branch circuit. 11. Follow proper Electrical Isolation procedures to avoid in - advertent activation of any	½ Mark for each of any four points of Dos = 2 Marks

Electrical equipment i.e., put "Men at Work" tally on the isolated circuit. Remove the fuses etc. before working.

12. Obey warnings to stay away from electrical circuits and locked - out equipment.
13. Wear rubber gloves and any other assigned protective clothing and safety equipment while working.
14. Inspect electrical tools before each use.
15. Keep all electrical circuit contact points enclosed.
16. Do use a quality surge suppresser with enough sockets for every component.
17. Do look out for overhead power lines every time you use an insulated ladder or pole. Stay at least 10 feet away from any electrical lines.
18. When in doubt, seek help from experts and advice to the juniors.
19. Keep away any chemicals which are compatible from electrical panels etc.
20. Follow manufacturers' recommendations and requirements while working on that machine / equipment.
21. Eliminate all potential tripping hazards in the work area.
22. If any device / machine emits an unusual odor, turn it off and unplug it immediately. Do not use the device / machine until it is repaired.
23. Wear safety glasses while working.
24. If you see that cables of electrical device are worn or frayed, make sure you replace it as soon as possible.
25. Ensure every rotating / static machine has been installed properly and is stable.
26. Employers should control any remaining risk by providing the worker / operator with the necessary information, instruction, training, supervision and appropriate safety equipment.
27. Ensure control switches are clearly marked to show what they do.
28. Have emergency stop controls where necessary.
29. If machines are controlled by programmable electronic systems, changes Made in any programme should be carried out by a competent person to all the concern persons.
30. Know the work content and work sequentially.
31. Place sign "Men are working" or other warning boards on the Main Switch before working.
32. Cultivate the habit of turning your face away whenever an electric arc or flash may occur.
33. Guard against arcs as well as high voltages, remember that burns from arcs may be very serious.
34. Take extreme care when breaking an inductive circuit as dangerously high voltage is likely to result.
35. Thoroughly discharge to earth all the cables before working on their cores.
36. Always treat the circuit alive until you have proved them to be dead.
37. Test insulating rubber glows periodically.
38. Place rubber mats in front of electrical switching panels.

Dont's for Electrical Supervisors Working in Supply Control Rooms:

1. Do not touch a person who is in direct contact with live electrical conductors. By this, you can receive serious shock too.
2. In hazardous area, avoid direct contact between explosive mixture and means of ignition.

		3. Do not inadvertently activate any electrical equipment. Follow standard electrical isolating procedure to avoid inadvertent activation on any electrical equipment. 4. Do not panic in case of power failure. Emergency lighting have been provided in all working areas in company through Diesel Generating Sets which start automatically within 10 - 15 seconds of the power failure. Stay calm until then. 5. Do not work alone in main switch or feeder panel enclosure. 6. Never leave electrical equipment without properly earthed. 7. Do not put in use any piece of electrical equipment that gives a tingling sensation when touched. This is defective. Inform about it to your supervisor immediately. 8. No live part should be within unsafe distance of a person working on live low and medium voltage mains, so that he does not come in contact with it unless he is properly protected. 9. Do not touch or temper with any electrical gear or conductor, unless you have made sure that it is dead and earthed. High voltage apparatus may give leakage shock or flash over even without touching. 10. Do not disconnect earthing connections. 11. Do not expose your eyes to an electric arc. Painful injury may result even with short exposure. 12. Do not close or open a switch or fuse slowly or hesitatingly, do it quickly and positively. 13. Do not use metal case flash light around apparatus which is energized. 14. Do not get closer than 10 feet to a power line (if you're an unqualified employee). 15. Do not reach blindly into a space that may contain energized equipment. 16. Do not use a power tool that smokes, sparks, smells, or shocks. 17. Do not store liquids of any sort near electrical equipment. 18. Do not assume the black coating on wires is insulation – it could be just plastic weatherproofing that provides no protection from contact injuries. 19. Do not use damaged or brittle electrical cords, even if bare wires aren't visible. 20. Do not allow untrained, unqualified staff to handle key maintenance or inspection tasks. 21. Do not undertake maintenance tasks in an arbitrary order. You need a way to rank electrical components in order of how critical they are and then follow that order logically. 22. Do not take a run - to - failure attitude to electrical parts. You should replace them before they become inefficient and potentially dangerous. 23. Do not renew a blown fuse until you are satisfied as to the cause and you have rectified the irregularity. 24. Do not close any Switch / GOS / Breaker unless you are familiar with the circuit, which it controls and know the reason for its being kept open. 25. Do not work on energized circuits without taking extra precautions as use of rubber gloves and gauntlets. 26. Do not touch or tamper with any electrical equipment or conductor, unless you have made sure that it is dead and earthed. 27. Do not work on the live circuit without the specific orders of the supervisor and make certain that all safety precautions have been taken. 28. Do not disconnect earthing connection or render ineffective safety gadgets installed on mains and apparatus.	½ Mark for each of any four points of Don'ts = 2 Marks

		29. DO not use fire extinguisher on electrical equipment unless it is clearly marked for that purpose. 30. DO not throw water on live electrical equipment in case of fire. 31. DO not remove danger notice plates or other signs or interface with safety barriers or go beyond them. 32. DO not allow visitors and un-authorized persons to touch or handle electrical apparatus or come within the danger zone of H.V. apparatus.	
	d)	Explain any four factors that govern the foundation of transformer. **Ans:** **Factors that Govern the Foundation of Transformer:** 1. Drawings of transformer from foundation design point of view • Dimension of the transformer • Plan dimension transformer base • Its length & width 2. Height of transformer. 3. Information about condition of soil as • Bearing capacity of soil • Soil density • Ground water table location 4. Weight of transformer as • Erection weight • Operating weight • Imposed weight • Accessories weight 5. Transformer's center of gravity location in empty condition and operating condition. 6. Vibration level of transformer. 7. Level of plinth (it should be above the maximum flood level of the site). 8. Ground water level. 9. Surrounding atmospheric conditions. **OR Equivalent Answer/Points**	1 Mark for each of any four factors = 4 Marks
3.		**Attempt any <u>THREE</u> of the following:**	**12 Marks**
	a)	Describe a step-by-step procedure for rescuing electric shock affected person. **Ans:** **Step by Step Procedure for Rescuing Electric Shock Affected Person:** In general, the following steps should be taken into consideration at time of treatment for electric shock. 1. **Consider your own safety first:** Before you do anything else, remember that your top priority needs to be your own safety, so before you touch the casualty you need to check if they are still in contact with source of the shock. If they are, they'll still be 'live' and touching them means you might end up being shocked yourself, so take all care of being your safety and do the further actives. **2. Switching OFF the supply / electricity:** Safely turn off the source of electricity if possible. If not, try to break connection between casualty and the object (the live wire or appliance) using a non - conducting object made of cardboard, plastic or wood, such as a broom or a mop. Don't touch the object with your	½ Mark 1 Mark

		bare hands. **3. Remove the person / casualty from contact of current:** Push a person / casualty with a dry stick of wood or pull him / her from the clothes. Remove him from contact of current without touching his / her body. If the voltage level is more than 400Volts, every attempt should be made to free the person from the contact with the electric conductor / circuit / system after protecting oneself. But in case of very high voltages like 11kV then switching OFF the supply is obligatory. **4. Remove the person / casualty from the burn / fire:** If person's clothes catch fire, torn clothes, wrap him in the blanket or coat and roll him / her to extinguish the fire. If any burns occur on the body of the person use proper oil / ointment on them and cover them with proper dressing. **5. Check the status of electrocuted person / casualty and artificial respiration:** Once it's safe to do so, check whether the casualty is conscious. Ask them if they can hear you and to open their eyes. Don't move them unless the situation is critical. **A. If the casualty is conscious…** Even if the person is awake and seems well it's important to monitor their condition for several hours after the shock. If they experience Confusion, Difficulty in breathing, Irregular heartbeat, Muscle pain and / or Seizures, Loss of consciousness take them to hospital immediately. **B. If the casualty is unconscious…** Call medical team immediately and ask for the emergency medical services. Stay calm, check the casualty's breathing. If they're breathing normally, put them in recovery position and stay with them until help arrives. If person shows no sign of circulation, such as breathing or movement, you should begin artificial respiration. In most cases of electric shock, the lungs and lower chest muscles stop working. Hence artificial respiration becomes necessary without the time delay. If person is not breathing, immediately start artificial respiration until the medical aid arrives. **OR Equivalent Answers/Points**	1 Mark ½ Mark 1 Mark
	b)	Describe the various factors affecting preventive maintenance schedule. **Ans:** **Factors Affecting the Preventive Maintenance Schedule:** 1. Type of machine / equipment and its working conditions. 2. Working environment of industry i.e., presence of dirt, moisture, chemical fumes, atmospheric temperature etc. 3. Some industry finds heavy load during particular period of year and during other period they are lightly loaded, during which maintenance can be carried out, ultimately the operating cycle of plant affect the schedule. 4. Whether the machine is continuously working or intermittently working? 5. If the machines / equipment is continuously overload then it needs more maintenance and also needs suitable time for the preventive maintenance so affects preventive maintenance schedule. 6. If machine fails, how much loss of money and time, it will cause due to its down period. 7. Ageing of machine / equipment (If the breakdown takes place, the cost of the repair will be more than cost of the machine, and whether it can be replaced by a new one). 8. Production requirement i.e., the machines / equipment used in production work comes under essential equipment and they need to maintained very much carefully.	½ Mark for each of any eight points = 4 Marks

9. Non availability of spares & raw material.
10. Non availability of tools, jacks, fixture required for preventive maintenance.
11. Non availability of trained & skilled technicians.
12. Operating cycle of equipment or machine affect the maintenance schedule.
13. Cost of the maintenance.
14. Due to accident, fires, worker strike the work is held up for certain period. This is also a cause of disturbing a preventive maintenance schedule.
15. Load cycle of the machine.
16. Cost of standby machines and equipment.
17. Cost of outage due to failure of supply against cost of maintenance.
18. Improper communication / co-operation with production department.
19. Importance of the machine / equipment.
20. Sometimes even if the maintenance may be necessary but the production requirement needs that machine may be kept running to complete the production target. It means that for particular time production is most urgent and profitable than the cost of breakdown period of machine during the repairs.
21. Large capacity / highly precise machine / equipment used in industry upon which maximum operation depends are to be maintained properly otherwise affects the preventive maintenance schedule.

OR Equivalent Answer

c) Describe procedure and objective of reduced voltage running up test on 3ϕ Induction motor.

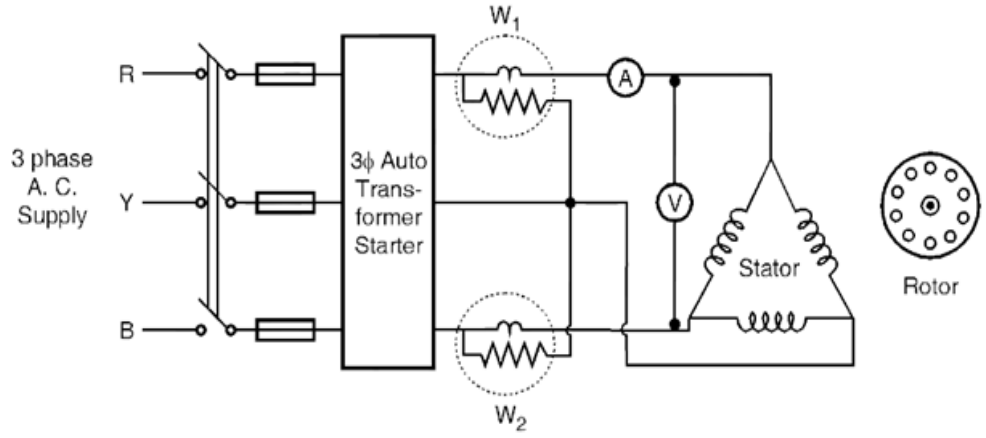
Ans:

Objective of Reduced Voltage Running up Test on 3ϕ Induction Motor:

1. To determine the ability of motor to run equal and nearly equal to rated speed of the motor even at reduced voltage in the both directions – forward & reverse.
2. To see whether there is any tendency of cogging & crawling presents in the motor.
3. This test is conducted to check the noisy running of motor.
4. To see whether, if noise level is more than tolerance limit which may be because of damaged bearings, also presence of loose bars & wrong connection of stator winding.

½ Mark for each of any two points = 1 Mark

Procedure of Reduced Voltage Running up Test on 3ϕ Induction Motor:



1.5 Marks for Diagram

1. The motor up to 37 kW shall be supplied with reduced voltage 1 / √3 of rated value for each direction of rotation with the help of auto transformer.
2. For motors above 37 kW, the voltage shall be 1/ √3 of rated value but motor shall be run

1.5 Marks for Procedure

only in the specified direction of rotation with the help of auto transformer.
3. The speed in this case is also recorded. In both the cases, the speed should be equal and nearly equal to rated speed of the motor.

OR Equivalent Answer

d) Prepare the trouble shooting chart for the following troubles in transformer.
i) Zero output voltage
ii) Low output voltage
iii) Oil temperature is very high
iv) Overheating of transformer winding

Ans:

i) Zero Output Voltage:

Cause	Troubleshooting Steps
Primary side fuses blown out	Replace the blown out fuses by rectifying reason behind it.
Tripping of incoming circuit breaker / MCCB	Check and rectify causes of circuit breaker trippng / MCCB tripping
Failure of primary winding	Repair if pohecksble or rewind primary winding
No conact of tap changer	Proprly connect of tap changer tappings.
Opening of the bushings connections	Make bushing connections proper and tight
Failure of primary winding	Repair if possble or rewind primary winding
Failure of secondary winding	Repair if possble or rewind secondary winding
Failure / shot circuit / opening of supply cable	Repair if possble or errect new supply cable
No incoming supply to primary winding	Check and rectify causes of incoming supply failure
Tripping off incoming supply because malfunctionig of one of the protective relays	Check and rectify causes of wrong opreration of protective relays.

½ Mark for each of any two points = 1 Mark

ii) Low Output Voltage:

Cause	Troubleshooting Steps
Loose conact of tap changer	Proprly connect of tap changer tappings
Loose connections at bushings	Make bushing connections proper and tight
Failure of primary winding	Repair if possble or rewind primary winding
Failure of secondary winding	Repair if possble or rewind secondary winding
Faulty OLTC	Repair OLTC
Heavly overloading / Unbalace loading	Load properly
Incorrect use of turns ratio	Make use of correct turns ratio
Shorted turns in the transformer	Check and rectify causes of shorted turns in the transformer.
Low primary voltage	Check and rectify causes of low primary voltage

½ Mark for each of any two points = 1 Mark

iii) Oil Temperature is Very High:

Cause	Troubleshooting Steps
Any internal fault such as short-circuited core, core bolts/ clamps insulation failure etc.	Replace the transformer and core to be lifted for thoroughly checking. Take corrective action according to observations and oil test report.
Low oil level in conservator	Check the oil level in conservator and top up if required
Slugged oil	Carry out purification of oil to remove sludge
Heavy overloading / Unbalanced loading	Load the transformer as per its rating
Faulty / inoperative cooling system	Repair / use effective cooling arrengments
Short circit in winding / core of transformer	Check and rectify causes of short circuit in winding / core in the transformer.
Use of improper quality of transformer oil	Use proper quality transformer oil
Very high ambient temperature	Use better cooling system in such environment

½ Mark for each of any two points = 1 Mark

(iv) Overheating of Transformer Winding:

Cause	Troubleshooting Steps
High input voltage	Supply transformer with proper input voltage
Slugged oil	Carry out purification of oil to remove sludge
Faulty / inoperative cooling system	Repair / use effective cooling arrengments
Low oil level in conservator	Check the oil level in conservator and top up if required
Very high ambient temperature	Use better cooling system in such environment
Heavly overloading / Unbalace loading	Load properly
Short circit in winding / core of transformer	Check and rectify causes of short circuit in winding / core in the transformer.
Inoperative temperature sensors	Use proper temperature sensors

½ Mark for each of any two points = 1 Mark

OR Equivalent Answer

4. Attempt any THREE of the following: 12 Marks

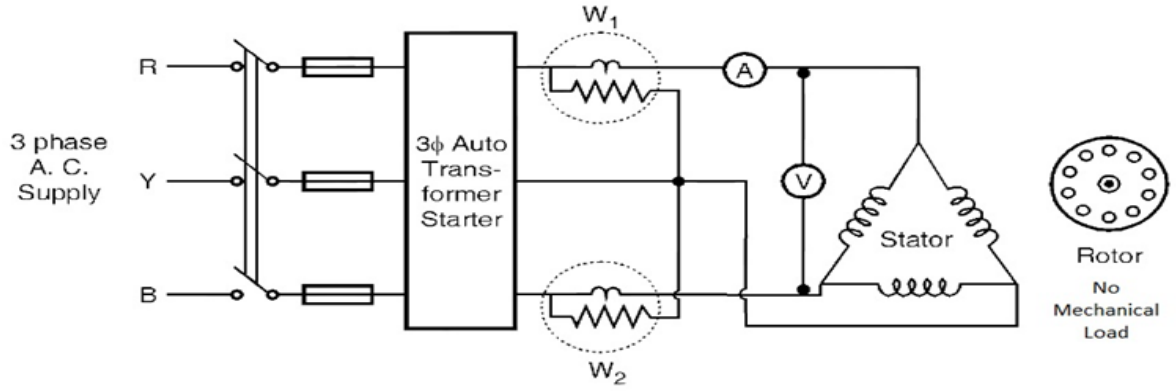
a) List out safety precautions of be taken against electric fire.

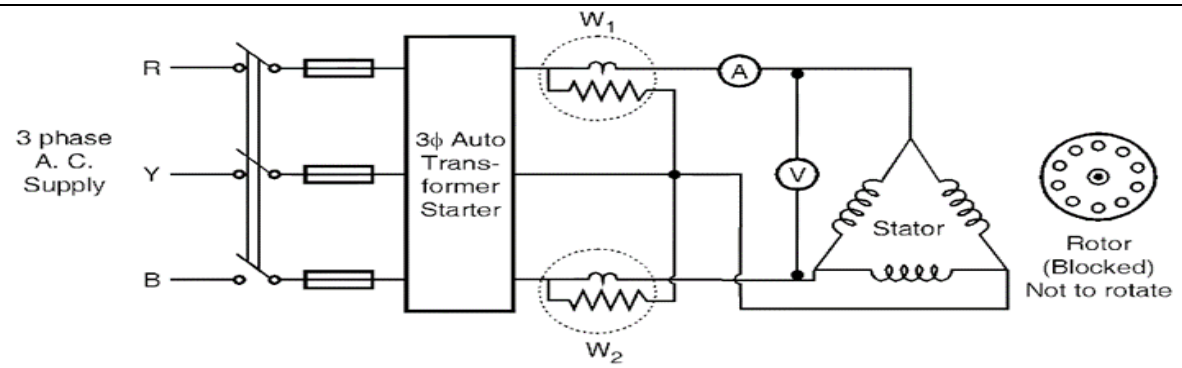
Ans:

Safety Precautions of be Taken Against Electrical Fire:

1. Use correct rating fuse and MCB.
2. Follow IE Rules while working with every electrical installation.
3. Use ISI Mark material / equipment.
4. Provide sound and proper Earthing.
5. Use correct rating wires, cables, auxiliaries etc.
6. Carry out regular and proper maintenance.
7. Keep heat - producing appliances unplugged when not in use.
8. Don't ignore signs of trouble like as burn marks/discoloration around a socket, burning smell when an item is plugged in or in use, electrical sparks each time you plug in a

½ Mark for each of any eight points = 4 Marks

		device, one (or all) of your breakers frequently trips or your fuses regularly blow etc. 9. Keep always ready and use proper firefighting equipment. 10. Avoid poor joints and loose connections. 11. Provide proper protective gears/system. 12. Replace or repair loose or frayed cords on all electrical devices. 13. Avoid running extension cords across doorways or under carpets. 14. Follow manufacturer's instructions for operating every electrical machine / device / equipment etc. 15. Consider having additional circuits or outlets added by a qualified electrician so you do not have to use extension cords. 16. Avoid overloading outlets. Plug only one high-wattage appliance into each receptacle outlet at a time. 17. Place lamps on level surfaces, away from things that can burn and use bulbs that match the lamp's recommended wattage. **OR Equivalent Answers/Points**	
	b)	Describe procedure for No. load and blocked rotor test to be carried out on 3ϕ Induction motor with neat diagram. **Ans:** **Procedure for No. Load Test to be carried out on 3ϕ Induction Motor:**  	1 Mark
		1. Determine the meters and their ratings based on the name plate readings of the three-phase induction motor under test. 2. Connect the circuit as shown in circuit diagram. 3. Set / check the three-phase autotransformer to be at zero output. 4. First switch on the 3-phase supply and close the TPST. 5. In this test the stator winding is connected to supply through auto transformer. 6. Gradually increase the voltage applied to the machine to the rated voltage. Motor runs at a speed quite close to its synchronous speed. 7. Take the corresponding readings of voltmeter (as input voltage Vo), ammeter (as input current Io), wattmeter (as input power Wo) & speed.	1 Mark
		Procedure for Blocked Rotor Test to be carried out on 3ϕ Induction Motor:	1 Mark



1. Determine the meters and their ratings based on the name plate readings of the three-phase induction motor under test.
2. Connect the circuit as shown in circuit diagram.
3. Set / check the three-phase autotransformer to be at zero output.
4. Block the rotor mechanically in such a way that it does not revolve (speed of rotor must maintain zero).
5. Now switch ON the 3-phase supply and close the TPST.
6. Gradually increase the voltage applied to the motor until up to full load current will circulate in the stator winding.
7. Take the corresponding readings of voltmeter (as input voltage Vsc), ammeter (as input current Isc), wattmeter (as input power Wsc).

1 Mark

c) List out Electrical and Magnetic faults (each four faults) in transformer.

Ans:

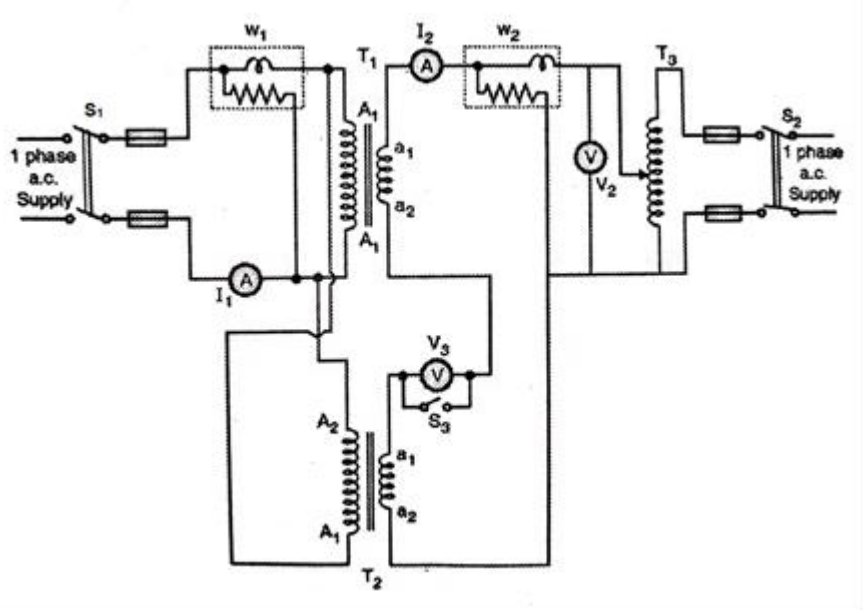
List of Electrical Faults in Transformer:

1. Damage in insulation.
2. Wrong electrical connections.
3. Opening of contact / connections or open circuit fault.
4. Overheating of Primary / Secondary winding.
5. Internal short - circuit or inter - turn fault.
6. Phase to phase fault.
7. Phase to ground fault.
8. Ground fault.
9. Over frequency.
10. Under frequency.
11. Over voltage.
12. Under voltage.
13. Sustained over loading.
14. Improper MCCB / Circuit breaker operation.
15. Short / open circuit in supply cable.
16. Broken / crack bushings.
17. Contaminated insulation oil.
18. Improper / no earthing.
19. Primary / secondary winding faults (open / short / interturn faults).
20. Tap changer faults (improper tap, short circuit, wrong setting, improper rating etc.).
21. Earth faults.
22. Short circuit fault.

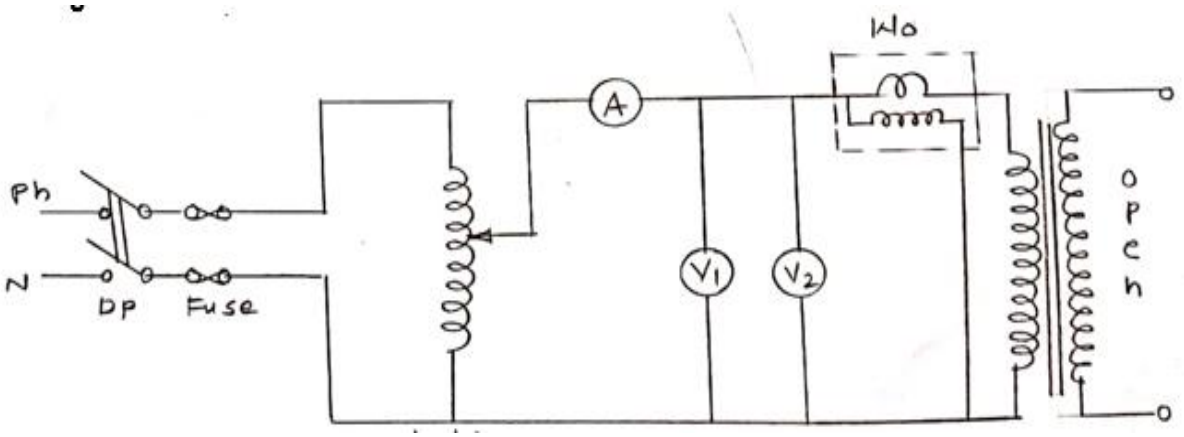
½ Mark for each of any four points = 2 Marks

		23. Poor contact connections. **List of Magnetic Faults in Transformer:** 1. Lose fitting of core stampings. 2. Short circuit between core laminations. 3. Localized heating of core. 4. Abnormal heating of core. 5. Warped and dented (marked) core and burns. 6. Failure of insulation between core clamping bolts and core. 7. Non-uniform distribution of magnetic flux. 8. Increase in core losses. 9. Break / crack in magnetic core. 10. Short / open circuit in magnetizing winding. 11. Wrong position of core / primary / secondary. 12. Short circuit between core laminations and windings. 13. Buckling of the innermost winding. **OR Equivalent Answers/Points**	½ Mark for each of any four points = 2 Marks
	d)	Describe desirable properties of transformer oil (any eight). **Ans:** **Desirable Properties of Transformer Oil:** • **Dielectric strength or breakdown voltage (BDV):** The transformer oil should have high dielectric strength not less than 40kV (rms) in drums and 30kV (rms) in the tank for gap of 4mm of electrodes. • **Water Content:** Moisture or water content in transformer oil is highly undesirable as it affects the dielectric properties of the oil adversely. Water content is expressed as Particles Per Million (PPM) and its permissible value is 50PPM. • **Acidity Content:** The acidity content value should be equal to or less than 0.4mg of KOH / gm. The oil should be reconditioned if the value of acidity is 0.5 to 1 mg of KOH / gm. • **Flash Point:** It is desirable to have high flash point of transformer oil. In general, it is more than 160^{o}. • **Fire Point:** The temperature at which an oil will ignite and continues for burning is the fire point. This should be about 25% above the flash point so it should be at least of 200^{o}. • **Chemical Stability:** The oil should be chemically stable i. e. should not be affected by chemicals. • **Purity:** The oil must not contain impurities such as sulphur and its compounds. Sulphur when present, causes corrosion of metal parts. • **Viscosity:** Good transformer oil should have a low viscosity so that it offers less resistance to the conventional flow of oil thereby not affecting the cooling of a transformer. • **Sludging:** The remedy is use oil which will not contain Sulphur & which remains without sludge formation for long period.	½ Mark for each of any eight points = 4 Marks

		• **Density:** This indicates the mass of substance per unit volume. As per IS, this should be 0.89 gm / cm^3 maximum. • **Appearance:** The oil should be perfectly clear and has pale clear yellow colour, transparent and free from suspended matter of sediments. • **Pour Point:** It is the lowest temperature expressed on a multiple of 3^o at which the oil is observed to flow when cooled. The oil should have high pour point at least 9^o.	
	e)	Describe back to back test on 1ϕ transformer with neat diagram. **Ans:** **Back-to-Back Test on Single Phase Transformer:** • T_1 and T_2 are two identical transformers, T_3 is autotransformer, S_1 (At the input side of primaries), S_2 and S_3 are switches. A-ammeters, V-voltmeters and W-watt-meters. • As shown in figure the primaries of two transformers (T_1 and T_2) are connected in parallel across the supply at rated voltage of primary. Their secondaries are connected in phase opposition or back-to-back fashion. When primaries of two transformers are energized by switching ON switch S_1, the emfs induced in secondary windings come in phase opposition. Since the two transformers are identical, there is no circulating current in the local circuit formed by secondary's even, if primaries energized. • To ensure that the secondaries are connected in phase opposition, a voltmeter (V_3) and a switch S_3 is connected in parallel as shown. V_3 should be of double range of that of secondary voltage, because, if the polarities are not connected in phase opposition the voltmeter may receive twice the voltage of secondary. When voltmeter V_3 indicates zero it ensures that secondaries are connected in phase opposition, then switch S_3 is closed. If voltmeter V_3 does indicate zero or indicate more than zero, then secondary connections are interchanged. • To circulate the necessary full load current one auto transformer (T_3) is used in the secondary circuit as shown. Voltage is injected by switching ON switch S_2 and by varying the voltage with the help of T_3, full load current is circulated in the secondaries. The current corresponding to this circulating current also flows in closed circuit formed in primaries, however it does not appear in the ammeter and wattmeter connected in primary side so the current taken from supply side is only the total no load current of two transformers. • The wattmeter reading (W_1) connected in the primary side indicates total no load loss or iron loss of two transformers. • The wattmeter connected in secondary side (W_2) indicates total copper loss or load loss of two transformers caused by the circulating current. • Since both the losses are known efficiency of the transformer can be easily determined.	2 Marks for Description 2 Marks for Diagram



5		**Attempt any TWO of the following:**	**12 Marks**
5	a)	List out the routine, type and supplementary tests to be carried out on 3ϕ Induction motor as per IS-4029-2010. **Ans:** **Routine tests to be carried out on 3ϕ Induction Motor as per IS-4029-2010:** 1. Measurement of Winding Resistance / D.C. resistance. 2. Measurement of Insulation Resistance. 3. High voltage test. 4. Reduced voltage running up test. 5. No load test. 6. Open circuit voltage ratio test (Slip ring induction motor). 7. Locked / Blocked rotor test. 8. Measurement of slip. **Type tests to be carried out on 3ϕ Induction Motor as per IS-4029-2010:** 1. Measurement of Winding Resistance / D.C. resistance. 2. Measurement of Insulation Resistance. 3. High voltage test. 4. Reduced voltage running up test. 5. Open circuit voltage ratio test (Slip ring induction motor). 6. Locked rotor test. 7. Measurement of slip. 8. Temperature rise test. 9. Momentary overload test. **Supplementary tests to be carried out on 3ϕ Induction Motor as per IS-4029-2010:** These are the additional tests carried out when either the manufacturer wants to have some improvements or purchaser wants any additional information about performance of induction motor. **These can be any one or more from routine / type tests** or anything else depending upon working conditions or requirements of induction motor such as: 1. Open circuit test.	½ Mark for each of any four tests = 2 Marks ½ Mark for each of any four tests = 2 Marks

		2. Short circuit test. 3. Full load test. 4. Determination of noise level. 5. Presence of harmonics. 6. Determination of zero phase sequence impedance. 7. Vibration test. 8. Oscillographic test. **OR Equivalent Answers/Tests**	½ Mark for each of any four tests = 2 Marks
5	b)	Describe open circuit test to be carried out on 1KVA, 230/110V transformer with diagram. Give the formula for calculating corrected case losses. **Ans:** **Open Circuit Test to be Carried out on 1KVA, 230/110V Transformer:**  This test is carried out on the transformer to assess the performance characteristics of the transformer without actually loading it. The data so obtained i.e., no load current, no load loss is used to determine constants R_O and X_O of equivalent circuit of transformer and to predict its efficiency. Consider the above circuit diagram, here the LV winding (110Volts in this case) is generally connected to supply through auto transformer and HV winding (230Volts in this case) is left open because sometimes the voltage is difficult to manage on HV side. The rms value of the emf is not very sensitive to harmonics hence to reduce error, both voltages i. e. average value as well as rms value of voltages are considered. A rectifier type voltmeter is used which measures average (V_1) value of voltage and another voltmeter measures the rms value (V_2). The ammeter indicates no load current when rated rms voltage is applied to primary side of transformer. Now the corrected core loss is calculated as $$\mathbf{Wc} = \frac{W_O}{P_1 + kP_2}$$ where, W_O = Reading of wattmeter at rated voltage V_2 V_1 = Reading of rectifier type voltmeter. V_2 = Reading of rms type voltmeter. $k = \left[\frac{V_2}{V_1}\right]^2$	2 Marks for Diagram 2 Marks for Description

		P_1 and P_2 are constants and their values may be taken as: $P_1 = P_2 = 0.5$ For oriented steel laminations and $P_1 = 0.7$ and $P_2 = 0.3$ For non-oriented steel laminations. **Power Factor** $$\textbf{Cos}\phi_0 = \frac{W_c}{V_2 I_0}$$ Magnetizing current $\mathbf{Im = I_O \sin \phi_0}$ Core loss component of current = $\mathbf{Iw = I_O \cos \phi_0}$ Hence, $$\mathbf{R_O} = \frac{V_2}{I_w} \quad \textbf{and} \quad \mathbf{X_O} = \frac{V_2}{I_m}$$	2 Marks for Formulae
5	c)	Prepare preventive maintenance schedule for 3ϕ Induction motor. **Ans:** The preventive maintenance schedule for three phase induction motor is as below: **A. Daily Maintenance:** 1. Examine visually earth connections and motor leads. 2. Check motor windings for overheating (the permissible maximum temperature is above that which can be comfortably felt by hand). 3. Examine control equipment. 4. In the case of oil ring lubricated motors: a) Examine bearings to see that oil rings are working; b) Note temperature of bearings; c) Add oil, if necessary; and d) Check and play. **B. Weekly Maintenance:** 1. Check belt tension. In cases where this is excessive, it should immediately be reduced and in the case of sleeve bearing machines the air gap between rotor and stator should be checked. 2. Blow-out windings of protected type motors situated in dusty locations. 3. Examine starting equipment for burnt contacts where motor is started and stopped frequently. 4. Examine oil in the case of oil ring lubricated bearings for contamination by dust, dirt, etc. (This can be roughly judged from the colour of the oil). **C. Monthly Maintenance:** 1. Overhaul Controllers. 2. Inspect and clean oil circuit breakers. 3. Renew oil in high-speed bearings in damp and dusty locations. 4. Wipe brush holders and check bedding of brushes of slip-ring motors. **D. Half yearly Maintenance:** 1. Clean windings of motors subjected to corrosive or other elements; also bake and varnish, if necessary. 2. In the case of slip-ring motors, check slip-rings for grooving or unusual wear. 3. Check grease in ball and roller bearings and make it up where necessary taking care to avoid overfilling.	1 Mark for each of any one point 1 Mark for each of any one point 1 Mark for each of any one point 1 Mark for each of any

		4. Drain all oil bearings, wash with petrol to which a few drops of oil have been added; flush with lubricating oil and refill with clean oil.	one point
		E. Yearly Maintenance: 1. Check all high-speed bearings and renew, if necessary. 2. Blow-out all motor winding thoroughly with clean dry air. Make sure that the pressure is not so high as to damage the insulation. 3. Clean and varnish dirty and oily windings. 4. Overhaul motors which have been subjected to severe operating conditions. 5. Renew switch and fuse contacts, if damaged. 6. Check oil. 7. Renew oil in starters subjected to damp or corrosive elements. 8. Check insulation resistance to earth and between phases of motor winding, control gear and wiring. 9. Check resistance of earth connections. 10. Check air gaps. 11. Test the motor overload relays and breakers.	1 Mark for each of any one point
		F. Yearly Maintenance: Maintain a register giving one or more pages for each motor and record therein all-important inspection and maintenance works carried out from time to time. These records should show past performance, normal insulation level, air gap measurements, nature of repairs and time between previous repairs and other important information which would be of help for good performance and maintenance.	1 Mark
6		**Attempt any <u>TWO</u> of the following:**	**12 Marks**
6	a)	State the use of following tools – i) Filler gauge ii) Bearing puller iii) Spirit level iv) Growler v) Dial Indicator vi) Earth tester **Ans:** **i) Filler Gauge:** 1. A feeler gauge is used for accurate measurements of very small gaps such as air gaps. 2. A feeler gauge is used for checking shaft alignment at flanges. **ii) Bearing Puller:** 1. Bearing puller is used to remove parts such as bearings, pulleys or gears from a shaft. 2. Bearing puller is used to put a new bearing on the shaft. **iii) Spirit Level:** 1. A spirit level is an instrument designed to indicate whether a surface level is horizontal or vertical. 2. Spirit levels are an invention typically used to determine if either a vertical or horizontal platform is exactly aligned. **iv) Growler:** 1. A growler is an electrical device used for testing insulation of a motor winding etc. for shorted coils. 2. A growler is an equipment used for finding shorted turns of armature coil or stator /	1 Mark for one use of each tool = 6 Marks

		rotor winding. **v) Dial Indicator:** 1. The dial indicator is used to indicate the run-out of the workpiece. 2. The dial indicator is used to check the alignment of shafts in electrical machines. **vi) Earth Tester:** 1. The earth tester is used for measuring the resistance of the earth. 2. It earth tester is used for sizing and projecting grounding grids.	
6	b)	List out the Routine, Type and special test to be carried out on transformer as per IS-2026. **Ans:** **Routine tests to be carried out on Transformer as per IS-2026:** 1. Measurement winding resistance of transformer. 2. Voltage ratio test. 3. Transformer vector group test. 4. Measurement of impedance voltage /short circuit impedance and load loss (Short circuit test). 5. Measurement of no-load loss and current (Open circuit test). 6. Measurement of insulation resistance. 7. Dielectric tests of transformer. 8. Tests on on-load tap-changer. 9. Oil pressure test on transformer to check against leakages past joints and gaskets. 10. Polarity test. 11. Phasing out test (In case of three phase transformer). 12. High voltage test. **Type tests to be carried out on Transformer as per IS-2026:** 1. Measurement winding resistance of transformer. 2. Voltage ratio test. 3. Transformer vector group test. 4. Measurement of impedance voltage /short circuit impedance and load loss (SC test). 5. Measurement of no-load loss and current (Open circuit test). 6. Measurement of insulation resistance. 7. Dielectric tests of transformer. 8. Tests on on-load tap-changer. 9. Vacuum test on tank and radiator. 10. Temperature rise test 11. Polarity test. 12. Phasing out test (In case of three phase transformer). 13. High voltage test. **Special tests to be carried out on Transformer as per IS-2026:** 1. Dielectric tests. 2. Measurement of zero-sequence impedance of three-phase transformers. 3. Measurement of acoustic noise level. 4. Measurement of the harmonics present in transformer emf. 5. Tests on bought out components / accessories such as buchholz relay, temperature indicators, pressure relief devices, oil preservation system etc.	½ Mark for each of any four tests = 2 Marks ½ Mark for each of any four tests = 2 Marks ½ Mark for each of any four tests = 2 Marks
6	c)	State necessity and Methods for revarnishing of insulation. Describe Vacuum impregnation method with neat diagram.	

Ans:

Necessity for Re-varnishing of Insulation:

- To seal all fibrous / hygroscopic materials in the winding against absorption of moisture.
- To bond the whole winding, wires and insulation mechanically, into a solid cohesive mass, so that it is made more resistant to shock, vibration and mechanical stress.
- To protect the winding against the destructive effects of oil, acid and other chemicals.
- To improve the electrical properties of the insulators.
- Insulation provided between layers as well as space between turns in the interior of coil contain considerable amount of air spaces, which tends to absorb moisture hence such air gaps are covered by re – varnishing.
- Insulating varnishes are used for coating and impregnating insulating materials to fill up voids in porous materials and winding to exclude all the trapped air.

½ Mark for each of any two points = 1 Mark

Methods for Re-varnishing of Insulation:

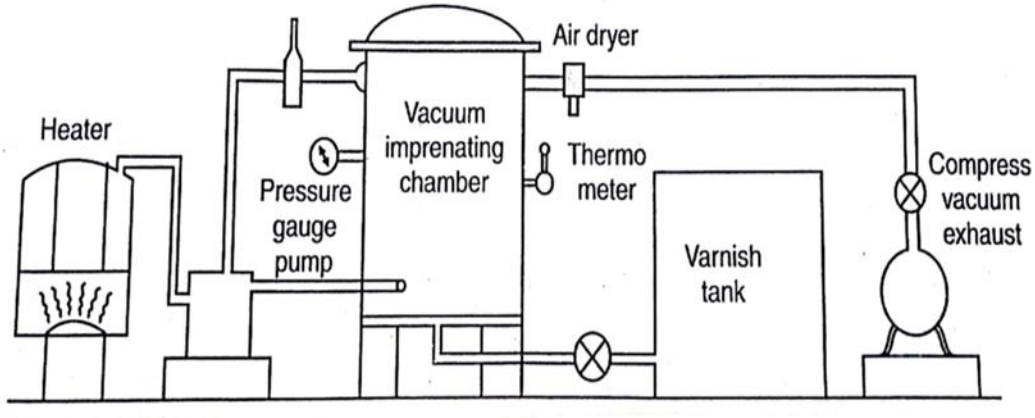
- By brush using air dry varnish.
- By spraying method using air drying varnish.
- Hot-Dip method using baking varnish.
- Vacuum Impregnation using baking varnish.
- Dip and bake epoxy varnishing.
- Trickle varnishing.
- Vacuum pressure impregnation.
- Ultra-sealed winding.

½ Mark for each of any two points = 1 Mark

Vacuum Impregnation Method:

Construction:

The vacuum impregnating plant consist of a large air tight double jacketed vacuum impregnated chamber which has a removable top cover. The interior part of tank can be heated up by circulating steam or hot air through the jacket. The insulating varnish is kept stored in another storage tank. A motor driven compressor cum vacuum pump with suitable valves to create vacuum in the tank is used which can also create pressure as required.



2 Marks for Diagram

Working of Vacuum Impregnation Plant:

- First the wound armature, stator or rotor is placed in the vacuum impregnating chamber by opening the top cover, then it is tightly closed.
- The chamber is then heated up to 100^0 C by circulating steam or hot oil through jacket of chamber for nearly four hours. During this period the air from chamber is pumped out by vacuum exhauster and the vacuum is maintained which will help in vaporising the moisture

2 Marks for

		present in the coils and removing the air completely. • Now insulating varnish from varnish tank is allowed to flow into vacuum impregnated chamber till the varnish come up to level in which windings are completely immersed, then the valve of varnish storage tank is closed. • The pressure from compressor of about 1.4 to 2.1 kg/cm2 is applied above varnish surface, which will make the varnish to be forced in all porous spaces in the interior of coils and this pressure is maintained for an hour / two hours according to size and weight of the winding. • Now the valve of varnish tank is opened and varnish is made to flow back to the tank under air pressure till the excess varnish also gets drained out. The valve of tank is is then closed and the armature is baked in the chamber at 1000 to 1100C for nearly 8 hours or till the varnish is completely dried out and become bone dry. • The air pressure and circulating steam or oil in the jacket is then stopped and the armature or stator is then removed by opening the top cover of chamber.	Description